



# THE LUXOR, EGYPT EXPEDITION

## Queen Nefertari Has Visitors

by Dorothy A. Wissmuller and Ian Gonzalez



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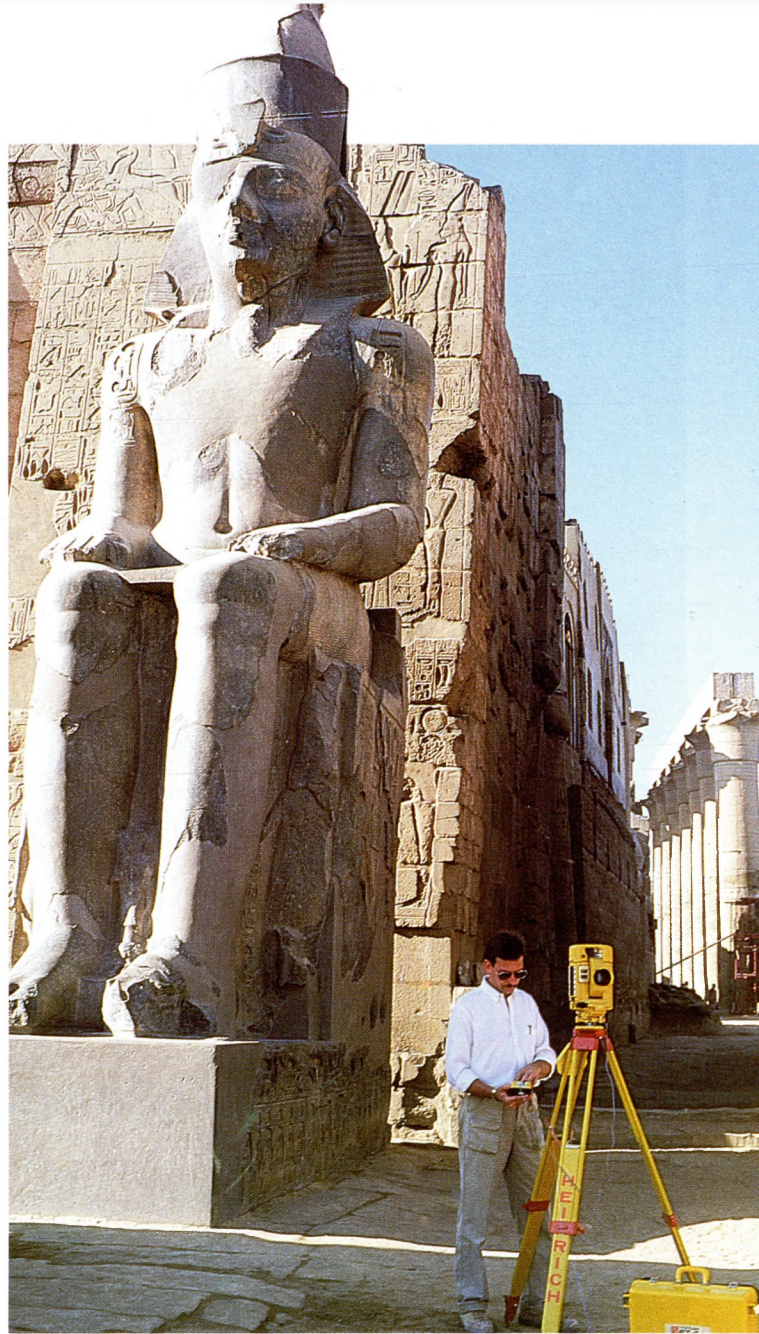


**H**igh above the desert floor, Robert Cameron crouched to position a tripod. Far below him in an east-west tracery whose orientation was toward the blue ribbon of the Nile river, Cameron could see the vestiges of his professional forbears in the layout of the ancient city of Thebes. This heady prospect confirmed for him the truth of John Rohmer's opening sentence in *Ancient Lives*: "Thebes stands as an altar between the sky's arc and the earth's curve, in a landscape so large that you can never comprehend it all, yet so small that you may walk across it in an hour."

Several months earlier, Robert Cameron had been approached by Dr. Bradford Washburn, Director Emeritus of Boston's Museum of Science and a renowned cartographer, and asked whether he might be interested in undertaking a surveying project in Egypt's Valley of the Queens. Cameron, owner of R.E. Cameron and Associates, Inc., an engineering-survey company in Norwood, Massachusetts, was no stranger to overseas billets, having previously worked in Pakistan and West Africa. This project was being funded by Earthwatch, a nonprofit organization devoted to organizing amateur and expert volunteers to aid scientific research around the world. The work was being undertaken on behalf of the Egyptian Antiquities Organization. Cameron needed no arm-twisting. He jumped at the proposal, signing on as principal investigator and taking charge of an expedition that came to include two of his sons (both registered land surveyors), a company associate, and 19 Earthwatch volunteers from diverse professional backgrounds.

It was a challenging and exotic assignment, and one, in a sense, that would take the surveyors back to their professional roots. After all, Ptolemy, (see "Ptolemy: The Father of Modern Surveying and Geography," *P.O.B.* Vol. 13, No. 5, June-July 1988 issue) lived in Alexandria, down the Nile from Thebes and the Valley of the Queens. It was this valley that the surveyors and their volunteer crew would map during a month's stay. At stake were the incomparable murals painted on the walls of Queen Nefertari's tomb that had been deteriorating over a period of eight decades since the tomb's discovery in 1904. Widely regarded by Egyptologists as the most exceptional New Kingdom (1552-1069 B.C.) tomb paintings in terms of draftsmanship and color, concerns about their deterioration due to water seepage have kept the tomb closed to the public for 50 years.

Queen Nefertari (her name means "self-generating beauty") was the favorite wife of Ramses II, the third pharaoh in Egypt's 19th Dynasty and its ruler for 65 years (circa 1289-1224 B.C.). He was a ruler of prodigious accomplishments and appetites, arguably the greatest builder



*Despite a number of setbacks in the expedition's plans, the crews were able to perform the necessary topographic surveys.*

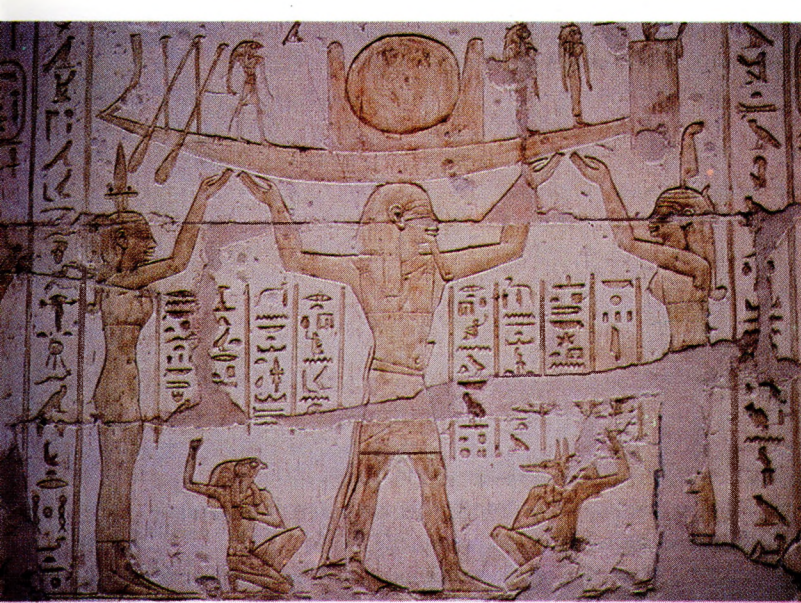
among the pharaohs, and the father of more than a hundred children. On the Nile delta he built Pi-Ramses-Great-of-Victories, a jewel among the cities of Egypt. He also erected magnificent temples at Thebes, Abu Simbel, and Luxor. The extraordinary esteem in which he held Nefertari is indicated by the dedicatory inscription over the temple he built for her at Abu Simbel: "Ramses II, he has made a Temple, excavated in the Mountain, of eternal workmanship...for the Chief Queen Nefertari Beloved of Mut, in Nubia, forever and ever...Nefertari...for whose sake the sun does shine."

The landscape of the Valley of the Queens is forbidding, almost lunar in its lack of vegetation and in the uniform color of its shaley limestone hills. Yet despite the area's bleakness and ruggedness, 57 tombs have been discovered in its hills.

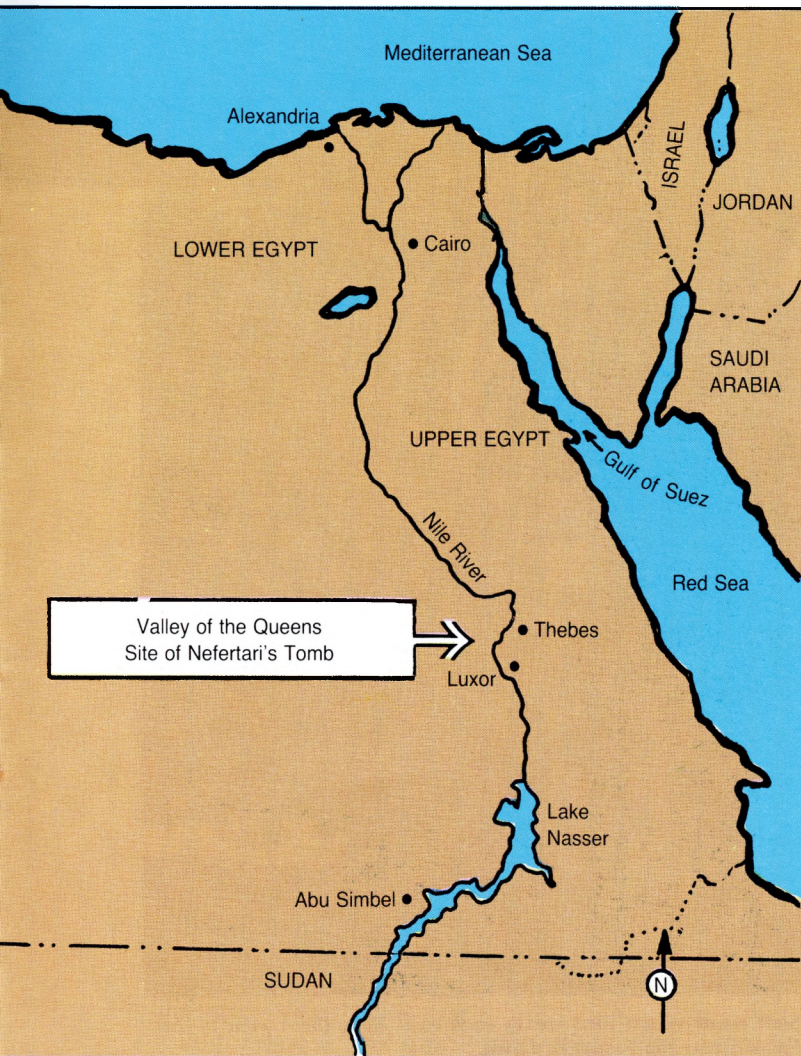
*The mural paintings that line the walls of Queen Nefertari's tomb are in danger of being destroyed by an unknown water source.*

*A view of the Temple of Deir el-Bahri (Temple of Hatshepsut). This is located on the far side of the Valley of the Queens. Here is where the crew did the majority of their training.*





*Temple wall carvings are found inside the numerous temples. These records of ancient history are also in danger of being destroyed because of deterioration.*



As Cameron had it explained to him, “The Egyptians chose the valley for the imperial burial grounds because boats were used for transportation up and down the Nile and because they expected the nearby high grounds to remain dry.” Ramses II had counted on the solidity and aridity of the place when he had his surveyors and architects plan and build Nefertari’s tomb. Other tombs in the area have survived unchanged and pristine over the years, but in the case of Queen Nefertari’s tomb, something went seriously wrong.

Hypotheses about about how the water is getting between the limestone rockface and the layer of plaster on which the murals are painted. Although the Nile plain floods annually, the rugged desert and high shale escarpments surrounding the valley receive rainfall only every ten or 20 years. Yet somehow, moisture has caused water soluble salts in the limestone to crystallize and expand outward, thus pushing the plaster away from the walls. Was the water introduced many centuries ago by a flood of unprecedented and unsurpassed proportion? Was the scarce rainwater pooling somewhere and being drawn up with excruciating slowness by the rock? Had there been excessive moisture in the plaster when the tomb was built? Could the presence of humans—archaeologists, curators, early tourists—have produced a rise in humidity or microbiological activity sufficient to imperil the paintings? Only the last of these hypotheses had been discarded, and it was up to Cameron and his atypical crew to provide the groundwork that might lead to an answer.

What the Egyptian Antiquities Organization required was a detailed topographical map of the valley and its surrounding escarpments. The preparation of a topographic map would not only show areas and boundaries but the elevations of the land itself. The map was to include all tombs north of the paved road, and to cover the high ground to the continental divide, which separates the two main drainage systems. The group had aerial photographs that they hoped could be integrated with the topographical data so that photogrammetry could be done. Finally, the Egyptian Antiquities Organization asked Cameron to make accurate profiles of all significant wadis (gulleys or dry riverbeds) by using laser instruments, and to establish points with absolute control, perhaps using GPS coordinates. Once the topographical map was complete, hydrological and geological engineers would go to work developing a complex profile of the geology, structure, drainage, and stratigraphy of the region, designed to discover the water source.

### Arrival in Egypt

Robert and Sue Cameron, their sons Rod and Scott, and company associate Andy Browne arrived in Cairo on February 11, 1987, several days before the actual mapping would begin. With them arrived 11 huge boxes of highly sophisticated surveying equipment—\$40,000 worth in all, loaned to the expedition by the Topcon Instrument Corporation of America and the Carl Heinrich Company. After the long flight, everyone was eager to get to their hotel; however, they had not anticipated any difficulty in clearing customs. Cameron explained, “When the customs officer asked





*The Cameron family (l - r): Rod, Sue, Bob, and Scott. The Camerons, along with the Earthwatch crew, were responsible for providing ground surveys to help determine the cause of the damage to the queen's tomb.*

us to uncrate all the boxes, I tried to suggest he spot-check one or two.” But after ticking off the contents of the two boxes against a serial-coded checklist, the officer tried to insist that they open the other nine boxes. Without hesitating, Sue Cameron stepped forward and irately explained that they all were suffering from jet lag and needed to rest.

“I guess a mother is a mother all over the world,” Rod was able to chuckle much later, “because that was that. We had no further delay.” The group spent the night in Cairo and flew to Luxor the following day. Unfortunately, the person in Luxor responsible for making their hotel reservations had not received the telephone message of the Cameron’s arrival. They tolerated—for the time being—staying at a lackluster hotel on a Luxor backstreet. It was three days before Abraham Mahmad Soliman, their liaison from the Egyptian Antiquities Organization, “found” them and had them transferred to the Winter Palace Hotel in Luxor, where he made amends by obtaining the “Queen Suite” for them. In the meantime, they’d met another Egyptian, Ahmed Eladly, who began to serve as an informal guide and expeditor. He arranged ferry service and located a van to transport their equipment to the Valley of the Queens. “He was an extraordinary hustler—in the good sense of the word. It seemed that everyone we met in Egypt was either Ahmed’s cousin or his friend,” Cameron recalled.

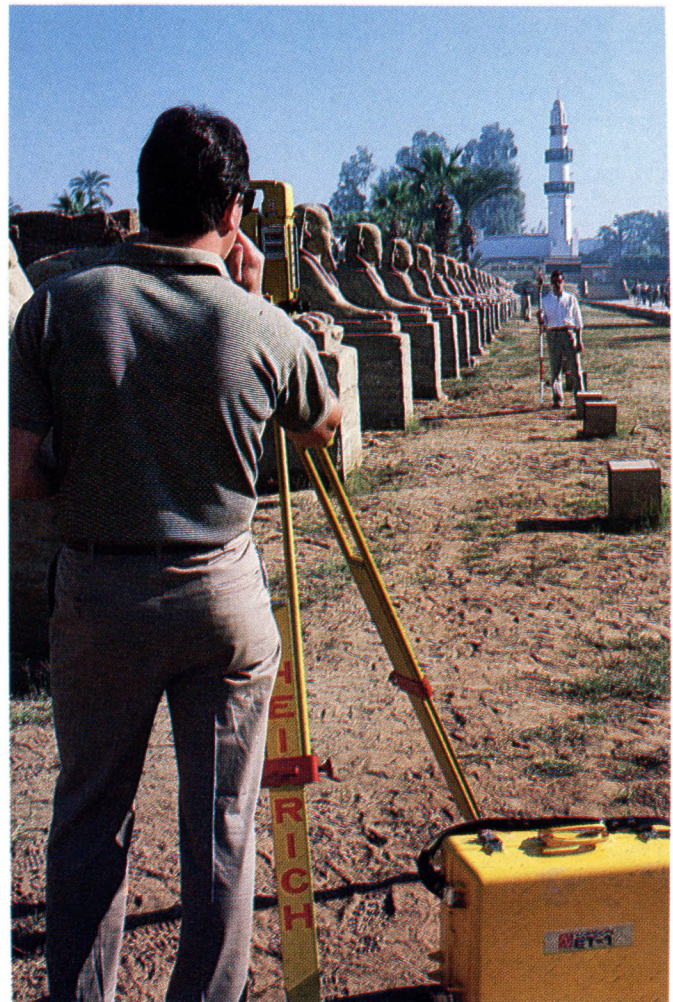
Soon after the Cameron’s arrival, a major blow was dealt to the expedition’s plans. The aerial photographs promised by the Egyptian Antiquities Organization turned out to be practically useless. They had too many shadows and were of such poor quality that Cameron despaired of using them to establish ground control. Hoping to rephotograph the region, Cameron petitioned the Egyptian government for clearance. Unfortunately, the Egyptians turned him down, citing military security concerns. The proposed study area was two square hectares (500 acres), which was far too large for anything but an aerial survey or an actual field study. Although Cameron was supplied with base maps, these also turned out

to be inadequate. They had been prepared by a 1926 British surveying expedition and were quite incomplete. (In midproject, Cameron discovered far more sophisticated maps at the University of Chicago’s Oriental Institute in Luxor. These had been drawn by a French team in 1964 and were unknown to the Egyptian Antiquities Organization. A final irony awaited him on his return to Boston, when he chanced upon copies of these maps in that city’s Museum of Fine Arts!)

In the absence of good aerial photographs and adequate base maps, Cameron realized that their original goals were impossibly optimistic. He determined instead to update the existing maps by using ground survey methods. He decided to concentrate his group’s early efforts at the entrance to Queen Nefertari’s tomb, and then to fan out to the high ground (the team had been further disappointed to learn they would not be allowed to work within the tomb).

Once the obstacles were overcome, the Camerons were ready to begin training the first of two Earthwatch teams, comprising of 19 volunteers in all. Team Number 1 worked at the site from February 15 to February 27. Team Number 2 took over on March 1 and left March 13. Each morning the crews left the luxury of their hotel rooms at the Winter Palace

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*Staff members test their survey equipment along the Avenue of the Sphinx, near the Temple of Luxor.*





*The rugged terrain, along with the extreme temperatures, made the survey work quite difficult.*



*In order to perform all the necessary surveys, both this entrance to the tomb and the surrounding region had to be considered. Nefertari's burial chamber lies at the end of a long, sloping passageway in the limestone hillside.*

or Sheraton in Luxor, boarded a rickety boat full of livestock, food vendors, and tourists, and crossed to the west bank of the Nile. It was a trip through time as much as space, for modern Luxor fell away in stages, was cast off unconsciously as the crews approached the Valley of the Queens, separated by 3.5 miles and 3000 years from the city they'd left behind.

The diversity in the backgrounds of the volunteers was extraordinary—there was a restaurateur, a science teacher/pathologist, a construction company president, a retired telephone company employee, a retired professor of computer science, a newscaster/actress, a hotel concierge, and a nurse—all-in-all they were two groups with enormous talent and unusual energy. Even Brian Rosborough, the president of Earthwatch, joined the first team for a few days.

Robert Cameron said, "We decided that the four of us (Robert, Rod, Scott, and Andy) could adequately train the two volunteer groups over a two- to three-day period to perform as two survey crews. Each crew would have a leader and a tape person, and the volunteers were charged with setting up tripods and holding rods."

Rod explained, "We simplified things. We looked specifically at the essential tasks to be done. We used a total station rather than theodolites, and instead of using a data recorder,

we involved four volunteers per crew to work the prism poles. It became a real team effort."

Though Scott Cameron had sole responsibility for operating the total station, all the volunteers were familiarized with its basic functions. The equipment was so automatic that general explanations were adequate: "It generates light, it bounces off a mirror, it's captured back in the box, where the EDM microchip computes the height differential..."

"The operation was made understandable, and the equipment could be handled by the volunteers," reported Rod. They learned how to set up tripods, and how to use automatic levels and hand equipment (rods, prism poles). While one of the volunteers took notes, several of the others handled the prism poles. Reducing survey data and calculating closures was done capably by several of the volunteers with the supplied equipment.

Within a few days, Cameron's team was trained in surveying essentials and they were carrying transit poles and reflectors up the steep escarpments of the site.

"We had thought before we came over here that we would be working on flat land with no trees," Rod Cameron said. "Well, there weren't any trees, but the site was on the side of a mountain." The terrain was extremely hazardous. The 1600-foot mountain was made up of steep slopes of crumbling shale. Add to that numerous middle-aged volunteers in sneakers and a number of precautions had to be adopted. For a time—until the Egyptian government forbade their use, again citing military precautions—two-way radios were used by all crew members for communication. The crews also immediately adopted the buddy system, so that no one worked alone.

Volunteer Betty Boetger, a retired telephone employee from Portland, Oregon said, "I've been on three Earthwatch expeditions to date, but this was my all-time favorite. Some days were taxing, with lots of climbing, but we usually had a nice breeze. The Camerons always stressed safety, with both their people and equipment."

Though Betty suffered from acrophobia (an intense fear of being in high places), Rod devised a plan to keep her Nikes climbing the escarpments. "I put my fingers in Rod's belt to make each climb. I looked between his shoulder blades and up we'd go!"

The intense heat and poor air quality of the desert climate also posed problems for the team. Although the escarpments provided enough shade so that the team never had to work long periods under direct exposure to the sun, Alice Olszewski, a high-school teacher from Cherry Hill, New Jersey (and a winner of the President's Award for Excellence in Science) said, "The sand air was terrible. It was like a fine talc. Everyday I made sure to walk around eating and offering everyone raisins and oranges to avoid dehydration. It's easy not to notice, because the air is dry and the heat doesn't really seem that bad." The air quality was exacerbated by the tourist industry, which forms a major part of Luxor's economy. Alice explained, "The tour busses were left running all day to keep the air conditioning on for the tourists. This caused terrible exhaust fumes to encircle our entire work vicinity." The teams also had to contend with smoke from the sugar-cane fields, which the Egyptians burned in order to return nutrients to the soil.



A further danger posed by the large tour busses was microseismicity (small recurrent tremors of the earth's crust), which could dislodge loose pieces of rock in the area of Queen Nefertari's tomb. Robert Cameron recommended to the Egyptian authorities that the busses not be allowed to approach so near to the site. "It seemed the logical step to take. After all, here we are aiding in the first phase of a project seeking to determine what is causing the plaster to crumble off the walls of this tomb. And yet all day long you feel the rumbling of these huge busses parked at the base of the site. The Egyptian authorities promised to consider my recommendations." In retrospect, Cameron can laugh at the enormous frustrations. "Everyone there is working at cross-purposes. No one seems to be fully cognizant of the large picture—they build tiny kingdoms unto themselves."

Alice Olszewski said, "The Camerons should get the Nobel Prize for patience. They were of the old, courtly school, but were modern in terms of dealing with scientific problems."

In a relatively short period of time, the volunteers became proficient with all the surveying equipment and methods. Though unable to cover the entire region, the survey teams were able to complete a detailed topographical survey of the entrance to the Valley of the Queens and some of the lower areas. In that respect, the expedition was successful. The Cameron/Earthwatch partnership prepared the way for a University of California-Berkeley survey team that was responsible for completing the topographical map.

Earthwatch president Brian Rosborough commented, "If

you ever get lost, just dream up the Camerons. Robert has a tremendous sense of what's important. And we'd love to have surveyors on every Earthwatch team."

## A Nerve-wracking Exit

Rod Cameron described the crew's parting from Luxor: "We told our great friend Ahmed that we had to get to the west bank of the Nile in time to catch the ferry. We had nine big boxes of equipment going back with us, along with two total stations. He said he'd take care of us.

"He returned with his brother-in-law's truck, that had been used to transport chickens. It was full of droppings. The truck was being repaired when he commandeered it, and so brake fluid kept squirting up onto the hood—the brakes were questionable at best.

"We had a tight schedule. We tried cleaning things up, but finally just picked up the equipment and left. We were the last vehicles to make the ferry; the rear end of our truck, packed with all this expensive equipment, hung precariously over the Nile for the entire crossing."

It was a fitting close to an expedition that had been run by the seat of the pants, one in which imagination and enthusiasm had overcome numerous roadblocks. The view of Thebes from that high escarpment, and the sense of communion with its planners and builders, will remain with Robert Cameron for a very long time. ▲

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## PROJECT UPDATE

According to Dr. Farouk El-Baz, geologist and director of the Center for Remote Sensing at Boston University, who served as the technical advisor for the project, the final determination of the source of water that caused the damage to the tomb of Queen Nefertari has not yet been made. Since the initial topographic work was completed by the Camerons and the Earthwatch teams, a number of additional surveys have been performed at the tomb site. These include: geological; topographical; meteorological; and structural surveys.

The geological survey established the type and nature of rocks in the area. The topographical survey incorporated the data from the Cameron/Earthwatch project, as well as data from a photogrammetrically produced map by Swissair Photo of Zurich, Switzerland. The meteorological survey determined the amount of occasional rainfall in the area. The data from the structural survey, which was performed by a team of geologists from Boston University, gives investigators clues about fractures and joints in the host rock in order to establish the amount of water that seeped through the rock, dissolving salt and recrystallizing it behind the plaster layer causing damage to the tomb paintings.

The data from all the surveys will be combined to create a hydrological model that will reveal what is the primary cause of the seepage into the queen's tomb.

The results will be announced during the 28th International Geological Congress to be held July 9-19 in Washington, D.C.

Dr. El-Baz considers the scarcity of good basic data the greatest obstacle that the survey crew faced. He points out, for example, that the limited number of aerial photographs that were available were not tied to control points. This lack of reliable survey data, plus the limited availability of meteorological data, restricted the investigators in their interpretation of the results. The computer simulations (which are based on the compilation of survey data) are extremely important to the group responsible for analyzing the results. It is their intention to improve the integrity of the results by statistical methods.

The most significant outcome of the project, according to Dr. El-Baz, was the fact that the group had to consider not just the tomb site itself but the entire region surrounding the site. This illustrates the importance of regional factors on this and similar tombs elsewhere in Egypt.

Dr. El-Baz is satisfied with the survey work carried out in Luxor by the various groups. He believes that whatever efforts were expended resulted in emergency conservation measures that contribute to saving Queen Nefertari's tomb and the wealth of history it holds within. ▲