AERAGRAM

Newsletter of the Ancient Egypt Research Associates Volume 4 ♦ Number 1 Fall 2000

The First Year of the Millennium Project: Unveiling a Royal Plan

Since 1988 when we began working in our concession south of the pyramid complex at Giza, we had been slowly uncovering, with each field season, the pieces of a very large, intriguing puzzle, some 200 to 400 square meters per season. We had hints of a production facility dating from the 4th Dynasty—bakeries, copper workshops, storerooms, etc.—but no sense of how it all fit together—not until this spring with the completion of the first year of our Millennium Project.

After eight months of clearing overburden with a front loader and hand scraping down to walls (along with some intensive excavation), we had opened up an enormous area of our concession—some 12,000 square meters—which we believe is the largest exposure of Old Kingdom settlement. And in this exposure we have "captured" the overall architectural plan (shown in our maps on pages 6–7 and 8, and in the photo below) of the complex. Our view is no longer restricted to scattered excavation squares.

We now gaze out onto a vast 4th Dynasty royal production facility, much larger and more complex than we had ever imagined, with row upon row of enormous galleries, paved streets, a hypostyle hall, a large house, storerooms, workers' quarters, and countless bakeries.

An Immense complex

The complex is immense—at least 52 meters (100 royal cubits) east-west. We do not know how far north-south it extends, but it clearly goes well beyond the 75 meters we have opened.

But sheer size is not its only distinction. The complex is impressive for its remarkable layout—something which has not been seen before in Old Kingdom sites. Built to a unified plan, aligned on a grid oriented slightly west of north,

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Looking northwest over our 1999–2000 excavation. The enormous cliffs at the right indicate how much overburden had to be cleared before we were able to reach the Old Kingdom layers. The 4th Dynasty complex of long galleries can be seen on the left. The tents are for workmen.

First Year of the Millennium Project

Continued from page 1

roughly perpendicular to the Wall of the Crow (see map on page 8), it is based on repeating modular galleries. These corridor-like structures, 34.5 meters long and 4.5 to 4.8 meters wide, have thick outer mud brick walls and a maze of inner walls that divide the space up into work areas, domiciles, etc. The galleries are massed in sets of eight abreast like a series of oversized boxcars lined up side by side.

Paved Street

Between two of the gallery sets (numbered II and III) we found one of the oldest paved streets in the world. Spanning 5.2 meters (10 cubits), it runs the length of the gallery system east-west and continues as far as we have been able to clear to the west for a total of 130 meters. Main Street, as we call it, is paved like a modern road with *tafla* gravel topped by compact grey alluvial mud. In the center of the street there is even a drain, a narrow trough about 20 to 30 centimeters wide, carefully formed in the gravel bed.

We have some evidence of a similar street (tentatively dubbed North Street) flanking the north side of gallery set II and the south side of what we believe is another gallery complex (tentatively numbered I).

This pattern of gallery-street-gallery is not repeated to the south. Instead another set of galleries, number IV, backs unto the south side of gallery set III, sharing its outer wall. This last set of galleries extends south beyond the limits of this year's excavation, so at this point we do not know if it is flanked by a street to the south.

Gallery Plans

The gallery, the long corridor-like structure, appears to be the basic unit of our complex. Each is unique in its details, but all galleries share certain common features. Their southern ends are broken up into small rooms that might be bakeries, workshops, or houses, while the middle

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The Millennium Project by the Numbers

Our eight months of excavation were a gargantuan effort. Just look at these numbers!

Area cleared	12,000 square meters
Amount of overburden moved:	34,000 cubic meters
Number of 5x5-meter excavation squares:	413
Bags of material from excavations:	3,479
Number of pieces of flint processed:	11,700
Amount of pottery processed:	7,200 kilograms
Individual pieces of pottery drawn:	2,000
Pieces of animal bone processed:	31,041
Bone pieces identified to genus	4,656

Above: Mohammed Musilhi skillfully scoops up overburden with the front loader.

Egypt's Oldest Hypostyle Hall

Ever since our 1991 season we had been puzzling over enigmatic low benches that we had been uncovering in an area north of our 1991 bakeries. This season we were surprised to discover that these benches were part of a hypostyle hall, the earliest reported in Egypt.

"Hypostyle" literally means "under the pillars." Technically it is any roof resting on rows of pillars or columns. It conjours up images of great stone temples with large courts supported by forests of columns. The most famous is the great Hypostyle Hall in the Karnak Temple of Amen-Re in Luxor.

Our hall is about 15 x 25 meters and spans the width of three normal galleries (see map on page 7). We believe it is a hypostyle hall because it appears to have been covered with a roof supported by pillars, which were positioned along the enigmatic benches. The columns were probably wood, each about 23 centimeters in diameter, judging from the holes in the tops of some of the benches. The evidence makes it certain that the builders first set up the columns on the bases and then built the benches around them.

The hypostyle halls well known to Egyptologists were either for ceremony and ritual, or symbolized these activities. According to Pharaoh Ramses II, the Karnak Hypostyle Hall was "a place where the populace extols the name of his Majesty…within which…Amon is made manifest to the populace."

Our hypostyle hall, however, appears to have served some practical function rather than being a place of ceremony. We are not certain what this function was but suggestions range from fish or grain drying to a dining hall.

Until our discovery, the oldest known hypostyle was in a temple—the Mortuary Temple of the Unfinished Pyramid of the 5th Dynasty pharaoh Raneferef at Abusir. The hall once contained statues of the king, suggesting it functioned as a throne room in perpetuity.

An earlier hypostyle-like structure stood at the west end of the entrance hall of the 3rd Dynasty Step Pyramid complex of Pharaoh Djoser at Saqqaqa. But this was not a true hypostyle because the columns did not stand free but were joined as four pairs by short masonry walls. Our hypostyle hall from the 4th Dynasty thus appears to be the earliest known true hypostyle in ancient Egypt. How it was used remains a mystery.

Thanks to All Who Made our Millennium Project Possible

Our Supporters

The first year of our Millennium Project was possible because of Ann Lurie's extraordinary grant on behalf of the Ann and Robert H. Lurie Family Foundation. This was accompanied by the challenge that we sustain and increase other support. David H. Koch has made our work possible since our first season in 1988–'89, and his major contribution allowed us to go forward with Ann's initiative. Bruce Ludwig and Jon Jerde also made major contributions toward the Millennium Project.

We are grateful to all our loyal supporters, particularly Robert Lowdermilk, Glen Dash, Matthew McCauley, Fred and Suzanne Rheinstein, Sandford and Betty Sigoloff, Victor and Nancy Moss, David Goodman, and Marjory Fischer, who substantially contributed to our Millennium challenge. Don Kunz, Richard Redding, Lora Lehner, Bonnie Sampsell, Art and Bonnie McClure, and Charles Rigano also helped us.

Supreme Council of Antiquities

For a very successful season, we are grateful to Dr. G. A. Gaballa, Secretary General of the Supreme Council of Antiquities (SCA). None of our work would have been possible without the generous assistance of the SCA Giza Inspectorate. I am pleased to carry out this research as part of a long collaboration with Dr. Zahi Hawass, Undersecretary of State for Giza and Saqqara.

I owe a special thanks to Abd al-Hamid, chief engineer of the SCA at Giza for his help with equipment used in moving the overburden. We are grateful for the kind assistance of Ahmed al-Hagar, Director of Giza, Mahmoud al-Afifi, Chief Inspector for Giza, and Mansour Bureik, Senior Inspector. We thank Mohammed Sheeha and Ashraf Abd al-Aziz who represented the SCA at the excavation site, and Ahmed Hussein who served as our inspector in the storeroom. A hearty thanks goes to Mohammed Musilhi for his skillful use of the front loader.

Ashraf Abd al-Aziz, our inspector, worked full time as an archaeologist also, commanding four excavation squares, and helped train Marian Raouf Sadek and Dania Yousry Hafez, who assisted him and supervised two excavation squares on their own. I greatly appreciate their efforts during the 1999–2000 season.

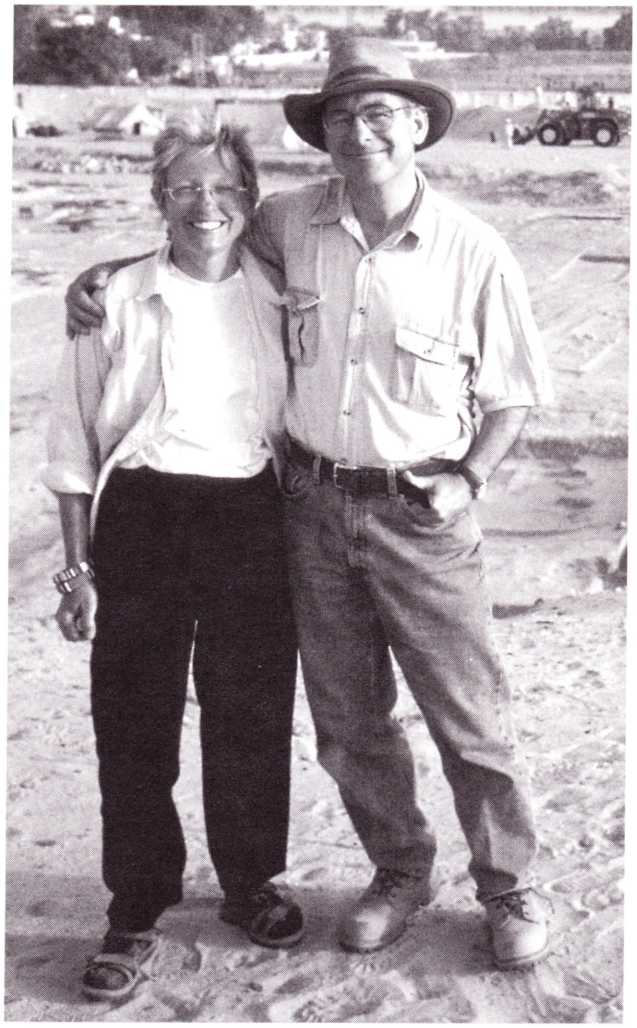


Photo by Tom Hill

Ann Lurie and Tom Hill visited Giza on March 27th, 2000, so that Ann could see the progress on the project she has so generously helped fund. Here Ann stands with Mark Lehner on overburden north of the main cleared area.

The 1999–2000 Millennium Project Crew

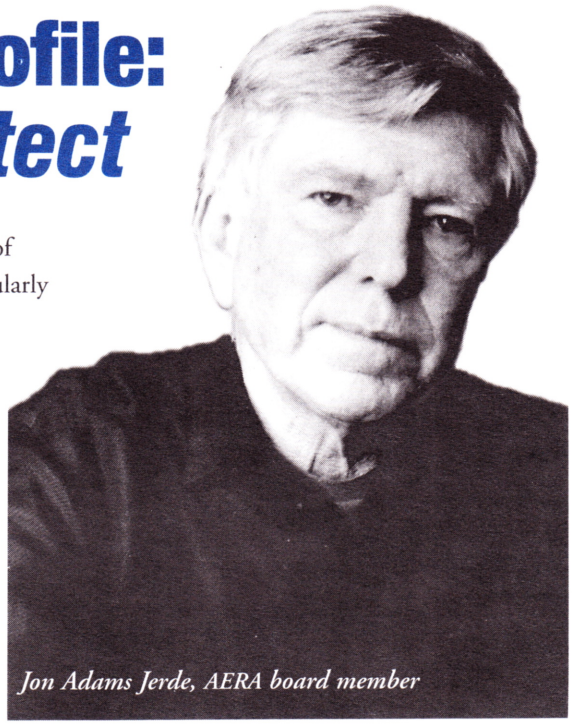
Dr. Mark Lehner (Harvard Semitic Museum & U. of Chicago)	Director
John Nolan (University of Chicago)	Assistant Director
Mohsen Kamal (University of California, Los Angeles)	Archaeologist
Dr. Richard Redding (University of Michigan)	Faunal analyst
Dr. Nicholas Conard (University of Tübingen)	Lithics analyst
Cordula Werschkun (University of Tübingen)	Assistant lithics analyst
David Goodman	Surveyor
Anna Wodzinska (University of Warsaw)	Ceramicist
Sarah Sterling (University of Washington)	Archaeologist
Justine Gesell (University of Heidelberg)	Archaeologist
Tobias Tonne (University of Tübingen)	Archaeologist
Ric and Laura Brown (Massachusetts College of Art)	Artists
Glen Dash	Geophysical surveyor
Hratch Papazian (University of Chicago)	Archaeologist
Ashraf Abd al-Aziz (Supreme Council of Antiquites)	Archaeologist
Marian Raouf Sadek (Supreme Council of Antiquites)	Archaeologist
Dania Yousry Hafez (Supreme Council of Antiquites)	Archaeologist
Amir Abd al-Hamid	Project manager

Our Crew

Through all the rigors of this field season—dust storms, intense heat, make-shift labs, and brutally long days—our crew toughed it out. I am very grateful for their skill and dedictation.

~ *Mark Lehner*

AERA Board Member Profile: *Jon Adams Jerde, Architect*



Jon Adams Jerde, AERA board member

Jon Adams Jerde and his urban planning and architecture firm, the Jerde Partnership International (JPI) in Venice, California, joined us in our work at Giza in 1990. As part of a proposal for conservation work on the Sphinx, they took on the task of building a three-dimensional computer model of the stone beast by digitizing the photogrammetric elevations and maps that Mark Lehner and Ulrich Kapp had produced during the American Research Center in Egypt (ARCE) Sphinx Project from 1979–'83. Jon donated computer equipment and the expertise of Tom Jaggers, JPI's computer wizard, to create the digitized contours and "flesh" of the Sphinx.

Though architects often look to the past for inspiration, how many would commit such resources to a structure created 4,600 years ago? But Jon is no ordinary architect, satisfied with merely designing buildings.

A "visionary" is what *Newsweek* called him in 1988. Jon's mission is nothing short of transforming civic life. His goal is to create places that bring back community, that renew public life. And one source of inspiration is ancient Egypt.

Jon and his partners, widely acclaimed and highly honored for their innovative work, design large multi-function urban districts. Focusing on the built environment as experience rather than objects, their goal is to create spaces that invite civic life. Inspired by the environment, their projects "speak the language of local culture," but go beyond the original context to create a bold, new identity.

Jon's initial inspiration came during a year abroad. After completing a degree at the University of Southern California School of Architecture, Jon toured Europe on an Architectural Institute of America (AIA) Travel Fellowship. Intrigued by European architecture and the use of space in public areas, he was particularly struck by the way in which European cities combined work, play, and shopping in one district. Jon began to think about designing spaces that offered more than the bland American shopping mall.

After returning to the U. S., Jon began working for a traditional architectural firm but continued thinking about new ways of creating urban districts. He finally quit to start his own partnership and take on the task of revitalizing a bleak skid row in San Diego.

With this project, Horton Plaza, Jon and his fledgling firm revolutionized the concept of a shopping mall. Working with existing buildings in six blocks of an abandoned historic district, they drew upon the architectural strengths of the older buildings but injected new life with bold features, such as a "village path"—a big S curve cut diagonally through the complex. Like later JPI projects, Horton Plaza offers whimsy, surprise, and bright, bold colors. And like other JPI complexes it houses a wealth of business and residential uses—retail, office space, apartments, restaurants, cinema, hotel, and an outdoor theater. Shortly after the complex opened in 1985, the Los Angeles chapter of the AIA recognized the Jerde Partnership with a merit award.

The Jerde Partnership first caught the attention of the world with its innovative design for the 1984 Summer Olympics, which was honored by the AIA and many other organizations. Using an easily assembled "kit" of banners, tenting, giant canvas stars, and light-weight structures reminiscent of a medieval jousting tournament—all in a vivid palette—JPI tied together 75 disparate Olympic sites scattered throughout sprawling Los Angeles.

Since the early '80s JPI has gone on to design many large projects around the world on every continent. One of the most striking projects in a long list of stunning designs is Canal City Hakata in Fukuoka, Japan, opened in 1996. Located along a river, the complex is organized around a semicircular canal which flows through a canyon in the interior.

Other JPI work includes the Fremont Street Experience in Las Vegas; the Mall of America in Bloomington, Minnesota; Bellagio, a hotel inspired by Tuscany in Las Vegas; the Beursplein subterranean shopping street in Rotterdam; Universal CityWalk, which ties together the Universal City complex in Los Angeles; and many other examples around the world.

In addition to a very full schedule of design work, Jon lectures widely. He teaches summer seminars at the Harvard Univer- sity Graduate School of Design and speaks at many conferences.

Jon has been widely recognized for his contributions to urban design. Among his many awards are the Golden Plate from the American Academy of Achievement, the Distinguished Alumnus Award from the School of Architecture at the

University of Southern California (USC), and the AIA's first Pacific Rim Award. Jon is a Fellow of the AIA, a member of the Urban Land Institute and the Architectural Guild at USC. We are proud to claim him as a member of the AERA board.

Jon Jerde: Friend and Catalyst
by Mark Lehner

I first met Jon in Los Angeles in 1985 around 7:00 one morning when Bruce Ludwig delivered me to the Jerde Partnership. This was Bruce's very first stop in his long journey of development work for our enterprise at Giza. He could not have chosen better. At the time, all he told me was that Jon Jerde had been in charge of the award-winning design for festooning all of Los Angles for the 1984 Olympics.

I gave a slide lecture to 125 coffee-sipping members of Jon's firm. I showed alignments across the Giza Plateau. I wondered about the intentions of the ancient architects. I asked whether such orthogonal planning might have contrasted with the architecture of everyday life of that time.

Jon approached me afterward, intent on hearing more. I was soon to learn that ancient cultures from the Inca to the Anasazi, but especially Egypt, were a prime source of inspiration for Jon's work.

In my own studies of ancient architecture and urbanism, I have come to see an important distinction between settlements that are planned top-down by central authorities, and those that are self-organized, bottom up, by individuals, households, and neighborhoods. All around the world, traditional villages are self-organized with typically winding paths and roads, and intricate maze-like patterns of access to private areas. Complexity of this traditional kind is what we find charming, non-alienating, and otherwise aesthetically pleasing in traditional houses, neighborhoods, towns, and cities. And these are the very features that intrigue Jon and inform his own designs for mixed urban zones. They have been the subject of countless conversations Jon and I have had over the last 15 years. From this cross-fertilization of architecture and archaeology I have gained many insights.

In 1989 I traveled to Egypt with Jon and Janice Jerde and Isaac Tigrett, founder of the Hard Rock Cafe and (later) House of Blues. It was a great experience to see the relics of this ancient culture through Jon's eyes. As we walked down the long tube-like tomb of the Pharaoh Ramses VI in the Valley of the Kings, we saw not just the static design of hieratic gods, kings, and glyphs. We sensed that the whole composition was meant to convey a weird journey, basically like a dark flume ride. What a thrill it would be, we all thought, to use computer graphics and Omnimax technology to recreate the dreams and thought forms of an ancient peoples, rather than just their staid monuments and buildings.

Not long after our Egypt trip, Jon made available his computer equipment and the talents of Tom Jaggers for the more prosaic task of producing the three-dimensional model of the Great Sphinx.

Later we teamed with John Sanders, Director of the University of Chicago's Oriental Institute Computer Laboratory, and Peggy Sanders of Archaeological Graphic Services, to model the entire Giza Plateau. "Virtual Giza" has continued to grow in our computers ever since.

As I write, we are embarking on a new phase of our Giza Plateau model with Tom Jaggers. We hope to move into Geographic Information Systems to use the model with our data base containing all the information from our excavations and surveys.

I am very grateful that the Jerde Partnership takes time from its work designing, literally, dozens of multi-million dollar projects all around the globe to help our exploration and study of the Giza Pyramids. Jon joined AERA's Board of Directors in 1995 and became a major financial contributor. We could not do without Jon's help, and that of his firm.

Personally the best part of Jon's friendship is sharing ideas. Discussing ancient Egyptian stone architecture as *simulacra* of the architecture of real life, or talking about the footprint of the state in great sites like Akhenaten's Tell el-Amarna, or reflecting on the critical balance between central planning and self-organizing, I have enjoyed the breath of fresh insight from Jon Jerde.

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Harvard University

AERAGRAM is published by **AERA**, the Ancient Egypt Research Associates. It reports on ongoing research and other developments on the Giza Plateau for friends and supporters of AERA and others interested in ancient Egypt.

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First Year of the Millennium Project

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and northern parts are more open. These look very much like the traditional elements of ancient Egyptian houses, yet stretched out into long corridors: a back cooking, baking, or heat-generating industrial room, a core living area, and an open court or columned hall at the more open ends of the galleries.

The columned hall in the northern end in some of the galleries was a surprise. The remains included low walls or benches, parallel to the major walls, in which various column bases were embedded, indicating a row of columns, presumably to support a roof—technically a colonnade.

Roofs would have provided partial shade and protection from the wind, probably for cooking. We found evidence of cooking in a couple of the galleries during previous field seasons, such as ash deposits. This year we excavated a circular burned patch in J7, near a gallery entrance, which was probably the remains of an oven.

A "worker's house" first turned up in 1997–'98 in the southern end of a gallery in set III (squares D9–E9). It was a very simple two-room affair, with a rectangular cooking installation in the back, outer gallery wall. This season we found a more complex house plan in other galleries of sets II and III. These include a repeating pattern: a small vestibule leads to a main room and small niche or inner (sleeping?) room. An additional room or corridor lies on the other side of the vestibule.

Like a traditional Egyptian house, the chambers at the back of the habitations in the southern ends of the galleries were used for cooking, baking or roasting, as indicated by thick deposits of concentrated ash. In 1998 we excavated a bakery in the southern end of a gallery in set II (square L11). In square D17–D17x at the southern end of another gallery, we found clear evidence of copper working for household use—a copper fish hook and needle, along with abundant slag, charcoal, and ash.

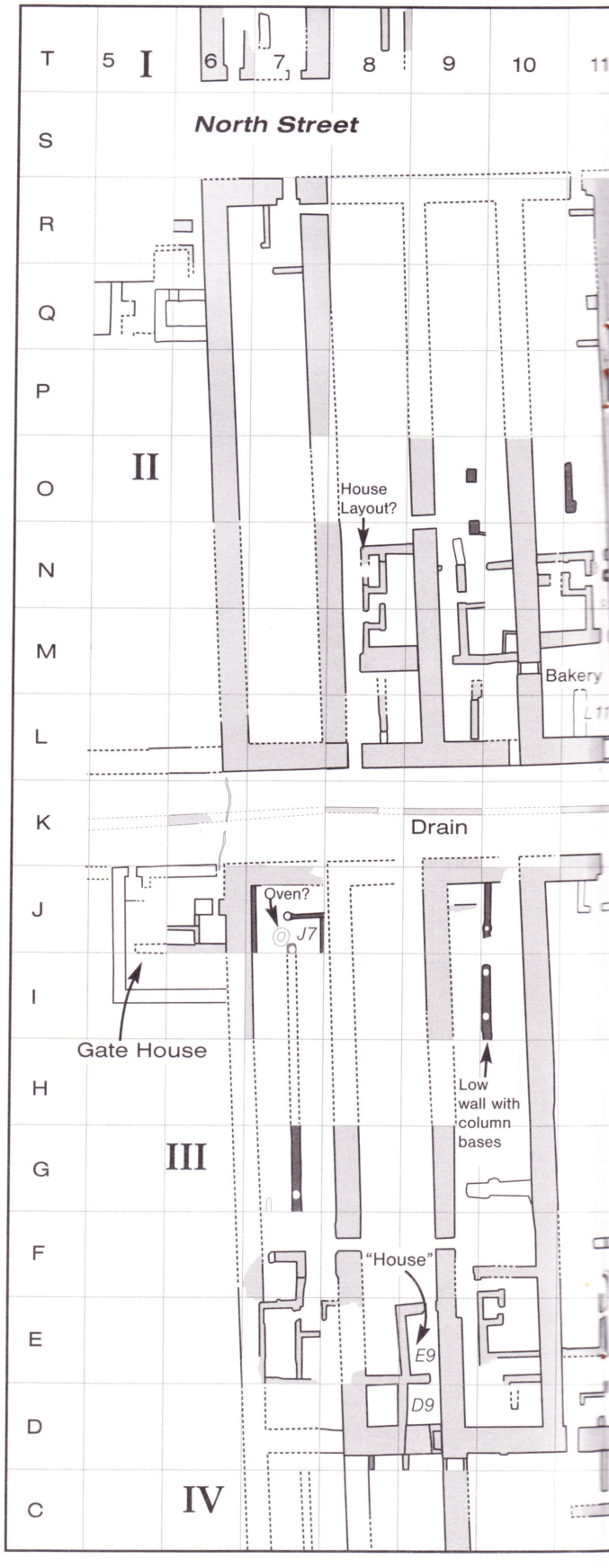
Workers' "Row Houses"

Along the east wall of gallery set III, we found another type of residential layout—simplified versions of workers' houses. Short field stone walls form a series of oblong chambers, about 2 meters wide and 4 meters long, oriented east-west. They are divided into two chambers by a partition wall, with evidence of cooking in the rear (west) chamber.

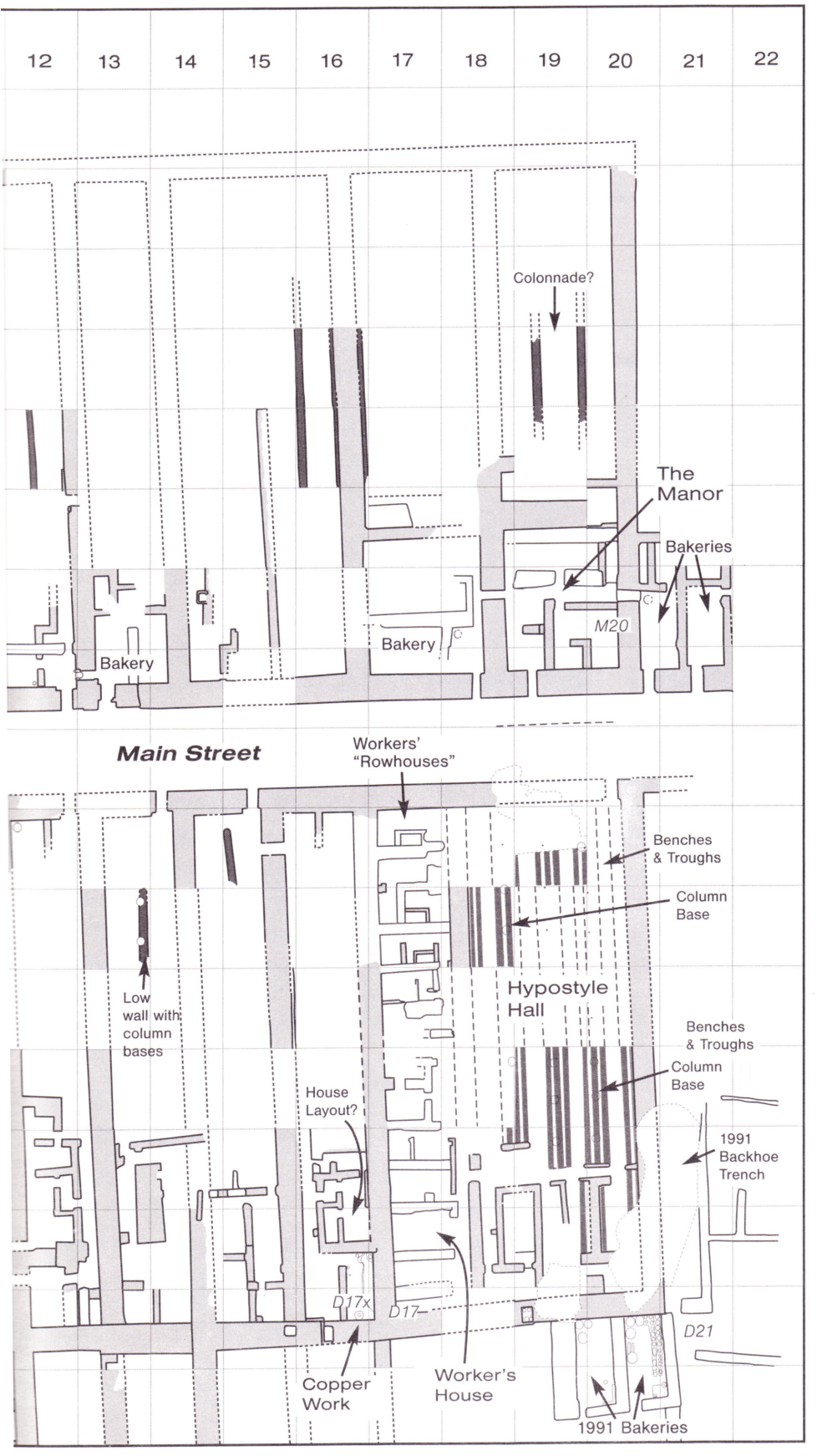
Next to these "row houses" we were surprised to discover a hypostyle hall, a structure with a roof supported by rows of pillars. This building, which we believe is the oldest Egyptian hypostyle hall, is described on page 2.

The Manor

Our complex was not limited to workers' housing. At the east end of gallery set II we found what appears to be a large residence with some of the features of a traditional ancient Egyptian house. The "Manor," as we call it, is about 10.5 meters by at least 15 meters, with thick outer walls. The southeastern room, which we partially excavated (square M20), was well maintained and probably decorated. Fragments of marl plaster in the fill had thin red paint layers, indicating portions of the walls had been painted—perhaps a dado around the base. The western room was apparently used for cooking or baking as suggested by ash layers. There are also two bakeries attached to the east side of the Manor. Just to the north there may be a colonnade. Two long thin



Map of Zone C, showing the outlines of a royal production facility. Portions of this area were excavated during previous seasons, but most of it was cleared as part of the Millennium Project's first year. This year's work also extended to areas outside this map and can been seen in the map on page 8 which offers a broader view.



Key: Mud brick walls

Stone walls

Probable walls

Gallery sets: **I, II, III,** and **IV**

Note regarding "Probable walls:" We did not actually see the outer faces or lines of the walls but we are reasonably certain they exist.

benches in the open area are similar to the colonades of the galleries, but on a larger scale.

The West Side

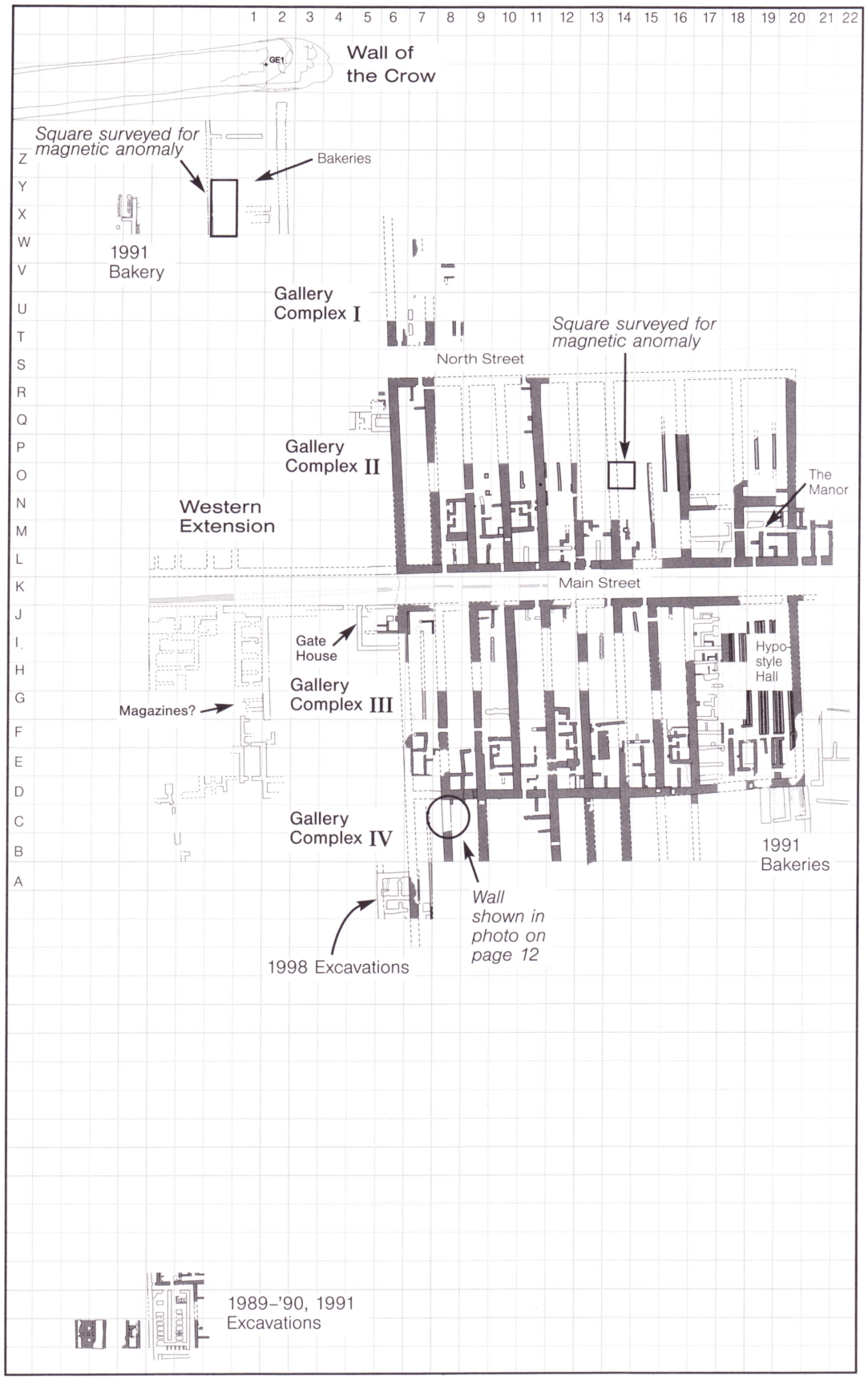
West of the gallery complex we found other types of structures, not as formally organized as the galleries and built of yellow fieldsone from the nearby Maadi formation, rather than mud brick. At the northwest corner of gallery set III, we found a building nearly 100 meters square attached to Main Street, which we dubbed the "Gate House." Farther west we found another building attached to the south wall of Main Street (see map on page 8). Between this compound and the Gate House there is a bank of small chambers—possibly magazines.

To the northwest we also found evidence of yet more structures. We had to clear along the Wall of the Crow in order to accommodate riders coming from the nearby stables and ended up finding remains of bakeries not far from where we excavated bakeries in 1991. On the southern side of the wall, toward its eastern end, we exposed large rectangular areas of dark ash enclosed by field stone walls. Right up against the wall, we found thick, reddish dumps of concentrated pottery sherds—mostly bread molds—similar to deposits we had seen in square D21 next to another set of bakeries excavated in 1991.

Scratching the Surface

The first year of our Millennium Project has been rewarding and exciting. We have unveiled an important part of the social and economic dimensions of the Giza Pyramids. We now have abundant evidence of the infrastructure that accompanied these colossal projects, as well as some intriguing firsts—such as the first hypostyle hall—and surprises—the long galleries never seen before in Egyptian Old Kingdom sites.

But we have literally only scratched the surface. Starting this fall, the second year of our Millennium Project, we will begin intensive excavations in the cleared areas to get a better understanding of these facilities. We will also continue clearing beyond the margins of our excavation to the north and west to uncover more of this buried complex. ~ *Mark Lehner*



Map of part of our concession showing all of our work this season and some of our earlier excavation squares. We still have a long way to go before we have opened the entire area. Our goal this coming field season is to clear to the north and west of the gallery complexes, as well as intensively excavate areas previously cleared.

Key: Mud brick walls

Stone walls

Probable walls

Fall Field Season

As you read this we are aleady at work on the second year of our Millennium Project. And, as you can see from the map on the left, we have our work cut out for us, with an enormous area yet to clear.

Our priorities are to push on to the north and west as well as excavate intensively the areas we already cleared. We will work from October until the end of November and break for the holidays. We resume work in January and continue on until June.

Thirty-six people from abroad will be joining our Egyptian staff for a total workforce of 60 to 70. In addition to our archaeologists and specialists (lithics, ceramics, animal bones, plants, surveying) we will be joined this year by osteoarchaeologists, a hearth researcher, a charcoal analyst, and a remote sensing expert (see next page).

Look for a report on this fall field season in our next issue of *AERAGRAM*.

Help Support the Millennium Project!

Your contributions can help us continue our work. Ann Lurie, who funded much of the work during our first year, has offered to continue her support if we raise additional funds from other donors.

Gifts of any size are welcome. Please send contributions or inquiries to:

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Giza Ground Truth: *Magnetic Anomaly Surveying* by Glen Dash

At Giza we face such an enormous task in trying to determine the footprint of the Old Kingdom complex that Glen Dash, one of our supporters and an expert in remote sensing, suggested magnetic anomaly surveying as another method for locating structures. Glen joined us this past winter to test his technique.

This was what I had been waiting for. I was standing on clean sand, at a layer which just days before was two meters below the surface. The Giza Plateau Mapping Project was moving outward from its home base which had been established in what we called Zone C. My assigned task for this day was to map an area off the end of our charts. Our survey map (see map on the left) extended as far north and west as square R4. This day I'd be working in a square without a name. We had run out of letters.

I finally had near perfect conditions for using magnetic gradiometry, which measures small perturbations in the earth's magnetic field. Iron is one of the most plentiful substances in the earth's crust, and every bit of iron, to one degree or another, perturbs the earth's magnetic field. Some materials, such as limestone and sand, produce little perturbation. Others, like fired pottery, produce surprisingly strong magnetic fields and, if massive enough, can be detected from more than a meter away.

Modern Debris Wreaks Havoc

The process of performing a magnetic anomaly survey is not easy. It's made difficult by the effect modern man has had on his environment. We drop little bits of metal everywhere. On the surface of the Giza Plateau there are horseshoes, rusted pots and pans, bottle caps, and even truck parts. We dug up all of those things during the spring 2000 season and more. Bits of man-made forged or cast iron serve to concentrate the earth's magnetic field so intensely that they will mask any archaeological features for a distance of up to three feet. Scatter enough horseshoes, nails, bottle caps, and pots and pans around the site, and you'll see nothing of the ancient architecture.

Initially, I had signed on to work in Zone W (for west) and had attempted to map magnetic anomalies without removing the top few feet of sand which contained all this modern debris. In one 20 x 20-meter square I located and removed ten pounds of junk metal, including 20 horseshoes. In an adjacent square, slightly lower in elevation than the first, it was pots and pans. Still farther to the north and west, a 20 x 20-meter square revealed hundreds of bottle caps. It was almost as if I could discern the modern occupation patterns from the junk I was finding. Interestingly enough, there was a lesson to be learned here.

Gradiometer survey in progress. Becky Dash operates the FM 36 gradiometer while Glen Dash watches. Both wear surgical scrub suits because these clothes have no metal that could interfere with the survey equipment. Menkaure's pyramid rises in the background and at the right, the west end of the Wall of the Crow disappears under the sand.

It is hard to correctly determine a site's usage from what is left behind. Some future archaeologist could easily have jumped to the conclusion that the first square that I had surveyed, the one with the horseshoes, was the corral, and the second square, the one with the pots and pans, was the kitchen. But why would a corral be located next to a kitchen? It's not the kind of ambience one would find attractive. Actually, the horseshoes had been shed by horses

Continued on page 10

Magnetic Anomaly Surveying

Continued from page 9

galloping through the first area, a point where riders pick up steam. As for the second area, locals riding to work on their donkeys would toss their garbage in the low depression. Plastics blew away and organics decayed so what was left were the iron pots and pans, which can remain for a long time in Giza's dry climate.

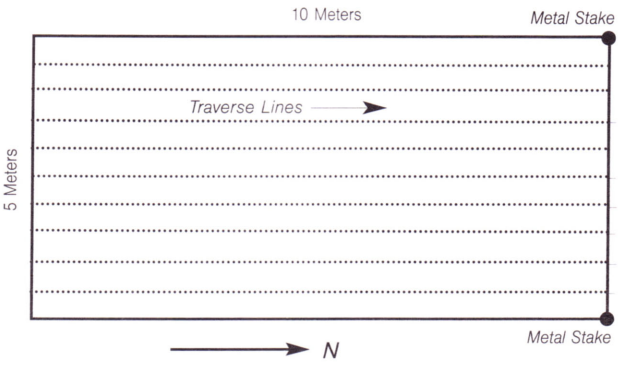
A Fresh Start

This new area that I was assigned to survey, however, was cleared by the bulldozers. They had pulled away a good two to three meters of the sandy overburden and, at the same time, had removed all the modern metal (including what looked like the front end of a tractor). The surface I was standing on now should have been deposited here some time between 500 and 2500 BCE. We know that because it was below the level of nearby Late Period burials (circa 500 BCE), but above the Old Kingdom architecture that we thought might lie below. Lighter in color than the sand on the surface, it was pristine, uniform, and beautiful. The Old Kingdom architecture was still one to two meters beneath my feet, and nothing on the surface gave a clue as to what might lie below. I was standing on a level deposited before the Iron Age, and, by definition, there should be no man-made iron between me and the ancient layer.

Surveying

To map the magnetic anomalies, we laid out a square 5 x 10 meters (see drawing above on the right). Our ever efficient surveyor, David Goodman, had already put metal rebar on one end of the square, but I had managed to get there before he had done the same to the other. I placed plastic pegs at that end of the square and laid out tapes, forming two tracks, one meter apart. Each fiber glass tape was marked with a distinctive red marking every meter. Once tapes are in place, mapping goes speedily.

The instrument I was using, the FM36, was built in England by a company called Geoscan Research. This gradiometer is the top of the line instrument produced by Geoscan Research, and the one most frequently used by archaeologists. Unlike other magnetometers and magnetic gradiometers, this one had been designed specifically with archaeology in mind. Even though the design was old (circa 1985), it was still the best instrument for the job.



Survey grid for the gradiometer survey near the Wall of the Crow. The traverse lines are one half meter apart and 40 readings are taken on each traverse. The metal stakes align the survey area with the rest of the Giza Plateau Mapping Project.

Taking Readings

The process of taking magnetic anomaly readings went like this (see photo, page 9): You begin by standing near the southwest portion of the grid square. Flipping the magnetometer on will cause it to take four readings a second. The job of the surveyor is to walk steadily and to make sure that the gradiometer is aligned with the red markings on the tape each time the instrument beeps, denoting another one second interval.

As you reach the end of the square, the gradiometer stops beeping (it knows that this is 5 x 10 meters square). Then the surveyor walks back to the southern end of the square, repeating the process, this time walking between the two tapes, which are placed one meter apart. The surveyor repeats the process, periodically stopping to move the tapes along the 5-meter breadth of the square.

Suspense: Downloading

It is not really possible to get an indication of what the instrument is finding by watching its readings as one walks along. There is just too much information. So there is a moment of suspense when it is time to download the data into a computer where it can be observed.

The suspense is heightened by the fact that the 15-year-old serial communication technology used in the FM36 is, to an increasing degree, incompatible with the serial input port of some newer computers. A practical alternative is to use an older computer for downloading data. I use an old Toshiba Satellite laptop.

I brought the FM36 back to the storage tent. It provided shade and a table to place the computer and instrument on. The FM36's shipping case served as a chair.

Hooking the serial output port of the instrument to the serial input port of the laptop and firing up Geoscan Research's "Geoplot" software got me to the download screen. Setting the input parameters, I pressed download and prayed that today the two machines would talk to each other.

They did. I pressed a few more buttons and a 5 x 10-meter scale map appeared on the screen (see figure above right). What appeared is without a doubt an Old Kingdom building. This established that the AERA site extends far beyond the area that we had been excavating, right up to the base of the Wall of the Crow.

Moment of Truth

Reis Ahmed's crew was now assigned the task of removing the clean sand above the building. I climbed to the top of the Wall of the Crow, 10 meters to the north, to watch. One foot of sand was removed, then two, then three, with nothing show-

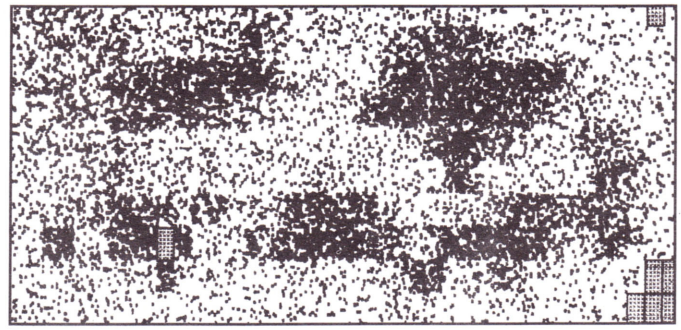
ing. But something had to be there. I knew that despite the increasingly skeptical look on the Reis' face, complimented by, what I suspect, were Arabic wisecracks at my expense.

Almost a meter and a half down, the edges of the building emerged. With a bit more excavation, we could identify it. It appeared to be a bakery. The strong magnetic signatures were caused by dozens, maybe hundreds, of bread molds used and discarded at the bakery. They had piled up against the walls of the building, along with other pottery.

Although we found one bakery 15 meters to the west in 1991, we didn't expect to find more bakeries here. The other bakeries of similar design were found to the south and east of Zone C. That seemed to make sense. The prevailing winds in the area blow from the northwest and the smoke and ash generated by the bakeries would have been carried away from the main area of the site. From the northwest corner of the site, though, prevailing winds would have blown smoke and ash directly over Zone C. But the Wall of the Crow, 10 meters high, would have blocked these winds, protecting this area.

Using Magnetometry

My visit to the pyramids was as much to study magnetometry as it was to study archaeology. Every site has unique characteristics, and it sometimes can take considerable time and effort to determine the conditions that will produce useful results. Here at the Giza Pyramids, and I suspect at sites south to Dashur, magnetometry can be a powerful and very revealing technique. The key is to strip off the modern layers, layers which are contaminated with modern metal. Once you reach a depth that precedes the Iron Age, there should be no refined iron to cause interference. It would also help if archaeologists found some other way to stake the corners of their squares than to use iron rebar.

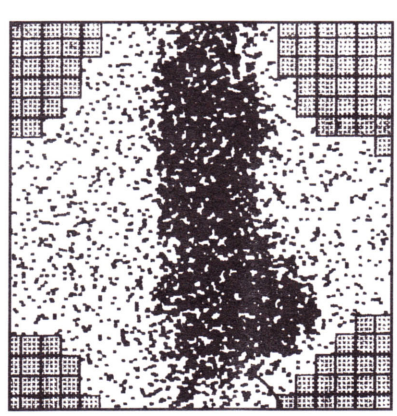


Results of the gradiometer survey for the survey area. The darker areas have relatively greater magnetic field deflection. The north-south alignment and the spacing of the anomalies indicate the presence of an Old Kingdom building of some kind. The right hand corners, where the metal stakes were located, could not be surveyed because their metal masks any magnetic anomalies. These areas that were untestable are indicated by the grid paper-like pattern.

Finding "Ghosts"

We also mapped a number of grid squares in Zone C itself which demonstrated other uses for magnetic anomaly surveying. In square O14 we found that this technique could identify where walls, now gone, once stood. A system of long and substantial gallery walls had been observed running through Zone C from north to south. One of the gallery walls should have run through the western corner of this square, but nothing was found.

A careful gradiometer run revealed the reason. The gallery wall had been there. In ancient times, pottery had piled up against the wall and now it was revealed by a dark mass running through the center of O14 (see diagram below). But sometime in the ancient past the mud brick gallery wall had been robbed or eroded away, possibly by floods which had destroyed much of the architecture in the north and eastern sections of Zone C.



Gradiometer results for square O14. The dark areas denote buried sherds. The lighter area to the left is where a gallery wall once stood before it was robbed or eroded away. The heavier sherds remained, where they had piled up against the wall, and now indicate where the "ghost wall" once stood. The squares that look like grid paper are areas that could not be surveyed because of the presence of metal, primarily metal stakes, which masks magnetic anomalies.

The heavier pottery remained, marking the eastern edge of the gallery wall, which was now a "ghost" wall. Although the wall was gone, its location is still readily observable with magnetic anomaly analysis.

Remote Sensing in 2001

I will return to the Giza Plateau in the spring of 2001, armed not only with our magnetic gradiometer, but with an induction type metal detector adjusted so as to be most sensitive to copper, and probably a ground penetrating radar. How I will use these instruments I really can't say. As with magnetometry, it will take a week or so of experimentation to determine how to get the most out of the instruments. But as our experiment in magnetometry has shown, these instruments indeed can provide a valuable data set to compliment the information obtained through more

Glen Dash is a graduate of MIT in electrical engineering and holds a law degree from Harvard University. He founded a consulting company in the early 1980s, sold it in the early 1990s and retired. "I now fill my time with investing, archaeology, philanphropy and writing."

His first dig was Tepe Yahya in Iran in 1973. More recently he performed surveys at Helike in Greece and Yeronisos in Cyprus. We are glad that he finds time to also work at Giza. And we are happy to welcome him as a new AERA board member.

AERAGRAM

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Inside

On the western side of the excavation, Mohsen Kamal measures stones of collapsed gallery walls while workers strip off the last of the sandy overburden. Looking toward the southwest, the 4th Dynasty "Workmens' Cemetery" is visible climbing up the slope. Teams from the Supreme Council of Antiquities have been excavating here since 1990. See map on page 8 for the location where this shot was taken.

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