KENTRO

The Newsletter of the INSTAP Study Center for East Crete

Volume 12 (Fall 2009)

Differential GPS: A New Tool for the Kentro

by Douglas Faulmann and Antonia Stamos

Everyone likes a new gadget, especially when it makes work easier and more efficient. If that gadget is easy to operate as well, then it is a truly useful tool. This, we believe, has been found in our latest addition to the arsenal of tools in use at the Kentro.

In September of 2008 INSTAP purchased a Topcon Hiper-Pro Differential Global Positioning System (DGPS) (Figure 1). The Hiper-Pro consists of three parts: a base station receiver, a roving receiver, and a handheld data collector. The system uses global positioning satellites to make topographic measurements with a high degree of accuracy. The Hiper-Pro DGPS utilizes wireless/Bluetooth technology to send information from the base station to the data collector, thus eliminating the jumble of cables. It also has internal lithium batteries, so the cumbersome battery packs of earlier models are no longer needed. These improvements have made it a very portable and lightweight system—one that can be used effectively by a single person. Under ideal conditions the Hiper-Pro DGPS has a workable range of up to four kilometers from the base station. The system was purchased to assist archaeologists in mapping and recording excavation sites, and this summer season was the first opportunity to use this new tool. Before we describe how the Hiper-Pro performed and the various projects on which it was used, a brief description is needed on how differential GPS works.

Figure 1. Surveying at Preveli with the new Topcon Hiper-Pro DGPS (L–R: Jeff Leon, Doug Faulmann, and Antonia Stamos).

The Global Positioning System (GPS) was developed by the United States Department of Defense. It consists of 24 orbiting satellites, each with highly accurate atomic clocks that send signals to a master control station, which tracks the satellites movements. This information is translated into three-dimensional positioning data that is sent back to the satellites to ensure that each satellite is transmitting accurate data. Receivers are then used (such as handheld devices or car navigation systems) to pick up this data from the satellites and calculate their own position. In order to determine its position, a GPS device requires at least four satellites to be within range to receive the data.

GPS was established mainly for military purposes, but now it is used widely by civilian establishments to determine accurate locations for ships, planes, cars, and cell phones, to name a few. Until 2000, the Department of Defense used something called selective availability (SA) to introduce errors of up to 100 meters into the satellite measurements so that hostile governments could not use the GPS data for targeted attacks on US locations. This of course caused problems for civilian use. The government has since stopped using SA, and now any GPS device can give accurate measurements within 10–15 meters. This is still not accurate enough, however, for geographic information systems (GIS) work and—where archaeology is concerned—for mapping sites. This is where DGPS is needed.

Differential GPS uses a base station that is placed over a specifically known point. This base station then receives data from the satellites and calculates its position. The unit compares this position with the known point and determines the difference. This difference then is applied to the GPS data recorded by another device called a rover receiver. The data is collected and recorded by a handheld data collector and then processed by mapping or computer-aided design (CAD) programs. DGPS, if used correctly, can enhance GPS accuracy to within 5–10 millimeters.

Figure 2. The human rover, Gianluca Cantoro, with the DGPS roving receiver.

After a quick lesson in Athens on how to operate the DGPS, we were ready to put it to use on various projects scheduled for the summer (Figures 1 and 2). We were very fortunate to have the services of Gianluca Cantoro, a landscape archaeologist from the University of Foggia, Italy, who happened to be researching at the Kentro, and who also had previous experience with DGPS. Gianluca had many great ideas on the ways the machine could be utilized to assist us on our projects, and he agreed to stay longer during the summer to help. In the end, after a very busy season, we found that the DGPS had many uses.

One of things it can do is create new control points from existing known points, which can be as far away as 10 kilometers. This is done by setting the base over the known point and then setting the rover on the spot at the excavation that will become the new control point, and letting them communicate with the satellites to set their positions. The rover's new coordinates are then calculated by inputting the known point's coordinates and then correcting the satellite data. We applied this method at the excavation of the Early Minoan house tombs at Petras in order to assist Antonia Stamos in creating a new plan of the site. We also found that by using this machine alongside the laser electron distance measuring (EDM) device that Dr. Stamos was using, we could greatly speed up the time needed to measure all the features and create the map. The data from both machines is compatible and can be processed using various mapping software programs such as AutoCAD or ArcGIS.

Once that project was complete we were off to southwestern Crete to help Thomas Strasser create a topographic map of his Plakias Mesolithic survey on the sides of the Preveli Gorge. The DGPS proved quite suitable, as the landscape would have made it quite difficult to map using other devices. Because the DGPS does not depend on "line of sight," we did not need to be in visual contact with the base station, and we could roam quite a distance without having to move the base. We also surveyed and recorded walls on the island of Chryssi, where Thomas Brogan was conducting an excavation.

These projects were the perfect preparation for our biggest job of the summer—to re-measure and map all the existing architecture on the island of Mochlos. We wanted to compare and correct, if need be, the work that had been done using the traditional method of triangulation. Two months of much trudging up and down the landscape, and thousands of measurements later, we completed the project. During this time we learned a lot about the strengths and weaknesses of the DGPS.

Among its strengths, the biggest has to be the speed at which it can collect data. This enables one to map much more in one day than could be done before, and with much more accuracy. The ease of downloading the data and processing allows one to have the results of that day's work the very next day. The DGPS can also be used to assist in drawing stone-by-stone plans and sections of architecture by cutting out the need to triangulate. It can also quickly record find spots, and not only where something was found, but the elevation as well.

The primary weakness of the machine concerns the satellites, since it needs at least four satellites in range to record correctly. If there are less than four it will not function properly. Fortunately, there is at least that much coverage on most days. We did find that the coverage varied throughout the day: the more satellite coverage there was, the quicker the machine would record points; the less coverage there was, the longer it took to record. It also has trouble if something such as a tree or power line is blocking the antenna, interrupting the signal from the satellite. But, generally, it performed quite well.

Many more things could be said about this machine, but suffice it to say that this tool was money well spent. Along with the laser EDM, this is another versatile addition to our toolbox of mapping instruments, and we are looking forward to working with it at more sites and further developing its uses.

Excavating the Bronze Saw on Chryssi Island

by Stavroula Apostolakou, Philip P. Betancourt, and Thomas Brogan

The East Cretan Ephorate is conducting an excavation on Chryssi Island with technical assistance from the INSTAP Study Center in order to save an important Minoan town that was specializing in aquaculture. The main economic base seems to have been based on fishing and processing murex shells to make the dye called Royal Purple. Houses were built on stone foundations (Figure 1). The buildings overlooked the Aegean Sea's clear blue water that provided both a livelihood and an idyllic setting for this small village from the Late Minoan IB-Final period.

The dye industry brought the inhabitants of the small community enough prosperity to afford a comfortable standard of living, and the excavations have found a substantial amount of evidence for the lifestyle of the people who lived here. One of the most dramatic finds in the summer of 2009 was a highly fragile bronze saw whose metal was so badly deteriorated that it had cracked and broken into two pieces simply from the weight of a triton shell that lay across it (Figures 2 and 3). Removing this saw from the ground without breaking it further required a slow and painstaking process, which was carried out by conservator George Missemikes. First, the saw was covered with gauze and painted with paraloid, a consolidant to help hold the saw's material in place (Figure 4). Repeated layers of gauze and paraloid gradually stiffened the thin artifact and made it stable (Figure 5).

After several layers of gauze and paraloid, a channel was excavated all around the artifact, and plaster was gently applied over both the saw and the edges of the soil it rested on (Figure 6). Slowly, the saw and its bed of soil were encased in a firm outer covering of plaster. As the plaster dried in the hot Mediterranean sunshine, it became hard enough to hold the saw firmly in place.

Figure 1. The excavation of the house on Chryssi Island where the bronze saw was discovered.

Figure 2. Melissa Eaby cleans away the soil near the saw in preparation for its photograph.

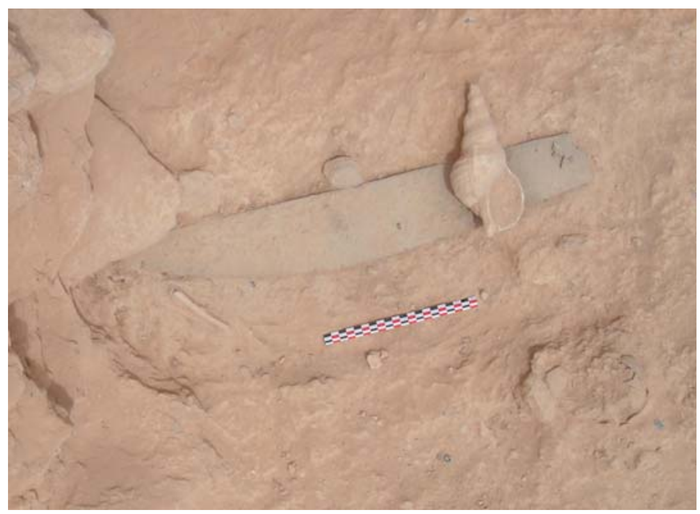

Figure 3. The saw was found on a floor with a triton shell lying on it. The scale measures 20 cm.

It was now time to begin the actual removal of the bronze blade. The trench around it was enlarged, and scraping with tools under the plaster-encased saw gradually removed the soil below it until the artifact could be freed from its place (Figure 7). Tied formally to a board (Figure 8), it was ready to be carried more than a kilometer to the waiting boat. Once safely ashore, it was transported to the conservation laboratory where Kathy Hall, senior conservator on the INSTAP Publication Team, slowly freed the saw from its plaster box in preparation for study and eventual display (Figure 9).

Figure 4. Conservator George Missemikes applies paraloid over the gauze placed on the soil.

Figure 5. The stablized saw is held in place by the gauze and dried paraloid, and a trench is excavated on both sides of the tool.

Figure 6. Plaster of Paris helps make the fragile saw more stable.

Figure 7. Encased in its box of plaster, the saw is almost ready to be cut free from its resting place.

Figure 8. Several men are needed to slowly lift the artifact so it can begin its journey to the conservation laboratory.

Figure 9. Kathy Hall, Senior Conservator at the Study Center, cleaning the saw in the laboratory.

The Excavation of House A.1 at Papadiokampos

by Chrysa Sofianou and Thomas Brogan

The Bronze Age settlement of Papadiokampos was recently discovered in East Crete by Chrysa Sofianou of the 24th Ephorate of Prehistoric and Classical Antiquities in the remote coastal plain that stretches west of the Trachilos peninsula. In 2007 and 2008 Sofianou expanded earlier efforts to document the chronology and size of this harbor town with the assistance of the director and staff of the INSTAP Study Center for East Crete. One of the project's primary goals is to explore what role the town—built on the strategic promontory separating the Mirabello and Siteia Bays—played in the broader Protopalatial and Neopalatial developments in the region. The ceramic and lithic finds from two LM I houses at the site suggest that the settlement was oriented towards the Siteia Bay and the palace of Petras in the Neopalatial period.

Three streams divide the Papadiokampos plain into Areas A, B, C, and D (Figure 1). The mapping team, led by Antonia Stamos, has recorded the remains of several houses in a 250-meter stretch of cliff that was formed along the coast by waves eroding the site over the past 3,500 years (Stamos 2008, 11, figs. 3–4). Although Floyd McCoy's preliminary survey of the coastal geology suggests that a substantial portion of the town has been lost in this process, the extant remains indicate the settlement may have covered an area as large as 4–8 hectares in LM I.

More detail has been provided by the recent excavations in Areas A and B, which recovered impressive Protopalatial and Neopalatial remains on the western side of the site (Figure 2). The pair of LM I houses now under study were built early in the Neopalatial period. After suffering damage, possibly from the Theran eruption, both dwellings were substantially rebuilt and then abandoned again suddenly in LM IB.

Fieldwork in 2007 and 2008 focused on House A.1 flanking the north side of the stream separating Areas A and B (Figure 3). A subsurface survey of the surrounding plot by radar and test trenches indicate that House A.1 occupies the eastern, coastal side of a large yard that was framed on three sides by a low stone

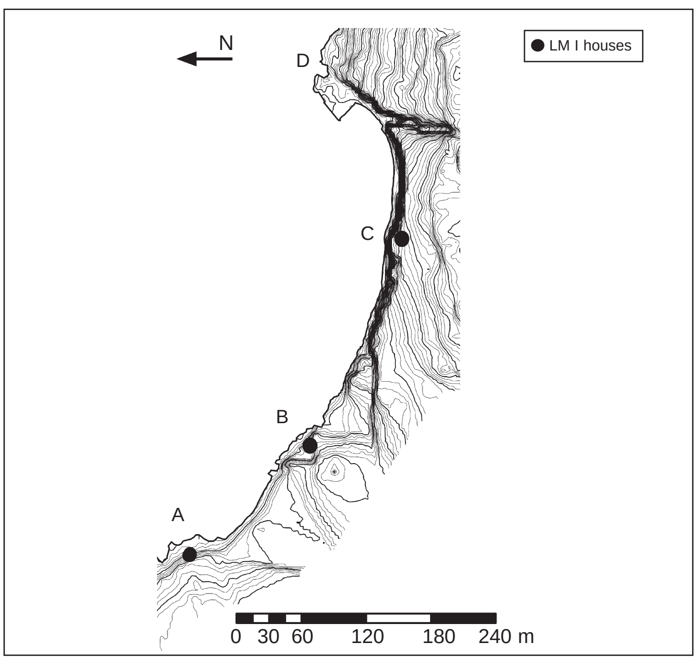

Figure 1. Contour map of Papadiokampos showing division of the plain into Areas A–D. Drawing by A. Stamos.

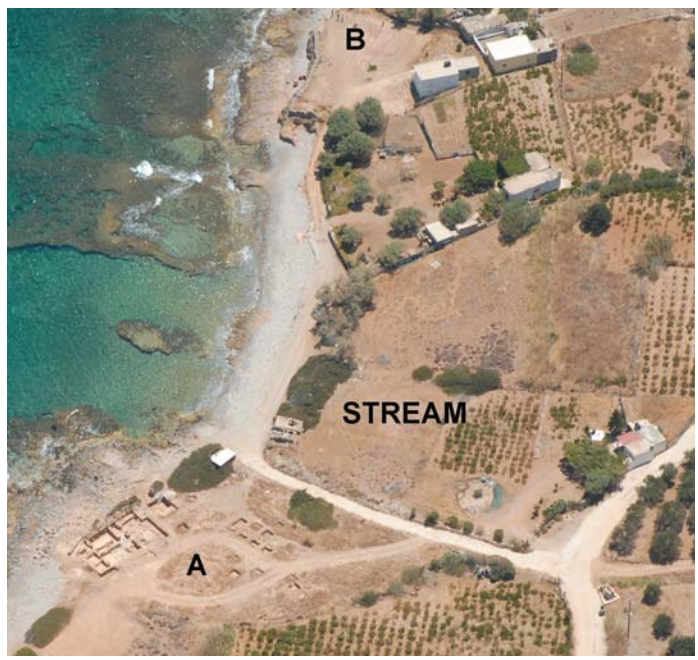

Figure 2. Aerial photo of Areas A and B at Papadiokampos. Photo by G. Cantoro.

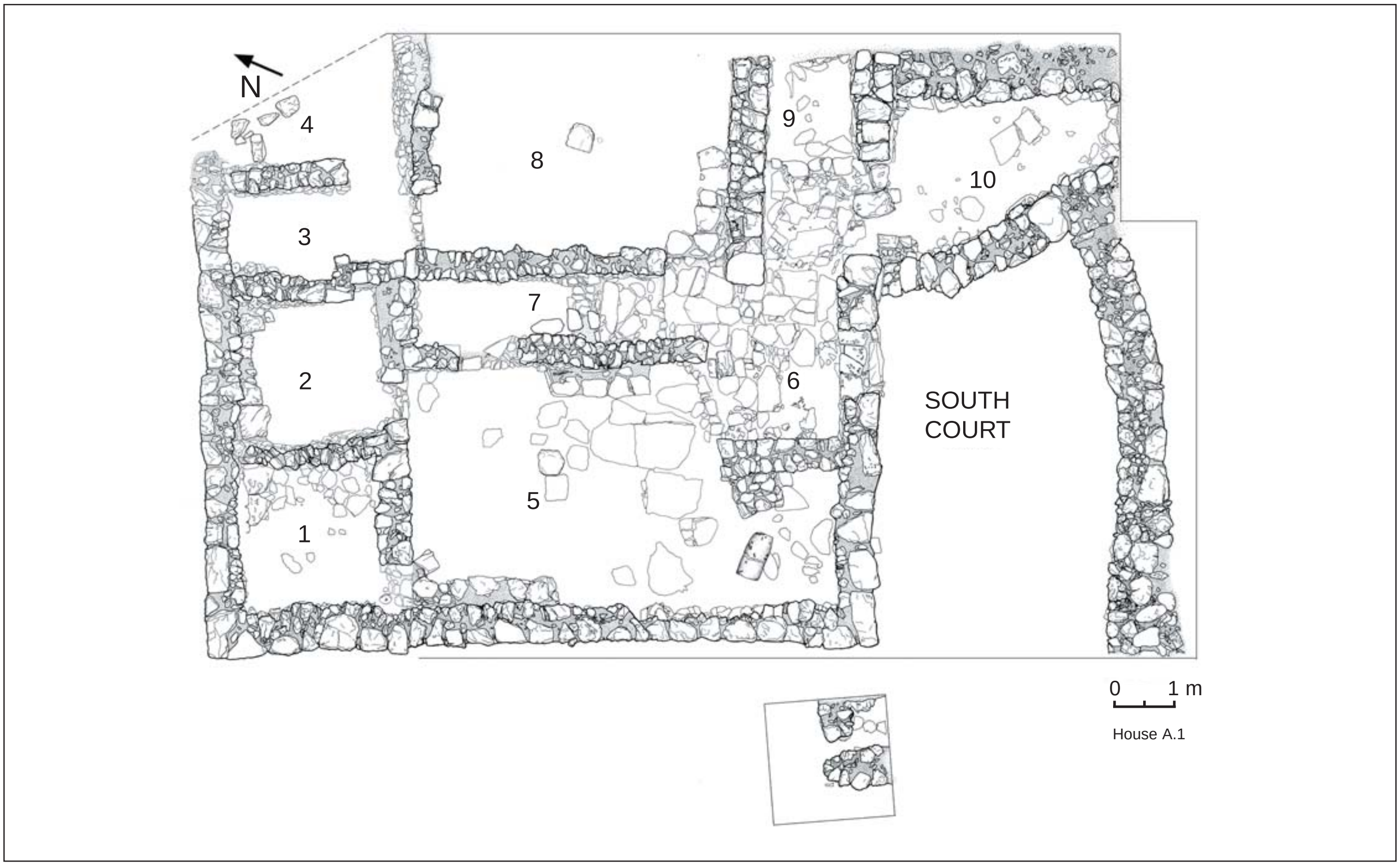

Figure 3. State plan of House A.1 at Papadiokampos. Drawing by A. Stamos.

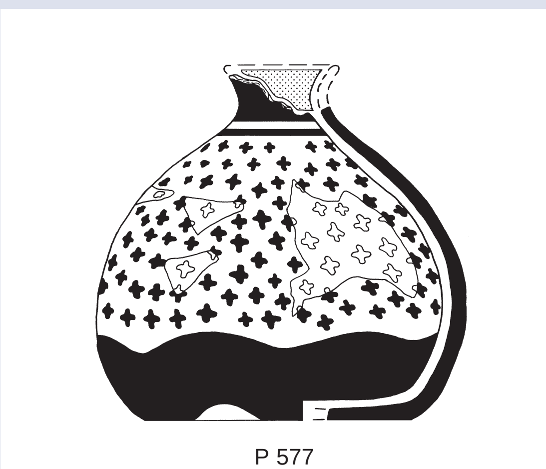

Figure 4a. LM IB tall alabastron (P 577) from Room 8. Scale 1:2. Drawing by K. Chalikias.

Figure 4b. Jar (P 412) with agrimi head in relief from Room 8. Photo by Ch. Papanikolopoulos.

Figure 5. Meal of limpets in a cooking dish on the South Porch. Photo courtesy of the Papadiokampos Project.

wall that protected the house from the nearby stream. The well-preserved house was originally built of stone to two stories on the outside while employing mud bricks for the interior walls of the upper storey. Roughly 80% of the original plan survives, including nine rooms and an exterior porch on the ground floor and a staircase leading to a similar number of spaces upstairs. The staircase divides the ground floor plan into two nearly identical suites of three rooms, each containing a large room with column and hearth with two smaller pantries on the north side for the storage of cooking and serving vessels and food.

The inhabitants of the house appear to have been farmers and fishermen, and the project is using a variety of recovery methods to learn more about their activities. The rich collection of artifacts collected by hand includes more than 500 ceramic vessels, 200 stone tools, two bronze daggers, a lead weight, and a small sealstone (Figures 4a–b). More than 350 soil samples from the house and porch were separated by water flotation, and 600 sherds and stone tools were sampled for chemical residue analysis. These ecofacts are being studied by project's botanist Evi Margaritis, faunal expert Dimitra Mylona, and chemist Ruth Beeston. The finds include intriguing evidence for fishing, the production of olive oil and wine, and the preparation and consumption of vast quantities of limpets and sea snails.

The South Porch and Room 8 provide two illustrations. In 2007 excavation of the porch recovered several stone tools and a bronze dagger next to a cooking dish with two kilos of limpet shells (Figure 5). This rather mundane assemblage documents a meal of limpets in preparation at the time of the destruction. Work in 2008 recovered a second meal in preparation in Room 8 (Figure 6). The space was provided with a large hearth built between the column and the south wall. Most of the finds appear to have been connected with the preparation and consumption of meals. They include tripod cooking pots, two basins, three to four jars, two jugs, one stirrup jar, two cup rhyta, and several cups. A number of carbonized, crushed olive seeds appear to have been used here as fuel for the cooking fire. The area of the hearth was only partially excavated, but the

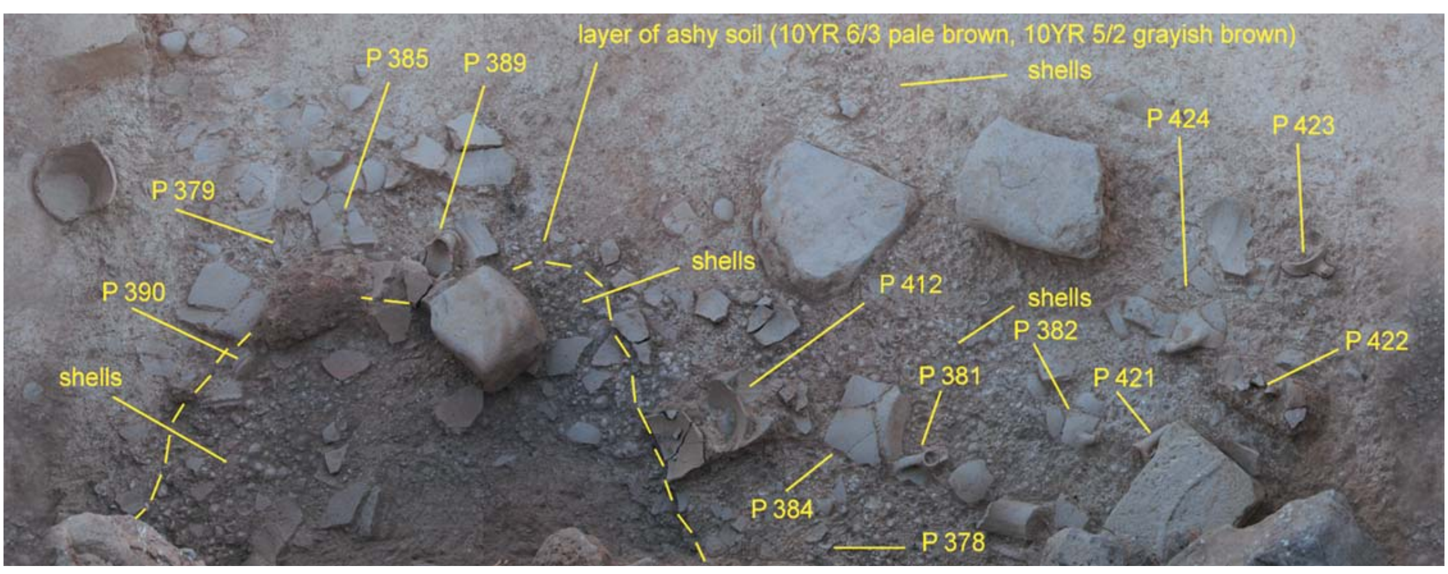

Figure 6. Detail of the floor deposit in Room 8. Photo by K. Chalikias.

southern side was flanked by a pair of large stones that may have served as seats or vessel stands. A misfired cooking pot (P 412), decorated with the head of an agrimi in relief (Figure 4b), was probably standing over the fire when the building was destroyed. Spilling from this vessel we found a Minoan recipe for seafood soup (Crete's famous *kakavia*): limpets, top shells, and crab. The discarded remains of the same meal (shellfish totals approaching 40–50 kilos) were found scattered across the southern side of Room 8 and around the hearth in Room 5.

During past year our study of the finds from Houses A.1 and B.1 has begun to provide significant evidence for the local economy. The inhabitants of House A.1 appear to have been unusually dependant on the fruit of sea while producing stone vases and modest amounts of wine and olive oil. The inhabitants of House B.1 appear to have been more prosperous, producing metal and textile goods and engaging in the trade of these commodities. This new evidence will facilitate our interest in assessing the possible role of this harbor town on Minoan trade routes. Preliminary study of the pottery suggests the inhabitants were consuming decorated pottery and bulk goods from sites in eastern Crete (e.g., Petras, Palaikastro, and Zakros) and metals (both copper and gold), stone, and wine from off-island sources in the southeast Aegean and the eastern Mediterranean.

References

Stamos, A. 2008. "Survey Says: 2008 Survey Projects by the INSTAP Publication Team (Skoteino Cave, Mycenae, Kynos, Papadiokampos, and Chrissi Island)," *Kentro* 11, pp. 9–11.

2009 Greek-American Excavation at Mochlos

by Jeffrey S. Soles

The Greek-American excavation at Mochlos, co-directed by Costis Davaras and myself, began its third campaign in the summer of 2009, marking 20 years of Greek-American collaboration at the site under the auspices of the Greek Ministry of Culture and the American School of Classical Studies in Athens. The first campaign in 1989–1994 uncovered large areas of the Late Hellenistic, LM III, and LM IB settlements at Mochlos, all stacked on top of each other. The second campaign of 2004–2005 explored earlier areas beneath the LM IB remains, and the current two-year campaign (2009–2010) is continuing to focus on this effort. Its primary goal is to reveal earlier settlement remains, particularly Prepalatial remains contemporary with the cemetery Richard Seager dug in 1908, including EM II workshops that produced the jewelry and stone vases found in the Prepalatial tombs. In the course of this work, the project is also uncovering a more complete plan of the LM IB town, exploring its northern limits, and clarifying areas that have been partially excavated in the past but are still in need of further investigation. The project also began work on a new map of the site this summer (Figure 1). Doug Faulmann, who has served as chief architect of the excavation since 1990, and Gianluca Cantoro, a doctoral candidate at the University of Foggia, employed a Differential GPS system to produce a new comprehensive plan—the first since the cleaning operations Davaras and I carried out in 1976. It is designed to show every phase of occupation, and while still a work in progress, it provides a good idea of the density of occupation along the south coast of the island where we are concentrating our work.

The project has now dug underneath many of the LM I floor levels on the site and identified parts of six Prepalatial houses and three streets that ran through this early settlement. The settlement appears to have had an open plan, unlike the closed settlement plan of Myrtos on the south coast of Crete. In 2005 it identified the remains of a stone-vase making workshop in one of these houses, and this year it uncovered an obsidian blade workshop underneath the LM I manufacturing center, C.7. This workshop may have been involved in other activities as well, and the most tantalizing finds of the summer were made here: a small crucible suitable for pouring small amounts of precious metal; the fragment of a gold strip, identical to gold strips found in the Prepalatial cemetery; and two small bronze tools, one of which would be suitable for making dot repoussé decoration. It was possible to excavate only a small area of the workshop since later EM III, MM II, LM I, and Hellenistic remains lay nicely stratified on top of it, but further investigation of the workshop will be one of the main goals of next summer's season. The project continued to uncover isolated pockets of EM II material elsewhere, and it is worth noting that all EM II levels provide evidence for a destruction at the end of the EM IIB period, which was part of a wider calamity that has been documented throughout Crete.

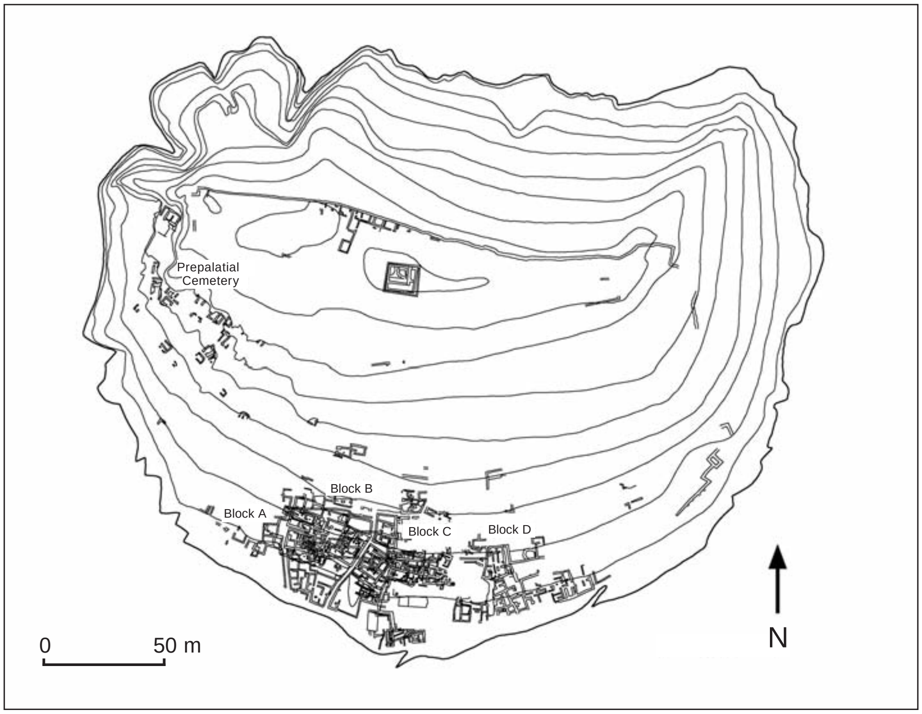

Figure 1. New map of Mochlos (D. Faulmann and G. Cantoro).

Excavation beneath LM I levels elsewhere produced unexpected results: the discovery of three MM IIIA houses, the first ever documented on the site. Two of these were uncovered beneath the terrace in front of the LM IB Ceremonial Building, B.2 (Figure 2). This terrace provided the main approach from the settlement to a sunken, hypaethral shrine at the southwest corner of the Ceremonial Building where David Reese found the remains of two human individuals in 2008 and where we believe the Minoans feasted and communed with their ancestors in 1430 B.C., shortly before the destruction of the site at the hands of Mycenaean Greeks. It is significant therefore that these ancestral houses lay immediately beneath the terrace that they used to approach this shrine. Aware that these houses were there, they designed the terrace to encase them and left votives on the terrace above in memory of their occupants. What is surprising, however, is how modest the MM IIIA architecture was, consisting of small rooms and narrow rubble walls that could not have supported an upper story. A large hearth lay outside the facade of one house with a complete set of cooking ware. By its side lay a three-sided prism seal from a Mallia workshop, the

Figure 2. View of terrace along south facade of Ceremonial Building B.2 (from east).

Atelier des Sceaux, which was destroyed at the end of MM IIB. Using soft steatite and a hand-turned solid drill, the artisan who made it carved a radiating whirl on one side, two standing men with a long saw on another, and a bucranium with horns "arrondies" on the third. Olga Krzyszkowska believes that all the seals from the Atelier were products of a single craftsman (Krzyszkowska 2005, 92–95), and this one certainly matches what is know about other features of his work. These prisms were used for sealing purposes, and the example from Mochlos raises interesting questions about the relationship between Mallia and Mochlos at the end of the Protopalatial and beginning of the Neopalatial period. A large part of the terrace remains to be excavated in 2010.

The third MM IIIA house was located to the north of Block C in an area affectionately identified as "Ano Mochlos" that we have only begun to explore. It was located alongside an extension of the main north–south street that runs through the LM IB settlement separating Block B from Block C. The lower, southern part of this street was excavated by Seager, and the upper northern part by the Greek-American team in its first two campaigns. In 2005 we found that the street made a sharp turn to its east behind a house at the northwest corner of the block. This year we laid out eight new 5-meter-square trenches in this area and found that the street turns again at a diagonal and continues up the hill to the northeast. We excavated two Minoan houses that were located on either side of the street where it continues to the northeast. The one on the west side, House C.11, we excavated in its entirety; it was a large, well-preserved house with an entrance vestibule provided with an ashlar bench, an upright ashlar slab, perhaps designed to support a lamp, and a mortar carved from an ashlar block (Figure 3). An interior staircase led from the ground floor down to a basement level and up to a second floor level. It is not yet clear when the house was built, but it was certainly renovated in the LM IB period when ashlar was introduced as a building material on the site. It was badly plundered at the end of this period, with only a few bronze tools and a stone sword hilt surviving to suggest the wealth of its original contents. The house was built on bedrock, and no earlier deposits survived beneath it. On the other side of the street, however, we were able to excavate part of another house that was badly damaged during the Hellenistic occupation of the site. Its LM I floor levels were destroyed by this occupation, but an MM IIIA floor deposit, which was probably once located beneath LM I levels, survived intact with a large amount of pottery. The facade of this house running along the eastern side of the street across from C.11 also survived, and our conclusion as a result is that the street itself should date to the MM IIIA period. This is an important discovery since it suggests that the Neopalatial town may have been planned at this early date and that its major streets were laid out at this time. The northern part of this house remains to be excavated, along with the continuation of the street itself. It appears to be leading to an important destination, and we hope to discover exactly what that destination is next summer.

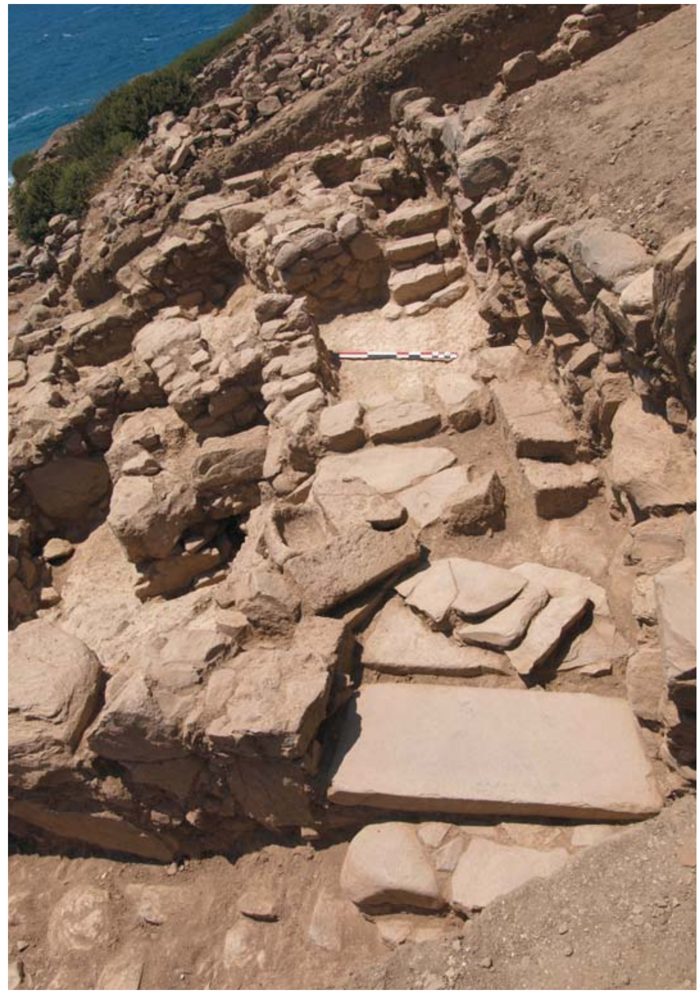

Figure 3. Vestibule of newly discovered LM IB House C.11 (from east).

References

Krzyszkowska, O. 2005. *Aegean Seals: An Introduction* (*BICS Suppl.* 85), London.

The 50th Wedding Anniversary Party of Philip and Mary Betancourt

On June 20, 2009, Phil and Mary Betancourt celebrated their 50th wedding anniversary, and they hosted a party at the INSTAP Study Center in celebration. Phil and Mary would like to thank Tom Brogan and Eleanor Huffman for their help in organizing the party, and everyone at the Study Center who helped make this event a huge success. They also extend their thanks to Chef Jad Alyounis for preparing a delicious feast that was enjoyed by all.

Mary and Philip Betancourt. Photo by E. Shank.

Donors and Friends

George Bass

Thomas Brogan and Natalia Vogeikoff-Brogan

Stefania Chlouveraki

Jack Davis and Shari Stocker

Heidi Dierckx

Doniert Evely

Doug Faulmann and Kathy Hall

Susan Ferrence

Geraldine Gesell

Elpida Hadjidaki

Jane Hickman

Eleanor Huffman

Bernice Jones

Robert Koehl

Garyfalia Kostopoulou

Al Leonard in honor of Mary Leonard

Holley Martlew

Linda Meiberg

Floyd McCoy

Allyson McCreery

Eleni Nodarou

Chronis Papanikolopoulos

Judith Papit

David Rupp and Metaxia Tsipopoulou

Jennifer Sacher and David Marshall

Evi Saliaka

Pepi Saridaki

Elizabeth Shank and Nathan Raines

Joe and Maria Shaw

Chryssa Sofianou

Jeff and Mary Ellen Soles

Antonia Stamos

Tom Strasser

Sevi Triantaphyllou

Loeta Tyree

Matina Tzari

Aleydis Van de Moortel

Maria Vlazaki

Gisela Walberg

Kleio Zervaki

Donations were made by friends and colleagues for the purchase of books for the Study Center's library in honor of Phil and Mary's anniversary. They would like to take this opportunity to thank the donors and everyone who shared in this special occasion with them.

Archeobotanical Reference Collection for the INSTAP Study Center for East Crete

by Evi Margaritis

Figure 1. Seeds of Pisum sativum.

Figure 2. Seeds of Capparis spinosa.

Archeobotanical research is facilitated by a laboratory equipped with stereomicroscopes, a well-stocked plant reference collection of high quality, and a library with a variety of seed atlases containing detailed drawings and pictures of seeds (Berggren 1969, 1981). A reference collection consists of modern seeds, not only of cultivated plants of economical value, such as barley, wheat, pulses, millet, fruits (e.g., olive, grape, cornelian cherry), but also of thousands of wild weed species.

Frequent checking of the archeobotanical material against a reference collection is vital as there is a considerable degree of overlapping between different species of cereals, pulses, and wild species.

The study of weed species is a vital component of archeobotanical research. Weed seeds are important for identifying crop processing sequences, but they can also provide precious information on crop husbandry practices (Jones 1992; van der Veen 1992; Jones et al. 1999). Archeobotanists have frequently used the weed seeds accompanying ancient cereal remains to assist in the identification of agricultural practices, because the range of weed species growing with the crops is a reflection of the conditions created by different cultivation methods. In this way, it has been suggested that cereal fields in different locations and managed under different crop husbandry regimes could be clearly distinguished based on the weed species accompanying the crop (Palmer 1998). The precise identification of weed species is therefore crucial in order to address and answer important archaeological questions.

The value of a modern reference plant collection is undoubtedly high; thanks to an INSTAP grant awarded to the author, it was possible to gather both economic and wild plants from the Cretan countryside. Whole plants, in their seeding period, were identified with the assistance of plant atlases and subsequently dried in paper bags. When completely dry, seeds and other parts of the plants—such as awns, chaff, and straws—will be removed, categorized, and stored in glass tubes. Family, species, date, and region of collection will be clearly labeled on the tubes. In the pictures, you can see seeds of *Pisum sativum* and *Capparis spinosa* gathered by the author for the reference collection (Figures 1 and 2). Other plant components such as wine residues (pressed grapes), the by-products of wine making that were subsequently used for fuel and manure, were also gathered at the Gorge of the Dead at Kato Zakros and will represent a valuable adding to the reference collection. As a further step, a digital database will be created with full details of the specific specimens contained in the collection with high-quality pictures accompanying them.

This reference collection aims to constitute a valuable tool for the archeobotanists working in archaeological sites in Crete, and it will assist in the detailed reconstruction of ancient husbandry regimes and economic models.

References

Berggren, G. 1969. *Atlas of Seeds and Small Fruits of Northwest-European Plant Species (Sweden, Norway, Denmark, East Fennoscandia and Iceland), with Morphological Descriptions*. Part 2: *Cyperaceae*, Stockholm.

———. 1981. *Atlas of Seeds and Small Fruits of Northwest-European Plant Species (Sweden, Norway, Denmark, East Fennoscandia and Iceland), with Morphological Descriptions.* Part 3: *Salicaceae-Cruciferae*, Stockholm.

Jones, G.E.M. 1992. "Weed Phytosociology and Crop Husbandry: Identifying a Contrast between Ancient and Modern Practice," *Review of Palaeobotany and Palynology* 73, pp. 133–143.

Jones, G.E.M., A. Boggard, P. Halstead, M. Charles, and **H. Smith.** 1999. "Identifying Crop Husbandry on the Basis of Weed Floras," *BSA* 94, pp. 167–189.

Palmer, C. 1998. "The Role of Fodder in the Farming System: A Case Study from Northern Jordan," in *Fodder: Archaeological, Historical and Ethnographic Studies* (*Environmental Archaeology* 1), M. Charles, P. Halstead, and G. Jones, eds., Oxford, pp. 1–10.

van der Veen, M. 1992. *Crop Husbandry Regimes: An Archaeobotanical Study of Farming in Northern England, 1000 BC–AD 500* (*Sheffield Archaeological Monographs* 3), Sheffield.

Evi Margaritis is the current Leventis Fellow at the British School at Athens. During her fellowship, Evi is examining the domestication and intensive cultivation of the vine and the olive in the Aegean and Cyprus on the basis of ethnographic, experimental, and archeobotanical data. She is also exploring issues of ancient farming, and is involved with various projects dated from the Neolithic to the Byzantine periods, including: Dispilio and Avgi Kastorias; Dhaskalio at Keros; Mycenae; Midea; Mochlos, Papadiokambos, and Chryssi in Crete; Thermi at Lesbos; the Athenian Agora; Corinth; the Lykaion mountain in Greece; Alassa and Nicosia in Cyprus; the British School at Rome's Portus project in Italy; and Nacovana and Karcadur in Croatia.

Petrographic Analysis of Early Iron Age Pottery from the Necropolis of Orthi Petra in Eleutherna

by Eleni Nodarou

Introduction

The site of ancient Eleutherna lies ca. 25 km southeast of the modern city of Rethymnon in west central Crete. The excavation of the extensive Iron Age necropolis at Orthi Petra produced finds dating between the 9th and 6th centuries B.C. It is a period of development that boasts elaborate architecture for burials as well as for the mundane structures and rich finds. In general, Eleutherna is considered to be a major city (*polis*) dominating smaller villages and maintaining contacts with centers outside Crete (Stampolidis 2004a, 2004b). The analytical project forms part of the publication of the ceramic material found in chamber tomb A1K1 (Kotsonas 2005, 2008) and was carried out under the direction of Nicholas Stampolidis, Director of Eleutherna (Sector III) Excavations.

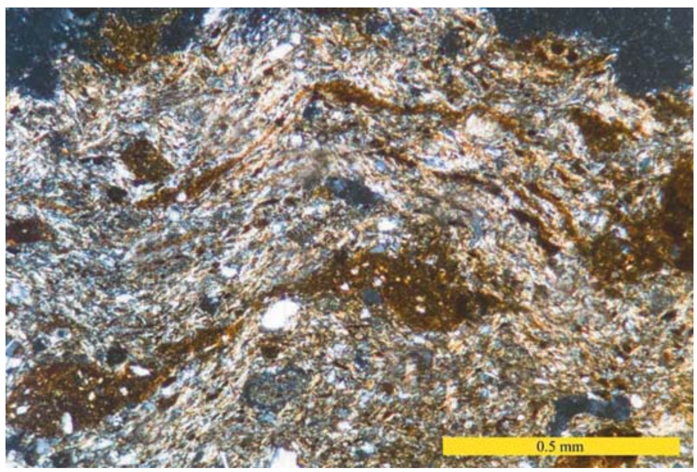

Figure 1. Local fabric, detail with clay pellets and striations (x100).

The Petrographic Analysis: Aim and Results

According to the typological study of the ceramic assemblage of 840 complete or nearly complete vessels carried out by A. Kotsonas (2005), the majority is considered to be locally manufactured or broadly Cretan, whereas almost 10% is thought to be imported from the Aegean and the Eastern Mediterranean. A small percentage consists of plain, undecorated domestic vessels such as basins, cooking pots, and cooking trays. The majority consists of elaborately decorated vessels, such as pithoi, jars, amphorae, oinochoai in coarse and semi-coarse fabrics, as well as smaller and finer vessels such as pyxides, aryballoi, and lekythoi. The petrographic analysis of selected pottery samples from various fabrics, styles, and shapes had a twofold aim: (1) to study and formulate a compositional characterization of the ceramic fabrics, and (2) to discuss their provenance and technological characteristics. Most of the samples derived from tomb A1K1, but selected material from other areas of the cemetery was also included in the analysis for comparative reasons (Nodarou 2008).

The analysis, based on the mineralogy and the texture of the fabrics, demonstrated that 50% of the samples belong to a metamorphic fabric group with phyllite, quartzite, and frequent clay pellets (Figure 1). This fabric represents local production and is intended for domestic wares such as pithoi, basins, and cooking pots.

There is also an array of fabric groups, including serving vessels and vessels for the consumption of liquids, that have been characterized broadly as “Cretan,” but it has not been possible to assign a specific provenance.

Finally, there is a highly micaceous fabric that stands out as markedly different from the Cretan fabrics (Figure 2). This fabric group was used to fashion amphorae, which stylistically and compositionally are thought to be imported from the Cyclades, possibly from Paros.

The presence of loners—i.e., samples that on the grounds of their mineralogy and/or texture could not be included in any of the established groups—is indicative of the multitude of material that reached the tomb throughout its use.

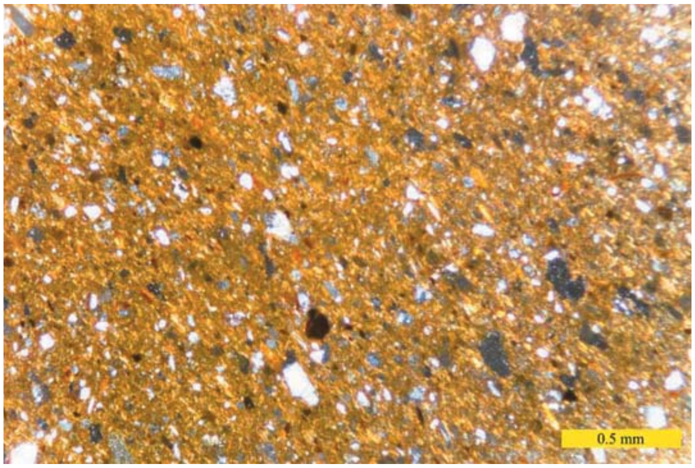

Figure 2. Micaceous fabric (import) (x50).

Discussion

Although the petrographic analysis, in several cases, has not been conclusive regarding the provenance of the vessels, it appears that the material represented in the tomb includes vessels that were produced locally, vessels that are definitely imported from outside Crete (such as pieces from Paros), and vessels that are considered broadly Cretan.

With regard to the technology of manufacture, it seems that local ceramic production was based on the use of red, low calcareous as well as Neogene calcareous clays. The majority of the pottery that was examined is quite fine, which is indicative of levigation or sieving of the raw material—i.e., the coarse inclusions were removed in order to increase the plasticity of the clay.

As mentioned before, Fabric Group 1, which includes 50% of the samples analyzed, represents local pottery production. Comparative raw materials from the modern potting center of Margarites strengthen our argument about local workshops operating in the broader area of Eleutherna. The scale of production is not easy to assess on the basis of just one tomb, but chamber tomb A1K1 is quite representative due to the quantity and quality of the ceramic vessels that it contained. However, the multitude of shapes manufactured in a rather consistent clay recipe is indicative of a production level above that of the household. The standardization of production can be interpreted as reflecting the fact that potters were installed on a permanent basis in the area and exploited the local clay sources.

Beyond provenance and technology of production, pottery plays a significant role as a social and economic indicator, and cemeteries are the places par excellence where display of status and social power is manifested. The limited amount of material sampled from other tombs in order to complement the study of tomb A1K1 demonstrated interesting similarities and differences in the vessel shapes and fabrics, thereby opening the way to a future systematic study of the Orthi Petra pottery that would shed more light on issues such as social complexity and intra-cemetery relationships.

References

Kotsonas, A. 2005. *Ceramic Styles in Iron Age Crete: Production, Dissemination and Consumption. A Study of Pottery from the Iron Age Necropolis of Orthi Petra in Eleutherna*, Ph.D. diss., University of Edinburgh.

———. 2008. *The Archaeology of Tomb A1K1 of Orthi Petra in Eleutherna: The Early Iron Age Pottery*, Heraklion.

Nodarou, E. 2008. “Appendix. Petrographic Analysis of Selected Pottery Samples from Eleutherna,” in *The Archaeology of Tomb A1K1 of Orthi Petra in Eleutherna: The Early Iron Age Pottery*, A. Kotsonas, Heraklion, pp. 345–362.

Stampolidis, N.C. 2004a. *Eleutherna: Polis, Necropolis, Acropolis*, Athens.

———. 2004b. “Η Ελεύθερνα της Πρώιμης Εποχής του Σιδήρου. Σχέσεις και την ανατολική Μεσόγειο,” in *Το Αιγαίο στην πρώιμη εποχή του Σιδήρου. Πρακτικά του Διεθνούς Συνεδρίου, Ρόδος, Νοέμβριος 2002*, N.C. Stampolidis and A. Giannikouri, eds., Athens, pp. 51–75.

Conservation of Pottery from the Minoan Shipwreck of Pseira

by Pepi Saridaki

Figure 1. Pottery cluster that includes a carinated cup and other fragments before cleaning (left), and as shown in radiograph (right). The X-ray was taken using a Faxitron 43855A X-ray System (56 cm focus-to-film distance, 110 kV, 3 min, 3mA).

Introduction

From April to September 2009, I undertook my six-month practicum at the W.D.E Coulson Conservation Laboratory of the INSTAP Study Center for East Crete as a part of my degree requirement for the Department of Conservation of Antiquities and Works of Art at the Technological Educational Institute (T.E.I.) of Athens, under the supervision of Stephania Chlouveraki. My work at the Study Center focused on the conservation of pottery from the Minoan shipwreck near Pseira (with the kind permission of Philip Betancourt and Elpida Hadjidaki, I was allocated this topic for my final dissertation while an undergraduate student under the supervision of Aikaterini Malea [T.E.I.]). The material comes from a ship that sank off the coast of the island of Pseira in the MM II period. The wreck, which was discovered at a depth of 50 meters beneath the sea's surface, was recently excavated by Elpida Hadjidaki (2005–2009). The ship was found to be carrying large numbers of transport containers (amphora, jugs, and jars).

Conservation Procedures

When I started the material was already desalinated, dried, and stored in archival boxes. To begin my conservation effort, the ceramic objects first were photographed, and some pots were scanned by electromagnetic radiation (X-ray) in order to identify the condition of the vessel wall and prevent further damage during cleaning. The resulting radiographs revealed additional information such as manufacturing details, and in many cases the radiographs allowed the collaborating artist to illustrate the non-visible parts of the objects (e.g., sections of vases that could not be measured previously because of the hard concretions that filled the interior of the vases) (Figure 1, right). Moreover, we also were able to identify and count the objects that were enclosed in clusters by extremely hard concretions (Figure 1, left).

Macroscopic and microscopic study revealed a variety of encrustations formed by marine organisms such as bryozoan colonies, corals, calcareous tubes built by worms, mollusks of several species, and many others, each of which behaved differently during cleaning. It also appears that the surfaces of many ceramic objects were damaged by the erosive action of the underwater currents. In some cases the surface was so worn that the inclusions in the fabric and the seams of the vases were visible.

The vases were cleaned by a combination of mechanical means (Figure 2). Initially, the hard encrustations were removed with an ultrasonic pen (Figure 3, left and center), often assisted by the use of a small chisel. After the removal of the hard and bulky encrustations, the fine remains were removed by sandblasting, which allowed us to maintain a more homogeneous patina on the vessel surface (Figure 3, center and right). The majority of the vases were fragmentary and covered with extremely hard concretions that held fragments together. After the removal of these concretions, the fragments were separated and consequently consolidated and mended. In other cases, the erosion and vulnerability of the surface was so severe that the cleaning process caused flaking, which required additional consolidation with 10% Paraloid B72 in acetone. As a final note, we decided that the complete removal of the marine encrustations should be avoided because this material tells an important part of the history of the ceramics and distinguishes them from similar finds on land (Figure 3, right).

Figure 2. P. Saridaki at work, using the ultrasonic pen at the W.D.E Coulson Conservation Laboratory of the INSTAP Study Center for East Crete.

Acknowledgments

I would like to thank Stephania Chlouveraki for her help in organizing this project; Tom Brogan and the staff members of the INSTAP Study Center for East Crete for their help, hospitality, and support during my stay; excavator Elpida Hadjidaki; and Philip Betancourt, who is leading the study of the pottery.

Figure 3. The phases of the cleaning procedure: before cleaning (left), after the removal of the hard concretions with the ultrasonic pen (center), and after the final cleaning of the surface with the sandblaster (right).

EM/MM Human Skeletal Remains from East Crete: The Kephala Petras Rock Shelter, Siteia, and the Livari Tholos Tomb, Skiadi

by Sevi Triantaphyllou

Introduction

In May and June 2009, the study of two important EM/MM human bone assemblages started to take place at the INSTAP Study Center for East Crete: the Kephala Petras rock shelter, which is located in northeastern Crete and was excavated in 2006 by Metaxia Tsipopoulou (Director of the National Archives of Monuments, and the 24th Ephorate of Prehistoric and Classical Antiquities, Hagios Nikolaos; see Tsipopoulou, unpublished manuscript 2007), and the Livari tholos tomb, which is located in southeastern Crete and was excavated in 2007 by Chryssa Sofianou (24th Ephorate of Prehistoric and Classical Antiquities) and Yiannis Papadatos (Univ. of Athens; see Papadatos, unpublished manuscript 2009). The study of the human bones was assisted by Eleftheria Tsichli, MA, University of Thessaloniki, and Natassa Kalogirou, MA candidate, Southampton University, UK (Figure 1). The human bone material was initially cleaned with soft brushes and water and sorted in accordance to major anatomical units: cranial bones, mandibles/maxillae/teeth, clavicles/scapulae, humeri, ulnae, radii, hand/foot bones, vertebrae, ribs, os coxae, femora, tibiae, fibulae, patellae, and unidentified bone fragments. The study of the skeletal material, which is in progress for both skeletal assemblages, started to take place by anatomical units in order to search for joins between different stratigraphic units.

Figure 1. Natassa Kalogirou sorting bones from the Livari tholos tomb.

Previous Studies of Human Skeletal Remains in Crete

Although there are a large number of excavated Minoan burial assemblages, there is a remarkable lack of studies of the human remains from them. This is partly due to the state of preservation of the human bones, and, to a certain degree, the treatment of the deceased, which often involving multiple reopenings of the tomb as well as repeated removals of the human bone material. Moreover, most of the tombs' excavations either took place many years ago when the systematic collection of the human material was very limited, or they have suffered badly from modern looting, resulting in the complete disturbance of the burial context. It is only recently that Tholos Tomb Gamma in Archanes (Triantaphyllou 2005) and the two tholoi tombs of Moni Odigitria in the Mesara Plain (Triantaphyllou, forthcoming) offered the opportunity for a thorough study of the human remains, suggesting the potential for recording and interpreting skeletal remains from similar contexts recovered in a commingled state of disposal.

Earlier work on prehistoric skeletal assemblages has been on the Early and Middle Minoan periods—EM/MM IIB at the Hagios Charalambos Cave, Lasithi (Betancourt, Davaras, and Stravopodi 2008); EM I/MM II at Pseira (Arnott 2003); MM I at Pezoules Kephala Kato Zakro (Becker 1975); and MM III at Knossos (Carr 1960)—and the Late Minoan period, such as LM III Chania (Hallager and McGeorge 1992). McGeorge has contributed mainly to the study of human remains on Crete by using a purely physical anthropological approach with limited reference to aspects related to the treatment of the deceased. Much of her work, therefore, has focused on the discussion of broad thematic topics such as the stature or the mean life expectancy of the Minoans (McGeorge 1988, 1989). More recently, she is responsible for a number of ongoing projects, e.g., the study of the EM Hagia Photia cemetery population and the EM−MM Hagios Charalambos burial cave (Betancourt et al. 2008, 578–594), which await final publication. The latter project presents many similarities to the Kephala Petras rock shelter in regard to the disposal of the human remains and the type of grave goods. Additionally, studies such as chemical analyses with special focus on stable isotope analysis of carbon and nitrogen for the reconstruction of Minoan diet (Tzedakis and Martlew 1999) and a strontium analysis for the exploration of the biological affinities of Cretan populations during the Bronze Age (Nafplioti 2007, 2008) have been applied to Minoan skeletal assemblages.

Methodology

The recording system followed the standards for recording commingled skeletal remains that was set for the two tholos tombs at Moni Odigitria (Triantaphyllou, forthcoming). In particular, each bone fragment was recorded according to typical anatomical features based on the standard anatomical units set for disarticulated skeletal assemblages established by Lyman (1994) and slightly adjusted according to internationally accepted standards for recording commingled human remains (Outram et al. 2005) in order to avoid duplication of anatomical units. Long bones, for example, were segmented into five different zones: proximal end, proximal 1/3, middle 1/3, distal 1/3, and distal end. Archaeological information related to trench number, level, and stratigraphical unit, as well as biological parameters such as taphonomy (erosion, encrusting, burning), completeness of skeletal elements, fragmentation, siding, age, sex, pathological conditions, and metric and non metric traits were entered into an Access database.

Preliminary Results

In total, 2,220 fragments—almost one-third of the identified and recordable human bone material recovered from the Kephala Petras rock shelter—of femora (3 crates), tibiae (2 crates), fibulae and patellae (1 crate), and another 1,078 fragments of femora, humeri, and ulnae from the Livari tholos tomb were marked, given an inventory number, and systematically recorded and measured. It is worth mentioning here the total numbers of other EM/MM assemblages of commingled skeletal remains recently studied. In the Moni Odigitria tholos tombs, the human skeletal material consists of a total of 3,630 and 1,461 identified bone and tooth fragments from Tholoi A and B, respectively (Triantaphyllou, forthcoming). In Archanes, Tholos Tomb Gamma produced only 72 post-cranial fragments (Triantaphyllou 2005, 68), while the recently published report of the Hagios Charalambos Cave makes reference to 11,000 entire or fragmentary bones identified so far (Betancourt et al. 2008, 580).

The study and analysis of commingled human remains differs from that of individual articulated skeletons involved in single episodes of primary burial. Both skeletal assemblages coming from multiple burials and commingled bone remains—such as those from the Kephala Petras rock shelter and the Livari tholos tomb—offer a unique opportunity to shed some light on issues related to the treatment of the deceased and the practices associated with the burial, re-burial, and multiple use of the disposal area. They also help identify the biological parameters of the case-study populations, such as the demographic picture (i.e., minimum number of individuals buried, sex, and age groups), health, dietary status, physiological stress factors, and the type of physical activities practiced during life.

In particular, issues which will be explored extensively in the Kephala Petras rock shelter and the Livari tholos tomb and have been partly seen throughout the first stage of investigation include:

A. *The character of the deposition of the human skeletal remains, whether primary or secondary.* Preliminary work on the material as well as careful observation of the photographic archives reveals that the skeletal remains of both the rock shelter and the tholos tomb represent mainly products of secondary treatment. Taphonomic factors related to disarticulation during cleaning of the primary disposal area at the Kephala Petras rock shelter and to extreme fragmentation at the

Figure 2. Bone fragments with evidence of burning and trampling from the Livari tholos tomb.

Livari tholos tomb suggest that removal of the bone material from their original disposal area took place after the remains were skeletonized and turned into dry bones. At the Kephala Petras rock shelter in particular, skeletal elements present an overall complete or almost complete state of preservation often involving intact bones, which can produce stature estimations. This phenomenon would indicate that the human remains did not suffer from additional removal or further deliberate disturbance once placed in the rock shelter. At the Livari tholos tomb, on the other hand, skeletal elements show extreme fragmentation, which was probably caused from the combination of several factors related to the burning of the bones and also to intense trampling during multiple re-openings of the tholos. It is striking to note the high frequency of bones from the tholos that have evidence of burning, evident in the variety in coloration (black, blue/gray, gray, and white), distortion (slight to severe warping), and cracking (both transverse and longitudinal cracks) on the bone surface. Different degrees of alterations to the bone surface would be the result of several factors affecting bone elements during burning, e.g., the state of decomposition of the human remains (skeletonized versus fresh bone), contact with fire (direct or indirect), length of exposure to firing conditions, etc. In many cases it seems that bone parts were still covered with flesh, and the fat and soft tissue facilitated burning at high temperatures. The large number of burned bones recovered in the tomb (more than half of the total number of bones recorded), as well as bone alterations due to burning, appear to be the result of a lengthy and systematic process. Burned bones mostly of smoked black and blue/gray color with minimal severe alterations (e.g., cracking and warping) have been observed in most EM Mesara tholos tombs, but in significantly smaller frequencies, suggesting that they are the result of a hasty and short-term process. For example, Moni Odigitria Tholos Tomb A produced only 295 burned bone fragments out of a total of 6,922, while Tholos B yielded 60 burned examples out of the 2,727 bone fragments recovered. The low frequency of burned bone fragments in the above EM assemblages, as well as the slight character of alterations from firing processes, appear to represent activities associated with the fumigation of the disposal area where the human remains were primarily deposited as opposed to the intentional cremation of human remains, as was probably the case in Livari. Another interesting taphonomic feature demonstrated in the Livari bone fragments is intense trampling revealed either as bone splints with rounded edges or extremely fragmentary long bones regularly broken in transverse or oblique segments with clean edges on both sides of the shaft (Figure 2). Trampling can be associated with breakage of the bone material due primarily to the removal of the skeletal material after being burned and subsequent relocation within the tholos tomb during multiple re-openings of the tholos area. Similarly, extreme fragmentation as well as some trampling on the skeletal material due probably to its transportation into the location of secondary deposition and subsequent multiple re-openings in the tholos area seem to have taken place at Moni Odigitria Tholos A. Instead, in other recently studied EM secondary deposits such as the so-called ossuary of Tholos B at Moni Odigitria (Triantaphyllou, forthcoming), the Hagios Charalambos Cave (Betancourt et al. 2008, 580) and more recently the Kephala Petras rock shelter, as already discussed above, skeletal elements demonstrate an exemplary complete state of preservation suggesting minimal disturbance of the human remains from intense removal and subsequent trampling.

B. *The occurrence of preferential selection of certain bone categories, e.g., skulls and/or long bones as opposed to small bones that are usually lacking from secondary disposal of human remains*. Preliminary investigation of both assemblages reveals that there is no particular selection of anatomical units, and, therefore, all bone categories are included in the skeletal assemblage including small bones (hand/foot bones, phalanges), vertebrae, and rib fragments. Long bones are overrepresented as they are the norm in commingled assemblages due to robusticity and high resistance to extrinsic factors such as removal during secondary treatment.

Figure 3. Tibia with evidence of periostitis (non-specific infection) from the Kephala Petras rock shelter.

C. *Accessibility to the disposal areas of certain age and/or sex categories*. Preliminary investigation shows that all age categories and both sexes were disposed in the Kephala Petras rock shelter while there is a relative underrepresentation of the subadult age categories (-18 years of age) at the Livari tholos tomb. This picture is consistent with the idea that skeletal remains represent population groups linked with family relations rather than population segments based on age and/or sex divisions. Nevertheless, it is interesting to note a similar underrepresentation of the subadult age categories at Moni Odigitria, Tholos B—only four out of sixty-four individuals belonged to subadult age groups—while subadults show a relative good representation at Tholos A at Moni Odigitria and the Hagios Charalambos Cave (Betancourt et al. 2008, 578).

D. *The health and oral status as well as dietary patterns consumed by the case study populations*. Preliminary investigation of the Kephala Petras rock shelter femora, tibiae, and fibulae gave evidence of pathological conditions commonly found in prehistoric assemblages in the Aegean, such as different types of arthritis, long-term healed fractures and nonspecific infections, and, in particular, periostitis on the lower limbs (Figure 3). Musculo-skeletal markers as well as the evidence of trauma and nonspecific infections would be consistent with a population that was actively engaged in physical tasks involving farming/herding, walking in rough terrain, and travelling long distances.

Recent studies of human skeletal remains from pre-palatial Crete gave new insights on issues related to manipulation of the deceased as well as to biological parameters such as the demographic synthesis, health status, and diet of the case study populations. Primary investigation of certain anatomical units from the Kephala Petras rock shelter and the Livari tholos tomb clearly demonstrated the need towards this direction by providing some interesting information on the character of the two depositions based on taphonomic criteria, the demographic picture, and the health status of the case-study populations.

References

Arnott, R. 2003. "Appendix C: The Human Skeletal Remains," in *Pseira* VII: *The Pseira Cemetery 2. Excavation of the Tombs* (*Prehistory Monographs* 6), P.P. Betancourt and C. Davaras, eds., Philadelphia, pp. 153–163.

Becker, M.J. 1975. "Human Skeletal Remains from Kato Zakro," *AJA* 79, pp. 271–276.

Betancourt, P.P., C. Davaras, H.M.C. Dierckx, S.C. Ferrence, J. Hickman, P. Karkanas, P.J.P. McGeorge, J.D. Muhly, D.S. Reese, E. Stravopodi, and **L. Langford-Verstegen.** 2008. "Excavations in the Hagios Charalambos Cave: A Preliminary Report," *Hesperia* 77, pp. 539–605.

Carr, H.G. 1960. "Some Dental Characteristics of the Middle Minoans," *Man* 156, pp. 119–122.

Hallager, B.P., and **P.J.P. McGeorge**, eds. 1992. *Late Minoan III burials at Khania: The Tombs, Finds, and Deceased in Odos Palama* (*SIMA* 93), Göteborg.

Lyman, R.L. 1994. "Quantitative Units and Terminology in Zooarchaeology," *American Antiquity* 59, pp. 36–71.

McGeorge, P.J.P. 1988. "Μυθικοί Πυγμαίοι και Γίγαντες: Νέα στοιχεία για το ύψος των Μινωϊτών," *Κρητική Εστία* 2, pp. 10–18.

———. 1989. "A Comparative Study of the Mean Life Expectation of the Minoans," in *Πεπραγμένα του ΣΤ΄ Διεθνούς Κρητολογικού Συνεδρίου* Α΄ (1), Chania, pp. 419–428.

Nafplioti, A. 2007. *Population Bio-Cultutral History in the South Aegean during the Bronze Age*, Ph.D. diss., University of Southampton.

———. 2008. "'Mycenaean' Political Domination of Knossos Following the Late Minoan IB Destructions on Crete: Negative Evidence from Strontium Isotope Ratio Analysis ($^{87}Sr/^{86}Sr$), *JAS* 35, pp. 2307–2317.

Outram, A.K., C.J. Knüsel, S. Knight, and **A.F. Harding.** 2005. "Understanding Complex Fragmented Assemblages of Human and Animal Remains: A Fully Integrated Approach," *JAS* 32, pp. 1699–1710.

Papadatos, Y. 2009. *Ανασκαφή Προ-ανακτορικού Θολωτού Τάφου στη Θέση Λιβάρι, Σκιάδι*. Unpublished manuscript.

Triantaphyllou, S. 2005. "Appendix: The Human Remains," in *Tholos Tomb Gamma: A Prepalatial Tholos Tomb at Phourni, Archanes* (*Prehistory Monographs* 17), Y. Pappadatos, Philadelphia, pp. 67–76.

———. Forthcoming. "Tholos A and B: The Human Remains," in *Moni Odigitria: A Prepalatial Cemetery and its Environs in the Asterousia, Southern Crete* (*Prehistory Monographs*), A. Vasilakis and K. Branigan, eds., Philadelphia.

Tsipopoulou, M. 2007. *Burial Cave-Rock Shelter, Kephala-Petras*. Unpublished manuscript.

Tzedakis, Y., and **H. Martlew.** 1999. *Minoans and Mycenaeans: Flavours of their Time*, Athens.

Acknowledgments

I would like to thank the excavators, Metaxia Tsipopoulou, and Chrysa Sofianou and Yiannis Papadatos for entrusting me with the study of the human remains of the Kephala Petras rock shelter and the Livari tholos tomb, respectively. I am particularly grateful to the Director of the INSTAP Study Center for East Crete, Tom Brogan, for always supporting me in practical matters during my stay at Pacheia Ammos; to Phil Betancourt, who got involved more recently in the publication of the Kephala Petras rock shelter; Eleanor Huffman, the Assistant Director of the INSTAP Study Center; the staff of the INSTAP Study Center who have facilitated enormously my work there; the chief conservator of the Petras project, Kleio Zervaki and the archaeologist Garifalia Kostopoulou, who always respond immediately to last minute requests. This work would be impossible without the generous funding of the Institute for Aegean Prehistory.

INSTAP Study Center for East Crete

United States

INSTAP Study Center for East Crete
3550 Market Street, Suite 100
Philadelphia, PA 19104
Phone: 215-470-6970 or 215-387-4911
Fax: 215-387-4950
E-mail: elizabethshank@hotmail.com

At the U.S. Academic Office

Philip P. Betancourt,
Executive Director of INSTAP–SCEC
Elizabeth Shank,
Research and Administrative Coordinator

Kentro Staff

Elizabeth Shank, *Editor*
Jennifer Sacher, *Assistant Editor*
David Branch, *Production*

Shari Stocker, Jack Davis, Tom Brogan, and Vili Apostolakou at the Open Meeting of the American School of Classical Studies where Tom delivered the lecture "Flavors, Aromas, and Colors: Making 'Sense' of Recent Discoveries in the Urban Landscape of Neopalatial East Crete" on May 13, 2009.

Crete

Thomas Brogan, Director
INSTAP Study Center for East Crete
Pacheia Ammos
Ierapetra 72200
Crete, GREECE
Phone: 30-28420-93027
Fax: 30-28420-93017
e-mail: instapec@otenet.gr
www.instapstudycenter.net

At the Center

Thomas M. Brogan, *Director*
Eleanor J. Huffman, *Assistant to the Director*
Stephania N. Chlouveraki, *Chief Conservator*
Kathy Hall, *Senior Conservator*
Chronis Papanikolopoulos, *Chief Photographer*
Doug Faulmann, *Chief Artist*
Eleni Nodarou, *Ceramic Petrographer*
Michalis Solidakis, *Maintenance Personnel*
Maria R. Koinakis, *Custodian*

Members of the Managing Committee

Kellee Barnard
Philip P. Betancourt
Thomas M. Brogan
Jack Davis
Leslie P. Day
Susan Ferrence
Sherry Fox
Geraldine C. Gesell
Donald C. Haggis
Jennifer Moody
Margaret S. Mook
James D. Muhly
Irene Bald Romano
Elizabeth Shank
Jeffery S. Soles
Catherine Vanderpool
L. Vance Watrous