ANNUAL REPORT

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"ARCE Groundwater Lowering Response Project, Luxor"

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The Egyptian Antiquities Conservation Project (EAC)
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Awarded to

THE AMERICAN RESEARCH CENTER IN EGYPT (ARCE)

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INTRODUCTION

This is the third season for the ARCE Luxor Field School and Conservation programs. The 2009-2010 Season started in late September 2009, and the Field School was completed on May 28, 2010. Planning and preparatory work on the site continued until July 14, 2010. The official end of the season is July 14, 2010. Although lime slacking operations and lime mortar patching work will continue throughout the summer of 2010, this is actually part of the 2010-2011 season.

Approximately sixteen (16) projects made up the season with seven (7) either completed or will not be started again next season. The work covered projects in both Karnak Temple and Luxor Temple.

This report will cover some of the preparatory work as well as the specific projects themselves. The Appendix will contain examples and drawings generated.

PROJECT SETUP

Scope of Work

The majority of the work is centered at Khonsu Temple located in the Karnak Temple Complex. A total of 8 Scopes of Work have been generated with an example shown in Appendix A. A brief description, project director, duration, objectives and diagrams was developed to focus the work and to provide goals. The Scopes of Work categories were as follows:

- Karnak Conservation
- Stone Masonry
- Karnak Entrance Dewatering Pumps
- Talatat Project
- Sacred Lakes
- Luxor Conservation
- Luxor Roman Bastion
- Salvage Field School

Budget

From the 8 Scopes of Work 17 budgets were developed for each separate project. This is meant to control spending and to allow accounting to plan on expenditures. Because of the limited amount of grant money, this allows ARCE to plan for the lifetime of the grant. The basic field work has a four (4) year life to the grant. The 2009-2010 Season is the third year of the grant leaving one final season of field work.

Schedules

For monitoring budgets and progress, a total of 8 tracking schedules have been developed conjoining the budgets to time factors. The schedules break down the budget and insert them into schedule tasks. Based upon percent complete, the schedules calculate the amount estimated to be spent at the reported time period. This amount can then be compared to the actual reported expenditures to indicate if the project is ahead or behind the estimated schedule. Dependent on the difference, further investigation would be necessary to obtain the reasons for any large difference. Actual cost/Schedule comparisons will be done on a monthly basis.

An example of our schedule is shown in Appendix B.

DESCRIPTION OF PROJECTS

Groundwater Monitoring

The monitoring program includes a series of ongoing measurements intended to identify different types of movement of the temple structures. The measurements include:

- Measurement of the elevation of structures to identify whether structures are sinking or rising
- Measurement of distance between a group of temple structures to see if the temple structures are shifting in any direction
- Measurement of crack width and/or the tilting of temple columns.

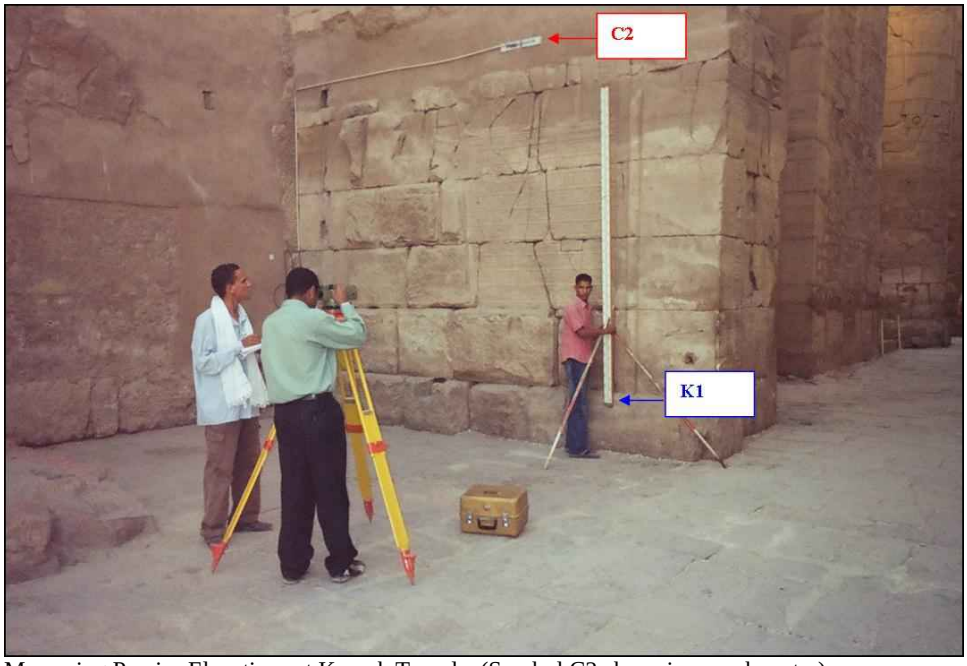
The three (3) types of methods used to measure the above is as follows:

- Precise Level Measurement – is a measurement of the precise vertical elevation (relative to sea level) of a point fixed on an ancient structure.
- Total Station Measurement – combines horizontal and vertical measurements between groups of temple structures. In this method, several survey measurements are made between locations visible from a reference survey point. The resulting geometry calculation tells the monitoring program whether any of the temple structures in the group has moved relative to the other objects.
- Crack and Tilt Measurements – At selected places on temple structures, special sensors are installed to measure the tilt of a position from the vertical (within a certain plane), or the width of a structural crack. At these selected locations, tilt meters and crack meters were installed. The locations for these sensors were selected in consultation between archaeologists and the SCA.

In addition to monitoring settlement and structural movement, the monitoring program routinely measures water levels at observation wells called “Piezometers”. They are located within or near to the temple sites. Groundwater level measurements help determine whether the groundwater levels correspond to the system design.[1]

[1] Information taken from Luxor East Bank Groundwater Lowering Response Project Report. Monitoring of Groundwater and Ancient Structures in Luxor and Karnak Temples. Number 6. September 2009 to February 2010.

The 2009-2010 Season continued the monitoring program and generated several reports. As of the last report, no significant movement or destabilization of the temple structures following startup of the dewatering systems at Karnak and Luxor Temples has been recorded or witnessed.



Measuring Precise Elevations at Karnak Temple. (Symbol C2 above is a crack meter)


Measuring groundwater level at the Piezometer

Karnak Entrance Dewatering

During SCA excavations in front of the entrance to Karnak Temple a boat ramp was exposed. During the course of excavation, groundwater was encountered. The SCA requested dewatering pumps and during the 2008-2009 Season, two were placed in this area. During the 2009-2010 Season, the piping was completed and the pumps were placed on line which lowered the groundwater thus allowing the SCA to continue their excavation. The pumps were handed over to the SCA for monitoring and maintenance.

The front of the ramp (looking east) before dewatering

The dewatering pumps (looking southwest (photo left) and looking east (photo right)

Conservation Field School

At the end of this season, ARCE has trained approximately 76 students on the basic principles of conservation. The field school comprises of classroom, lab and field work. Local experts and experts from all over the world conduct focus sessions for the students. Subjects such as masonry, salts, photography, management, geology, ceramics, drawing, materials and methods are taught in the classroom coupled with utilization of the lab and field work experience.

This season's class had 27 students that graduated on April 15, 2010. Ibrahim Soliman and Sultan Eid attended representing the SCA. The student's field season ended May 27, 2010.

Students being tested in the classroom

Students in the laboratory calculating the water absorption rate of different stone.

Students in the field working on columns in the main court at Khonsu Temple

Conservation Laboratory

In 2008, ARCE built a conservation laboratory within the Karnak temple precinct with several objectives. The lab is a fully equipped modern facility with basic laboratory instruments from analytical balance to conductivity meter and microscopes. It also contains a fume hood to manipulate dangerous chemicals, an oven and a simple but affective system to produce distilled water, later used during conservation work, such as cleaning decorated stone surfaces.

It is primarily used as a teaching space for the conservation field school where the trainees learn how to carry out basic conservation tests. Other uses include providing and preparing material used for conservation. The laboratory is also conceived to provide space, materials and equipment for other teams working in the greater Luxor area to carry out analysis or conservation work. Finally, it is planned to provide basic analytical capabilities in support of archaeological projects in Karnak.

At the end of the field season, the laboratory is used to prepare for the next season's activity. The slacking of lime is important for the quality of the lime mortar. The operation is performed just outside the laboratory at the east end.


Laboratory exterior which blends in with the outer wall (Euergetes Gate to the right) (left photo) and Laboratory west entrance (right photo)

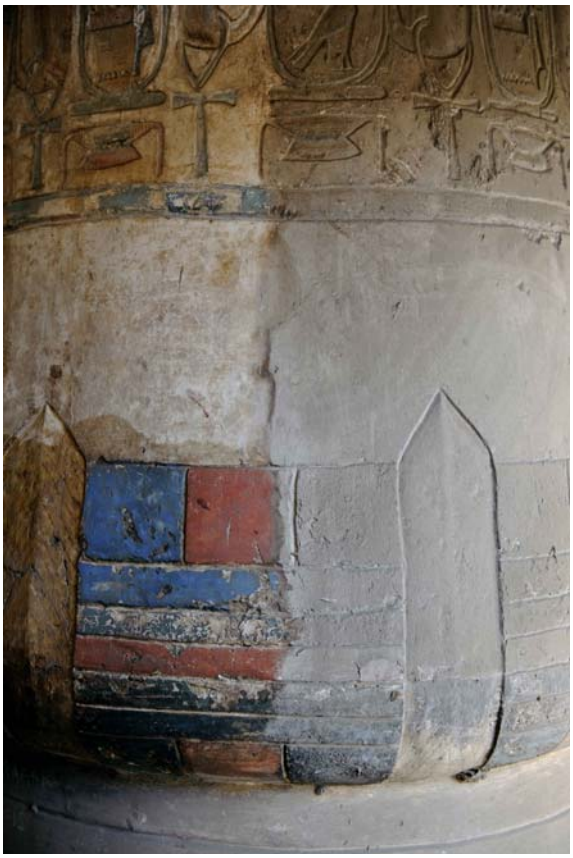
Laboratory interior


Laboratory experiments showing sandstone reaction with salt (left sample) and water (right sample) and red brick (background) (left photo) and experiments on how different adhesives react to the Luxor weather (right photo)


Lime slacking operation behind the laboratory

Conservation – Khonsu Walls

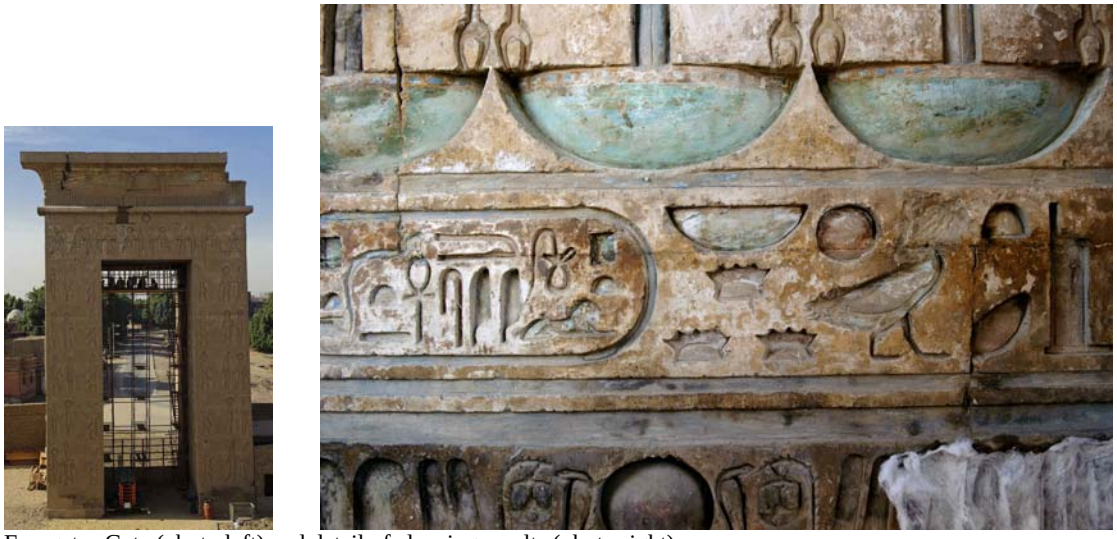
This season the west wall and four columns in the main court of Khonsu Temple has been cleaned by current and past students. The contrast is astounding. Colors that have been covered by dirt and soot have reappeared through the process of cleaning. Visitors to the site have been able to imagine the appearance of what it originally looked like.


Contrast of column cleaning operation

Hieratic writing discovered during cleaning operation. West wall (left) and Column (right)

Conservation – Euergetes Gate

The gate in front of Khonsu Temple was erected by Ptolemy III Euergetes who ruled Egypt from 246 to 222 BCE. ARCE's conservation students started cleaning by focusing on the ceiling and the jambs. The result was the reappearance of many colors.



Euergetes Gate (photo left) and detail of cleaning results (photo right)

Conservation – Karnak Second Pylon - Hypostyle Hall Wall

The Second Pylon was in desperate need of desalination as the salts from the groundwater were damaging the stone. ARCE and its student crew lead by Christie Pohl performed the removal of old cement patches, performed the necessary desalination techniques and re-patched where necessary using lime mortar. One of the methods used in desalination was a hiba poultice. Hiba clay is applied to the surface to draw out the salt. When the clay dries it is removed along with quantities of salt.

Hiba clay poultice after removal showing the salt removed

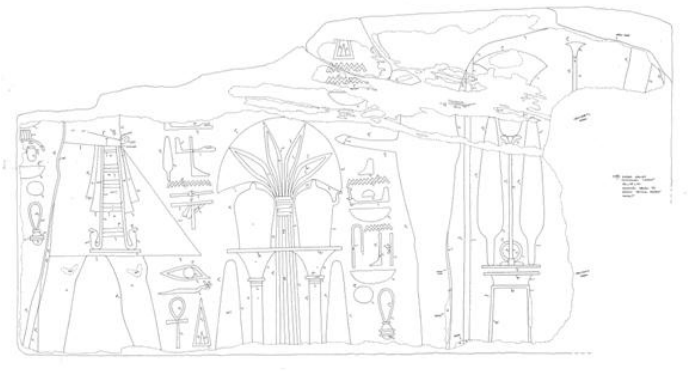
Students mechanically cleaning the wall

Khonsu Epigraphy

Chicago House recorded the exposed stone elements as a result of ARCE's activity associated with the roof work and the new flooring. A large portion of the exposed areas were almost inaccessible. Chicago House overcame this by sliding aluminum foil in the joints between the stone slabs and utilizing a hand made tool. They then proceeded to obtain a rub of the fragment. This allowed them to then draw the impression to record the finding which provided additional information on the temples history.

Applying aluminum foil in joint to obtain rub details

Documenting exposed sides of flooring blocks



Detail of floor block showing King (Seti I?) offering lettuce to Amun[2]

[2] Excerpt from a report entitled Preliminary Report on the Work of the Epigraphic Survey in the Temple of Khonsu at Karnak, 2009-2010. Drawing by Krisztian Vértes.

Khonsu Stone Masonry

Much stone masonry work was needed for structural repair as well as tourist enhancement. This season, ARCE with Dany Roy's team performed repairs on the northwest section of the roof as well as install new flooring in the main court. They also rebuilt the remains of a contra chapel at the north exterior end of the Khonsu Temple. Tourists will now have easy access with the installation of stone walks around the east side of the temple, running to the front entrance as the walks were completed this season.

Northwest section roof repairs

Main Court flooring before (left photo) and after paving (right photo)

Contra Chapel front exterior (left photo) and detail of interior (right photo)

Walks at the exterior of Khonsu Temple during installation (left photo) and completed

Talatat Project

The Pharaoh Akhenaten built his structures out of smaller blocks. Today they are referred as “talatat”. This season culminated the final season for the field work portion of this project. Over 16,000 talatat blocks were removed from the magazine, cleaned and conserved, recorded, photographed and neatly restacked and covered on new mastabas. Some of the stacks were found in disarray due to fox burrows undermining the existing mastabas. New mastabas were constructed along with new floor sections to discourage future fox burrows. Many structural repairs of the building were also made.

Talatat blocks shown as a consequence of fox burrows undermining the existing mastabas (left photo). Processed and covered talatat blocks neatly stacked on new mastabas (right photo).

Talatat blocks being cleaned, conserved and cataloged (left photo). Talatat block being photographed (right photo).

Karnak Sacred Lake

Before the Groundwater Lowering Project became a reality, the Sacred Lake at Karnak was normally refilled with Nile water. This caused a large weed buildup throughout the lake. ARCE shut off the Nile water and replaced it with cleaner groundwater. After removing the weeds, chemically treating and implementing a maintenance routine, ARCE handed the clean lake back to the SCA to maintain in April 2010.

Karnak Sacred Lake looking northeast (left photo). Karnak Sacred Lake showing pump station and treatment building in the northeast corner of the lake (right photo).

Karnak Nileometer

On the North side of Karnak's Sacred Lake is a long narrow structure running parallel to the side of the lake. This structure is a Nileometer, originally built by the Pharaoh Taharqo. Due to the structure being so close to the café at Karnak, trash and other debris has been deposited on the stairs and down in the lower part of the well. Complaints of foul odors were also expressed by the tourists to the SCA. ARCE cleaned out the structure and set up a sump pump with piping to Karnak's Sacred Lake to keep the well refreshed. To prevent further debris from being deposited in the structure, metal screening with wood frames was placed over the openings. The work was performed over the Christmas holiday. (Also see drawing in Appendix C).

Side view of the Nileometer in relation to Karnak Sacred Lake showing proximity to the outdoor café with the canopies to the left

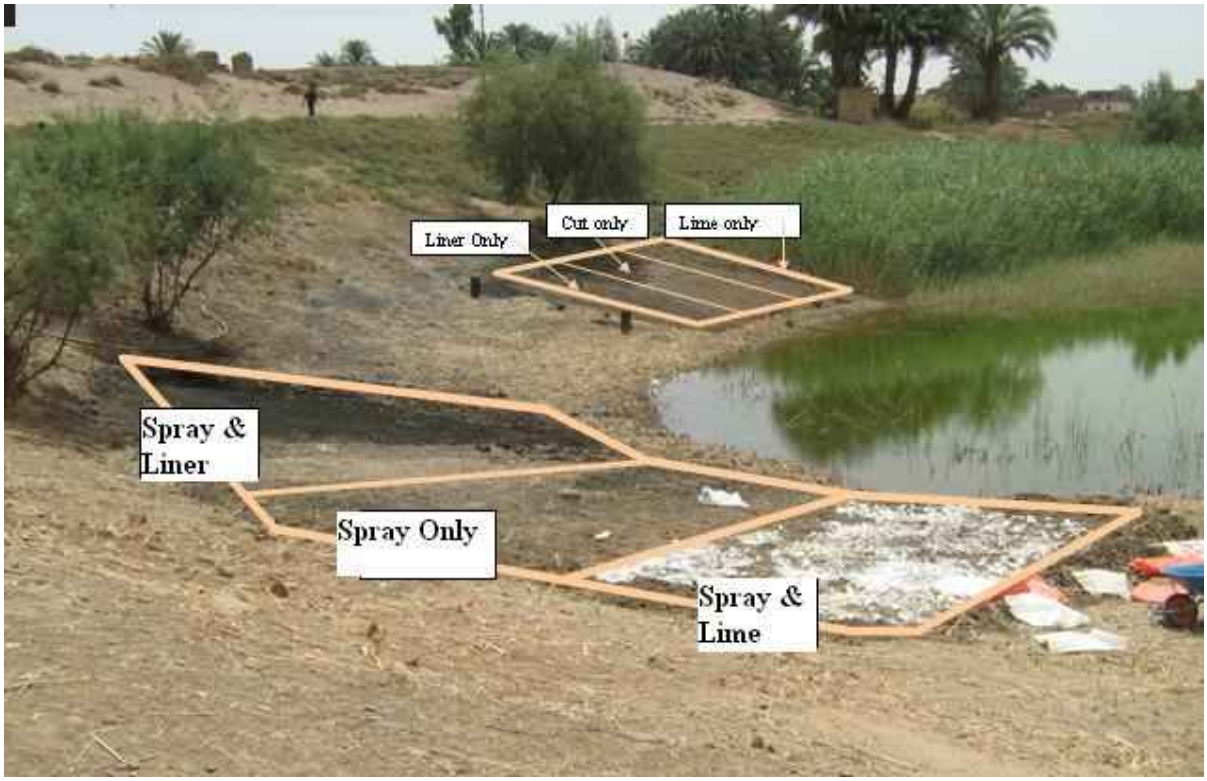
Entrance to the Nileometer (left photo) and the view looking northeast (right photo)

Mut Temple Sacred Lake

The Sacred Lake at Mut Temple had many problems with weed infestation surrounding the lake and in the lake itself. This season, ARCE staff led by Magdy Mokhtar with assistance from Betsy Bryan, developed test areas on the embankment to eliminate the weeds with the constraint of low maintenance after the weed removal. Although the testing is still ongoing, it seems that a thick plastic liner will eliminate weed regrowth on the embankment. During the next season, all the weeds will be removed from the embankment and the liner will be installed. The lake will also be drained, refreshed and treated.

Mut Temple Sacred Lake showing the weed growth on the embankment.

Removing the weeds for the test sections



Test section areas to determine the strategy for next season.

Luxor Temple Roman Bastion

The Temple of Luxor formed the center of a late Roman fortress built by Diocletian in the late third century AD. Most of the fortress walls have been destroyed, but one small area is preserved at the northeast corner of Luxor Temple. Led by Dr. Pamela Rose, the project exposed some of the surviving Roman architectural remains, which have not previously been recorded in detail. The findings were recorded and the site prepared for conservation and restoration.

Dr. Pamela Rose (left) directs the excavations at the Roman Bastion

General view of the Roman Bastion excavation area

Luxor Temple Pest Netting

Pigeon and bat droppings continue to plague many monuments throughout Egypt. Luxor Temple is not the exception. In order to reduce the damage, pest netting was installed in the ante chapel of the Sanctuary of Amun and the Sanctuary itself, this dating from the time of Alexander, to suppress the pests and thus reduce the droppings on the walls and columns.

Examples of framed metal netting over roof sections

Salvage Field School

In an area to the west of the Luxor Temple Avenue of Sphinxes lie the only known remains of the old Luxor Tell (The Ottoman city of Luxor). With the possibility of the tell being destroyed, a joint effort by the SCA, ARCE and Ancient Egypt Research Associates (AERA) was formed to implement a salvage field school to train SCA individuals in the means and methods of salvage and rescue archaeology. The project went from January 9th to March 15th 2010.

Salvage Field School excavations

Salvage Field School Pottery Class

Salvage Field School Pottery lay down area (left photo). Detail of pottery specimen (right photo).

CONCLUSION

The 2009 – 2010 Season received full cooperation and collaboration between ARCE, the SCA and USAID. The projects that were performed not only added value for the tourist industry but also scholarly contributions were realized as well. Many of the conservation projects preserved structures that were in a bad state of deterioration and were in the process of being lost forever. Through this collaboration, much of the material was preserved for future generations.

None of this would have been possible without the contributions of certain individuals:

SCA
Dr. Zahi Hawass
Dr. Sabri Abdel Aziz
Dr. Gamal Mahgoub
Mansour Boraik
Ibrahim Soliman
Afaf Philips
SCA Inspectors and Staff

USAID
Hilda Arellano
Sylvia Atalla Ishak
Richard Rousseau

ARCE
Board of Governors
Dr. Gerry Scott III
Dr. Emily Teeter
ARCE Luxor Staff
ARCE Cairo Staff
ARCE San Antonio Staff
Members and Supporters

Submitted by John Shearman
ARCE Associate Director – Luxor
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APPENDIX A

APPENDIX B

APPENDIX C