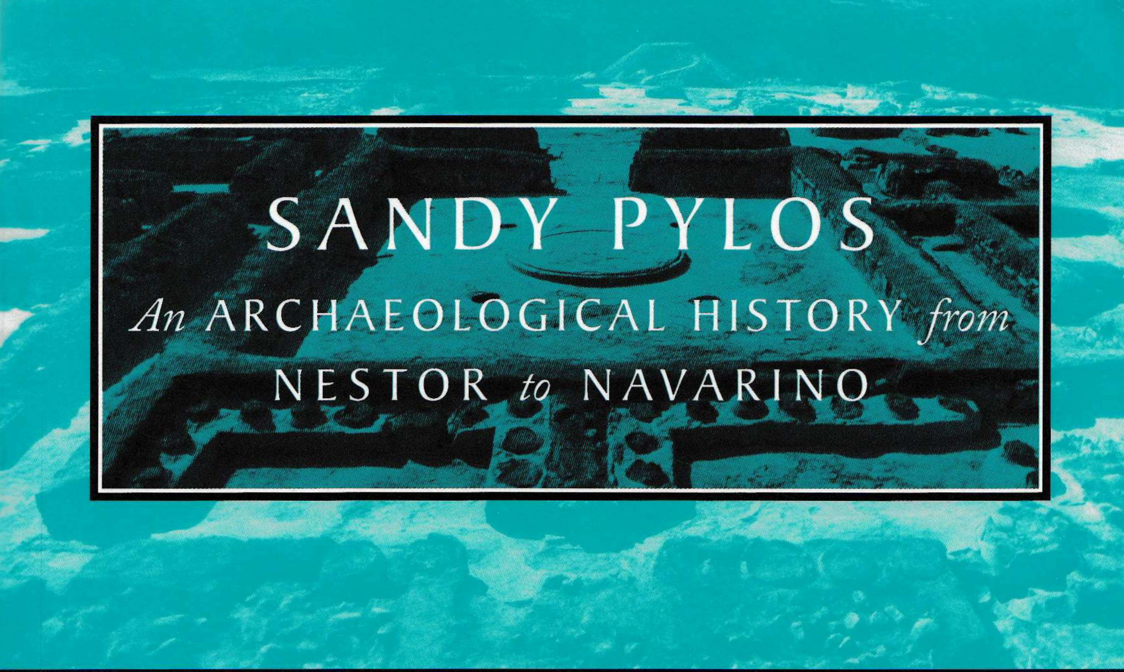

SANDY PYLOS

An ARCHAEOLOGICAL HISTORY *from* NESTOR *to* NAVARINO

EDITED BY JACK L. DAVIS

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CHAPTER I

The ENVIRONMENTAL SETTING

Messenia is the name both of a region and of an administrative district in the far southwest corner of Greece—an area segregated from the central Greek mainland by several mountain divides, bordered on three sides by the sea and on the fourth by the Taygetus Mountains, which rise to a height of 2,400 meters. Because of its remoteness, much of Messenia is only sparsely inhabited, and the entire province has a single regional center of traffic and commerce, its capital, Kalamata.

Although Kalamata possesses a port with ferry connections to Crete and a small airport with scheduled flights to and from Athens, most who visit Messenia will drive by car over winding roads through the center of the Peloponnese before arriving in one of the most beautiful parts of Greece. A mere 150,000 people in an area of 3,000 square kilometers share the best soil and most favorable climate in the entire Peloponnese. Most live in the city of Kalamata and in the towns of Pylos, Hora, Gargaliani, and Cyparissia; thus the spectacular coastal scenery of western Messenia, including the Bay of Navarino, remains almost unspoiled by modern buildings.

The great Bay of Navarino, the extensive swampy lagoon known as Osmanaga, and the beach barrier dividing these two are among the most prominent geographical features of western Messenia. West of the lagoon is a shallow sea inlet, ringed by tall sand dunes at a place called Voidokoilia ("ox-belly") because of its distinctive shape. Voidokoilia, crowned by the so-called Cave of Nestor on the nearby Navarino Ridge, certainly ranks as one of the most enchanting landscapes in Greece (Fig. 11).

To understand how this landscape evolved, it is necessary for us to widen our perspectives beyond those normally considered by historians and archaeologists, and to consider geological scales of time and space. The main geological and physiographic characteristics of Messenia are the result of a collision between two units of the earth's crust that are called the African and the European plates. These plates have been moving toward each other

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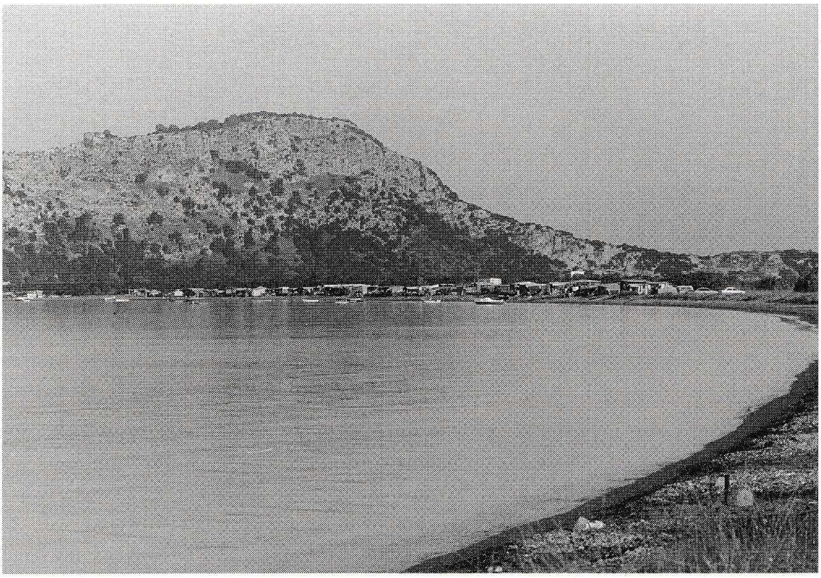

FIGURE 11

The north end of the Bay of Navarino, the castle of Palaionavarino, and the sand bar separating the bay from Osmanaga Lagoon. PRAP Archive. R. Dupuis-Devlin and E. Dallagher.

at a rate of approximately 1 centimeter per year, and during the past two million years, it seems that probably as much as 20 kilometers of the earth's crust has subsided between them.

These horizontal plate movements are accompanied by vertical displacements of the earth: mountain ridges are uplifted along tectonic faults, while coastal plains temporarily sink below sea level, where they accumulate large amounts of sediment. Subsequently, they may rise above sea level again, thus exposing their marine deposits.

Messenia's landscape was shaped by a combination of these processes. Precipitous slopes occur along tectonic faults: the island of Sphacteria and the Aigaleon range of mountains in western Messenia are good examples of such landforms. Extensive terraces of uplifted marine sediments now cover areas between ridges. In places, deposits that formed at the beginning of the Pleistocene, two million years ago, are now located as high as 400 meters above sea level. Streams that drain the mountain basins cut their beds deeply into these young, soft deposits and, in so doing, fashion the soft powdery marl bedrock into spurs (Fig. 12).

Since natural resources such as arable land, abundant fresh water, protected harbors, and mineral resources have all, to a greater or lesser degree, influenced the fate and fortune of both ancient and modern cultures, any attempt to reconstruct Messenia's history requires an understanding of the habitat in which Messenians, past and present, have lived. What is more, the success of royal palaces, trading cities, and even entire states has often reflected their geographic position either in their immediate landscape or in a larger geopolitical world-system.

Interrelations between the natural environment and the history of its human habitation are complex, and require that archaeological field projects like the Pylos Regional Archaeological Project engage physical scientists, including geologists, geomorphologists, geophysicists, botanists, and soil scientists. Their job is to investigate the evolution of the landscape around the archaeological sites that are of interest to the archaeologists. Specifically, the scientists aim to find out how the landscape has changed since it was first settled, how the environment has influenced the choice of places to live or land to farm, and how the natural habitat, in turn, has been affected and changed by people.

These were the goals of the physical scientists who participated in PRAP and who formed a significant percentage of its staff. And after several years of fieldwork and laboratory analysis, we are now in a position to sketch the

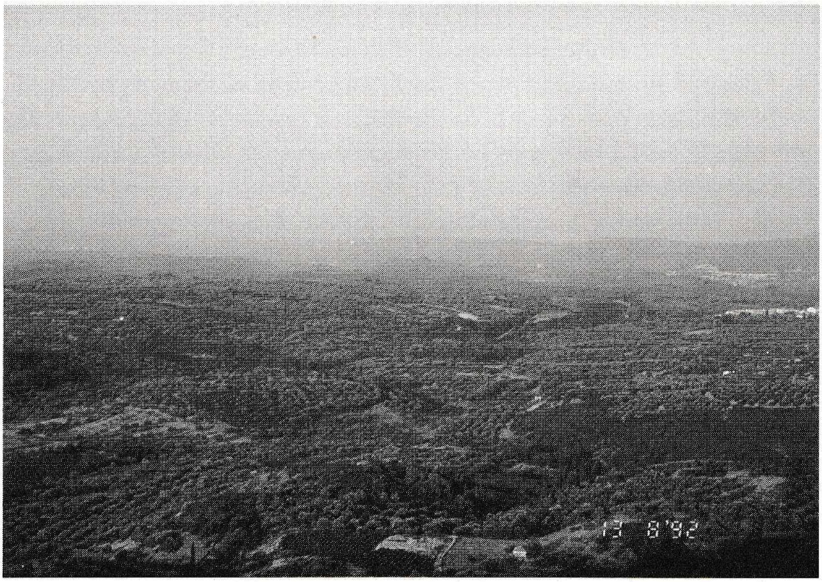

FIGURE 12

The Englianos Ridge (distant center) and the uplands around Hora from the top of the Aigaleon Ridge. PRAP Archive.

FIGURE 13

The area of the Mycenaean port basin (open area right of the large house in center) and the mouth of the Selas River from the town of Tragana. PRAP Archive. R. Dupuis-Devlin and E. Dallagher.

following history of the landscape of western Messenia, in the areas around the Palace of Nestor that formed the focus of detailed research by PRAP.

Ten thousand years ago, sea level was lower than at present, and the Bay of Navarino would have extended several kilometers farther north than it does today, reaching the foot of the ridge on which the modern village of Tragana is located. Osmanaga Lagoon, the beach barrier that separates it from the Bay of Navarino, and the dune fields at Voidokoilia did not exist at that time, although there *were* extensive stabile dunes north of Romanou. The two biggest rivers in the Pylos region today are those which run immediately north and south of the Englianos Ridge, then unite at its southwestern end to form the Selas River; several thousand years ago, this combined river would have exited into the Bay of Navarino (Fig. 13).

There is no doubt that these streams then flowed perennially. Rain would have been caught and preserved by a thick vegetation cover and by mature soils, which would have released their water slowly but steadily. Botanical investigations by our project allow such a reconstruction since they indicate that warmer and wetter conditions that followed the Ice Age supported open oak forests that, at low elevations, contained beech, holly, hornbeam, pistachio, and almonds with pine forests and evergreen shrubs at high elevations and on poor sandy soil.

At the end of the last Ice Age, it appears that Greece was largely deserted. The first farmers seem to have traveled from the Near East to northern Greece during the seventh millennium B.C., and to have chosen to settle in the most fertile plains facing the Aegean Sea, across which they would have traveled from Turkey. They brought with them the knowledge required for both agriculture and animal husbandry, including the ability to produce all tools needed for woodcutting and farming. Messenia, being far from the Aegean Sea, was settled later in the Neolithic. Pollen remains from this period are not exceptionally well preserved but are adequate to show that the first settlement by farmers was not accompanied by major land clearance. In a natural replacement, the extensive pine forests gradually gave way to deciduous oaks.

Until the third millennium B.C., agriculture was limited to the most fertile floodplains, where the soft soil could be manipulated with primitive tools. With the introduction of the plow around 3000 B.C., even fields of marginal quality became arable on a relatively large scale. As a result, hill slopes surrounding the fertile floodplains were cleared of forests to make space for new fields and pastures. The population expanded rapidly, and more deforestation and land clearance ensued.

These major changes in agricultural practice occurred first in Thessaly, then in the Argive Plain, and finally, after a delay of about a millennium, in remote areas such as the southern Argolid and western Messenia. By the time that the southern Argolid was cleared for large-scale agriculture (around 2000 B.C.), the agricultural potential of Messenia seems to have been exploited, too. Since then, the Messenian landscape has undergone rapid and long-lasting changes on four occasions.

Our pollen cores from Osmanaga Lagoon show that by 2000 B.C., pine forests had been reduced to a fraction of their former size. The sedimentation rate accelerated sharply, and the amount of organic matter in the sediments increased. We also found a 15-centimeter-thick sediment layer containing much charcoal, possibly stemming from forest fires, which may have been set intentionally to clear the pine woods. It appears that this first phase of deforestation brought about landscape instability and triggered a phase of increased fragility that has lasted until the present day.

The second period of significant environmental change coincides with the formative stages of Mycenaean civilization. Although the landscape seems to have regained stability between 1800 and 1600 B.C.—when even the pine forests were able partly to recover—shortly thereafter, between

1600 and 1400 B.C., the pines were suddenly and completely wiped out. Dramatic environmental destruction seems to have accompanied early Mycenaean agriculture. In addition to the total disappearance of pines, the number of oak trees dropped by half, making space for plants that are indicative of steppe and macchia communities. This radical change in the vegetation cover is best explained as the result of human-induced deforestation combined with subsequent overgrazing, which suppressed the recovery of trees.

Around 1400 B.C., however, the environmental situation took another turn. The steppe communities declined, and olive trees replaced them. New species of plants appeared, including rye, walnut, plane tree, and Judas tree. At the same time, sediments from Osmanaga Lagoon record a time of relative landscape stability between 1400 and 1200 B.C. Considering how prone to erosion the Pylos area is, it is more than likely that the steep slopes of Englianos were protected by terrace walls to prevent them from slumping. But whatever system the Mycenaean Greeks used to obtain landscape stability, it could not be maintained after the collapse of the kingdom, when archaeological evidence suggests that population density dropped precipitously.

During such phases of social and political readjustment in Greece, natural resources tend to be abused. In this instance, however, it did not take too long before the landscape became stabile once more, as its surface was protected by vegetation that grew almost without restriction. Indeed, deciduous oaks spread to such an extent that they may have covered over half of the total surface of the Pylos area. Although deciduous oaks are much less resistant to grazing than are evergreen oaks, with a deemphasis on husbandry, deciduous oaks have the competitive advantage of faster growth. At the same time, the number of olive and pistachio trees decreased, presumably because there was nobody resident on the land who would cultivate and maintain them.

The physiography of the Pylos area has not experienced any major changes since the end of the second millennium, except that the sand barrier at the northern end of the Bay of Navarino closed between 800 and 500 B.C., isolating Osmanaga Lagoon from the remainder of the gulf. What *has* changed significantly during the past three millennia is the plant cover.

The third phase of major environmental change coincides with the Classical to early Roman periods and marks one such alteration in plant communities. The study of the vegetation argues for a dense population and a high level of agricultural production between 500 and 100 B.C. After the end of the Spartan control of Messenia in the middle of the fourth century B.C. (see Chapters 6–7), the olive reaches an all-time peak (between 350 and 100 B.C.), when a quarter of the entire surface of the Pylos area may have been covered with olive trees. Many of the plants that are likely to have been cultivated at that time, including cereals and grapes, are hard to discern in fossil assemblages. This intense land use was accompanied by a significant drop in deciduous oaks and above-average erosional rates, as reflected in the physical parameters of sediments from our cores in Osmanaga Lagoon.

Land use diminished during the time of barbarian raids and Slavonic invasions in the later first millennium A.D. Fewer olives were cultivated and deciduous oaks recovered, each trend indicating decreased human activity. The sedimentation rate—an indicator of landscape instability—slowed down to a third of its previous value. During the Middle Byzantine period, the environmental data points to more intensive agriculture, while archaeological evidence suggests settlement was also more widespread (see Chapter 8). But no major changes in the environment occurred before the modern period, the fourth and last phase for which there is abundant evidence of human interference with the landscape.

Core samples from sediments just beneath the floor of the lagoon confirm what can be observed by eye in the present landscape. Agriculture has had such an impact on the vegetation that almost no examples of undisturbed natural plant communities can be found anywhere in the landscape. A mixture of cultivated land and pasture covers southwestern Messenia. Natural forests have completely disappeared, and macchia, a seminatural shrub vegetation, has spread over steep and inaccessible slopes. In many places, where grazing is most intense, the macchia has been degraded even further into another kind of plant community, called phrygana (or garrigue), a light, open, shrub plant community of 0.5–1 meter in height that covers many dry, sunburnt, eroded slopes with thin soil. Phrygana tends to look patchy, because many of its plants are cushionlike, and some parts of the community are dominated by only a single species of plant.

A flight to the cities and economic oscillations have forced most landowners to emphasize low-labor monocultures, mainly olives. The invention of deep plows, bulldozers, rototillers, and herbicides in this century was accompanied by a massive destruction of soils and shrubs. Today, in many areas, no low vegetation exists between the olive trees. Almost everywhere on the soft marl bedrock, soils have already been destroyed to the point that it is hard to find remains of them. Most farmers are simply plowing bedrock! For them, however, this is no cause for alarm, since the silty marl has very good physical properties for agriculture, and what it may lack in terms of minerals and organic compounds can be added with modern chemical fertilizers.

Widespread erosion has far more serious consequences for archaeologists, however, because artifacts contained in the soil are washed away, too. Hence, the loss of soil has, in many instances, destroyed archaeological strata. How much of the surface has been destroyed in recent years can often be measured at the bottoms of olive trees, where it is clear that in some instances the roots have been exposed to a depth of 1 meter.

Although calculating the total amount of natural and human-induced erosion that has occurred since prehistoric times is difficult, there are a number of ways to derive estimates. As a general rule, geologists hold that 1 meter of uplift in one thousand years should be equivalent to 1 meter of erosion in one thousand years—for internal mountain-building and external destructive processes on earth are roughly in balance. For western Messenia, we can be more specific if we examine the state of preservation of rock-cut chamber tombs, one of the most typical forms of burial employed by the Mycenaeans at the time of the Palace of Nestor.

Although the size and shape of these tombs vary considerably, in the Pylos area they tend to consist of a chamber that is 2.5–4.5 meters deep, with a doorway (or *stomion*) and an entrance passageway (*dromos*) that are together 4–9 meters long. Of those examined by PRAP in detail, only the rear wall and less than 1 meter of the chamber of several such tombs located on the Englianos Ridge itself were still preserved. In other words, it is obvious that since the later second millennium B.C., a few vertical meters of soil and bedrock have been removed from the surface of the slopes of the ridge in these locations (Fig. 14).

More evidence for very recent environmental destruction exists in the form of conspicuous, well-defined knolls, consisting of undisturbed marl bedrock, usually 3 to 5 meters high and several meters wide. Their surfaces are level and overgrown by grass and bushes, whereas their sides are usually vertical. Some of the mounds bear trigonometric markers, some ancient graves, some both. Apparently these mounds represent leftover bedrock prominences that have been spared from plowing and bulldozing. Their tops are remnants of the former surface, which used to extend laterally before the surrounding area was lowered by excessive plowing. The date of the destruction most likely falls between the erection of the trigonometric stations and the planting of the olive trees on the lowered surface around them—in most cases, in the last thirty years. In two instances, these "leftovers" suffered even more destruction shortly after we had investigated them (see Chapter 10).

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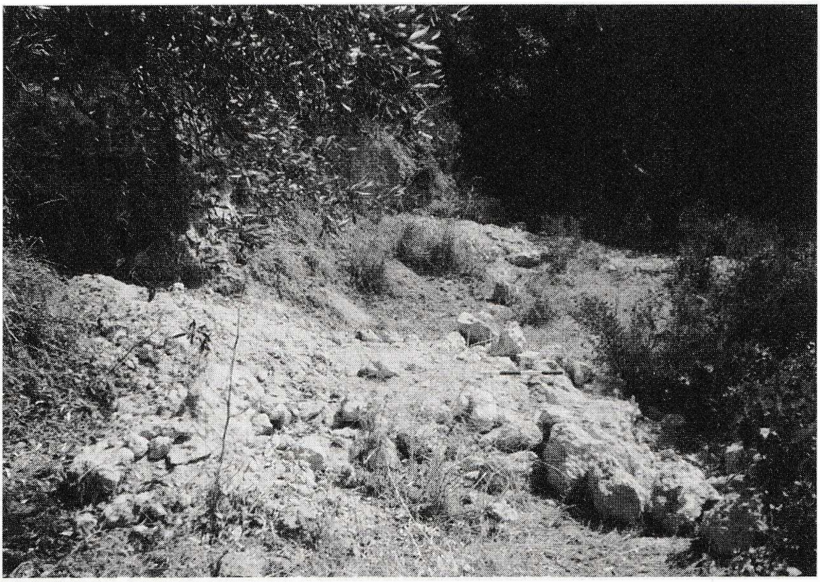

FIGURE 14
Destroyed chamber tombs on the Englianos Ridge. PRAP Archive. J. Bennet.

At the end of this journey through the last few thousand years of environmental evolution in southwestern Messenia, we return to our starting point: the present landscape around the Palace of Nestor. Those factors which characterize today's landscape—high rates of tectonic movement, erosion compensating for uplift, and intensive human land use—have also determined the landscape in prehistoric and historic times. Messenia was always blessed with fertile soil and relatively abundant fresh water. Geopolitically speaking, however, it has almost always lain far away from the pacemaking centers of culture. We shall explore the effects of this isolation in subsequent chapters.

FOCUS

The PHYSICAL SCIENTIST'S ROLE *in* REGIONAL ARCHAEOLOGY

Reconstructing the history of the Pylos region—or of any other landscape—means determining a sequence of events, like the scenes in a motion picture, showing when and for what reason landscape changes occurred. In environmental reconstructions—much as in screenplays—important moments are emphasized and presented in detail, whereas periods when little or nothing happened are simply omitted. The organization of the physical scientific work on an archaeological field project is also somewhat similar to that needed to shoot a film. In both instances, a team effort, involving experts from many different fields, is required. While some people are dedicated to solving special problems, others concentrate on the ultimate results of the combined efforts.

The movie director, however, has a script that contains the story, scene by scene, leading up to the film's climax, whereas the director of the physical scientific work on an archaeological project only has the last scene of events from which his teams will have to work backward, collecting clues during fieldwork to determine which processes were responsible for environmental changes. This last scene is simply the present landscape—the product of a long evolution, yet a momentary frame in the eternal evolution of the earth. To decide which methods are needed to reconstruct the landscape and who might be the right people to employ these methods, it is important to start with a careful interpretation of the present landscape. Hence, conducting a reconnaissance is as indispensable for an environmental reconstruction as reading the script is for the production of a movie.

In 1991, during a first visit to our study area, we established four main areas in which intensive physical scientific work was required. First, the modern floodplains had to be investigated to determine how much sediment had accumulated in recent times and how deeply some archaeological sites might have been buried under the surface. Second, at places

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where architectural structures were likely to be hidden under the surface, we wanted to conduct a geophysical reconnaissance to trace these constructions without excavation. Third, the vegetation history of the past several thousand years had to be determined to find out about the extent and character of ancient land use. Finally, the soils had to be studied to establish their state of preservation and the past and present agricultural potential of the landscape.

We invited a total of twenty-seven scientists and graduate students for the physical scientific fieldwork on PRAP, and many more experts conducted laboratory analysis on material collected in the field. The idea was to stimulate new ideas for landscape reconstruction in Greece by bringing in scientists who had worked outside the Aegean. Specialists came from many disciplines, including geoarchaeology, geomorphology, geophysics, geochemistry, soil science, palynology, geochronology, micropalaeontology, and hydroengineering. They came from eight different universities and research institutes in the United States, Greece, Germany, Canada, Russia, and Switzerland.

In contrast to many other archaeological projects in the Aegean, the ultimate goal of the physical scientific work on PRAP was not to produce individual contributions from the experts involved, which—again using the comparison with movie production—often appear like disconnected takes and scenes that bear little or no relation to each other. Instead, we were aiming for a complete integration of the many disciplines involved, which would lead to a comprehensive story of the evolution of the landscape, not as a substitute for, but as a complement to, highly specialized articles in scientific journals.

The first expert to join our team was Sergei Yazvenko from the Department of Higher Plants at Lomonosov University in Moscow. Yazvenko had written a dissertation about the Holocene vegetational history of the Black Sea's coastal region and received a grant shortly after the commencement of PRAP that permitted him to move to Canada, where he now lives. Yazvenko's botanical research for PRAP led to one of the most detailed, complete, and accurately dated vegetation histories of southern Greece. The methods he employed are the subject of a separate focus in this chapter.

To locate buried architectural structures, we invited a group of geophysicists from the Polytechnical University of Braunschweig in Germany. Guided by Falko Kuhnke, this team had already mapped an entire Roman settlement in southern France without moving any soil. Geophysical mapping rests on measuring minute variations in the earth's magnetic field, which are often caused by accumulations in the soil of natural building ma-

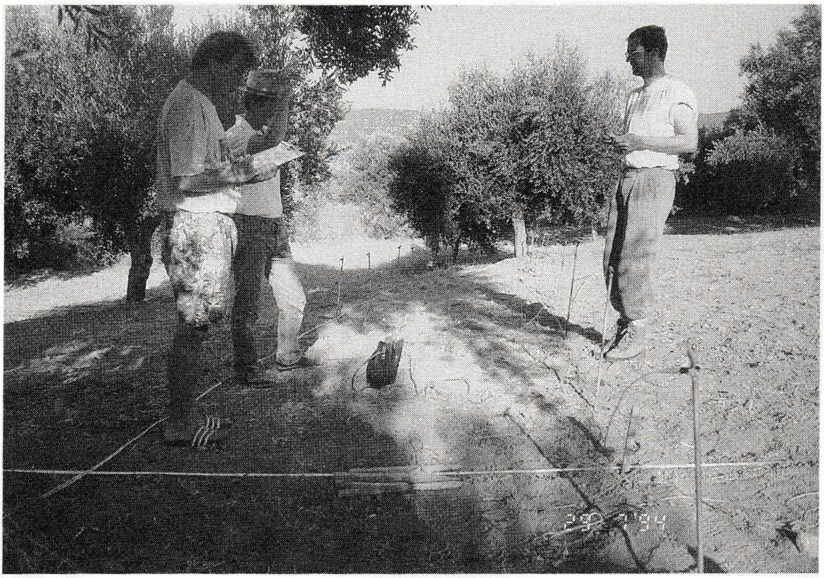

FIGURE 15
Geophysicists measuring subsurface anomalies at the Palace of Nestor. PRAP Archive.

terials such as stones or mudbrick. A second, equally useful technique measures the electric resistivity of the soil between two probes. Many thousand such measurements, at 1-meter intervals, produce a map that provides important clues about the size and extent of subsurface structures. These geophysicists systematically investigated a substantial area adjacent to the Palace of Nestor (Fig. 15), as well as three other sites (Bouka, Dialiskari, and Ordines; see Chapter 5 for the palace area, Chapter 7 for the other sites).

The next expert to join our team was Michael Timpson, from Northern Arizona University. For several years Timpson had worked as a soil scientist on American archaeological projects in eastern Crete. His role on the Pylos project was to determine how much of the prehistoric surface has been preserved until the present day and how much has been destroyed by erosion. Soils form in the uppermost epidermis of the earth through the movement of water, ions, and clay combined with the activities of plants and microfauna. The maturity of a soil mainly depends on the climate, the duration of exposure at the surface, and the type of vegetation that covers it. In Greece, at least one to two thousand years of landscape stability are necessary to generate a distinct soil with several different horizons. Timpson found that because of high rates of erosion, such undisturbed soils are extremely rare in the center of the study region. He was also able to distinguish between areas that now contain few archaeological sites due to soil erosion and areas that were never densely inhabited.

During the final season, we invited a few well-known authorities to examine specific problems that had arisen in the course of fieldwork. Jost Knauss, from the Polytechnical University in Munich, a specialist in Late Bronze Age water management, investigated the hydrological parameters of a basin near the town of Romanou, west of Pylos, and arrived at the conclusion that it was probably, at least in part, not natural (see Chapter 3). He also examined the Selas stream, which changed its bed not too long ago and now passes through the artificial basin. Günther Wagner, from the Max Planck Institute of Nuclear Physics in Heidelberg, and his colleague Yiannis Bassiakos, from the Demokritos Institute in Athens, were asked to help us date the first two Palaeolithic sites in Messenia—both of which were discovered by PRAP. Using a technique called thermoluminescence dating, they were able to determine when the sediments surrounding the stone tools were last exposed to sunlight, which in turn has provided a date for the deposition of both sediment and tools.

During the final season of the project in 1995, the physical scientists present in the field at times outnumbered the archaeologists—perhaps hinting at the increased significance of the role of physical sciences in archaeological research in Greece.

FOCUS

The PORT *of* NESTOR

During the course of PRAP's explorations, some of the natural scientific research evolved into a clue-gathering investigation reminiscent of a whodunit detective novel. It all began with an earlier study of the landscape evolution of western Messenia. Almost twenty years ago, our colleagues John Kraft from the University of Delaware and George Rapp and Stanley Aschenbrenner from the University of Minnesota realized that the bed of the Selas River, which passes along the western side of the palace, appears to have been diverted by human interference. A few thousand years ago, the river exited into the Bay of Navarino, but it has since abandoned this old bed and now takes a right-angle turn to the west, thereby avoiding its former floodplain and exiting into the Ionian Sea.

Kraft and his colleagues assumed that this diversion was constructed artificially to prevent the fertile floodplain at the northern end of Osmanaga Lagoon from drowning during annual river floods. They also argued that the most likely period during which this kind of human interference with the hydrological environment might have occurred would have been the Late Bronze Age, because several Mycenaean engineering feats of a comparable character are already known. Among these is a similar river diversion at Tiryns that is still functioning today, over 3,000 years after it was constructed.

These arguments, however, remained on the level of a hypothesis meant to stimulate further research. The close examination of the Selas River consequently became a focal point of the physical scientific work on PRAP—one that kept us busy for five years, until we finally found what appears to be a simple explanation for a complicated system.

During the first season of fieldwork, while trying to collect clues about the peculiar course of the Selas River, I noticed that the stream passes through an alluvial plain of unnatural rectangular shape just a few hundred meters before it exits into the Ionian Sea north of the village of Romanou

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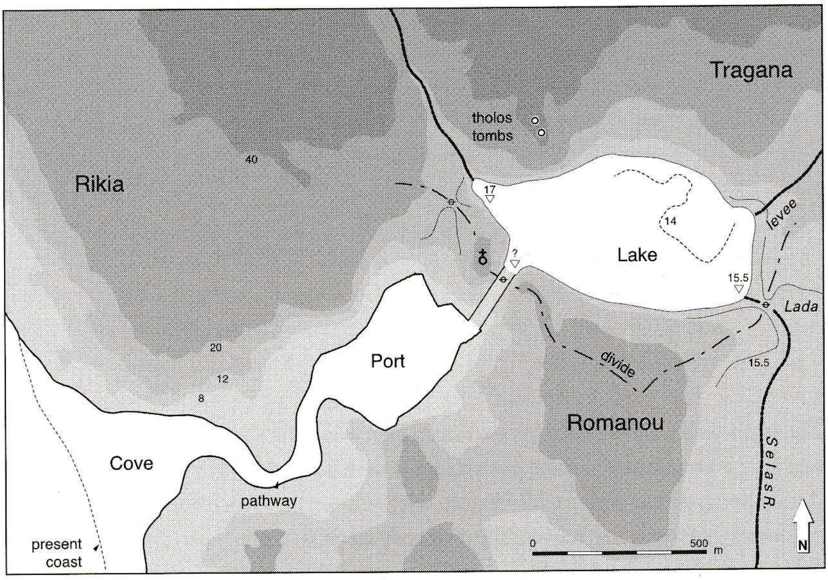

FIGURE 37

Reconstructed prehistoric topography of the area of the Mycenaean port. PRAP Archive. E. Zangger.

(Fig. 37). This rectangular floodplain looks like it might have been a water-filled pool that later became silted up. If this is correct, the remarkably straight boundaries of the floodplain, which measures about 230 by 320 meters, and its location in a dune environment, where natural lakes are unlikely to occur, would have argued in favor of a man-made basin. The only conceivable function of an artificial basin so close to the sea would, of course, be that it served as a protected port. Thus, early on, the working hypothesis was formulated that the rectangular floodplain near Romanou might represent a silted-up port for the Late Bronze Age kingdom.

Determining whether there was once water in the basin is relatively easy—at least in theory. One has to investigate the subsurface deposits to see whether there are sediment layers in the stratigraphy that only form underwater. During the second season of fieldwork, we therefore attempted to take a sequence of cores across the plain using a hand drill or auger. Soon it turned out that theory and practice can be quite different matters. All of our cores terminated at shallow depths in a thick layer of impenetrable gravel. At this stage, we were ready to drop the initial hypothesis and abort the investigation of the basin, but after much encouragement from our archaeological colleagues, who had even secured some extra funding, we returned the following year with a rotary drill truck hired from a local well-driller.

Using this device, we were finally able to reach deeper, despite the continuous threat of collapsing drill holes (Fig. 38). Under the gravel, we discovered a thick layer of clay—a deposit that does indeed only form underwater (Fig. 39). Thus, the initial hypothesis, that the floodplain might conceal a former basin that used to be filled with water, was verified. In the next step, we had to find out whether the water in the basin had been fresh or salty. Microscopic investigations of sediments extracted from the holes revealed shells of many hundreds of organisms that could only have lived in a marine environment. Hence, the water in the basin must have been well connected to the open sea.

This discovery also proved the hypothesis that the basin was—at least in part—constructed artificially, because there is no natural process that would create and keep open this kind of steeply sloping depression so close to the shore. Eventually the basin was filled in, apparently quite rapidly, by the several-meters-thick layer of gravel that had caused us so much trouble. Geologically speaking, the depositional environment changed from one extreme to another. First, the basin had only accumulated wind-blown clay; later, it became quickly filled with coarse gravel carried by the river. These gravel deposits evidently originated after the change in riverbeds. When the Selas River chose its new bed through the basin, it first filled the depression with stream gravel deposits.

Obviously, we wanted to find out when the basin was constructed, how long it was functional, and when the river changed its course, thereby destroying the basin. The well-dated cores taken from Osmanaga Lagoon—mainly to collect pollen samples—aided us in solving this problem. It turned out that the amount of fluvial material deposited in Osmanaga Lagoon dropped to a low rate around 1400 B.C., and then to an even lower level around 1200 B.C. Evidently, Mycenaean engineers did indeed interfere with the course of the Selas River, at first diverting the stream only partially. After 1200 B.C., however, when the palace administration had collapsed, the river permanently chose the shorter course to the Ionian Sea.

Why would Mycenaean engineers want to interfere with the river? This next question turned out to be the most puzzling problem of all, because the port basin and the redirection of the river appeared to us to be mutually exclusive. An artificially constructed basin near the sea that is used as a sheltered port, by itself, makes perfect sense. This kind of construction, called a *cothon* harbor, was even quite popular during the Phoenician dominion of naval trade in the Mediterranean. No engineer, however, should

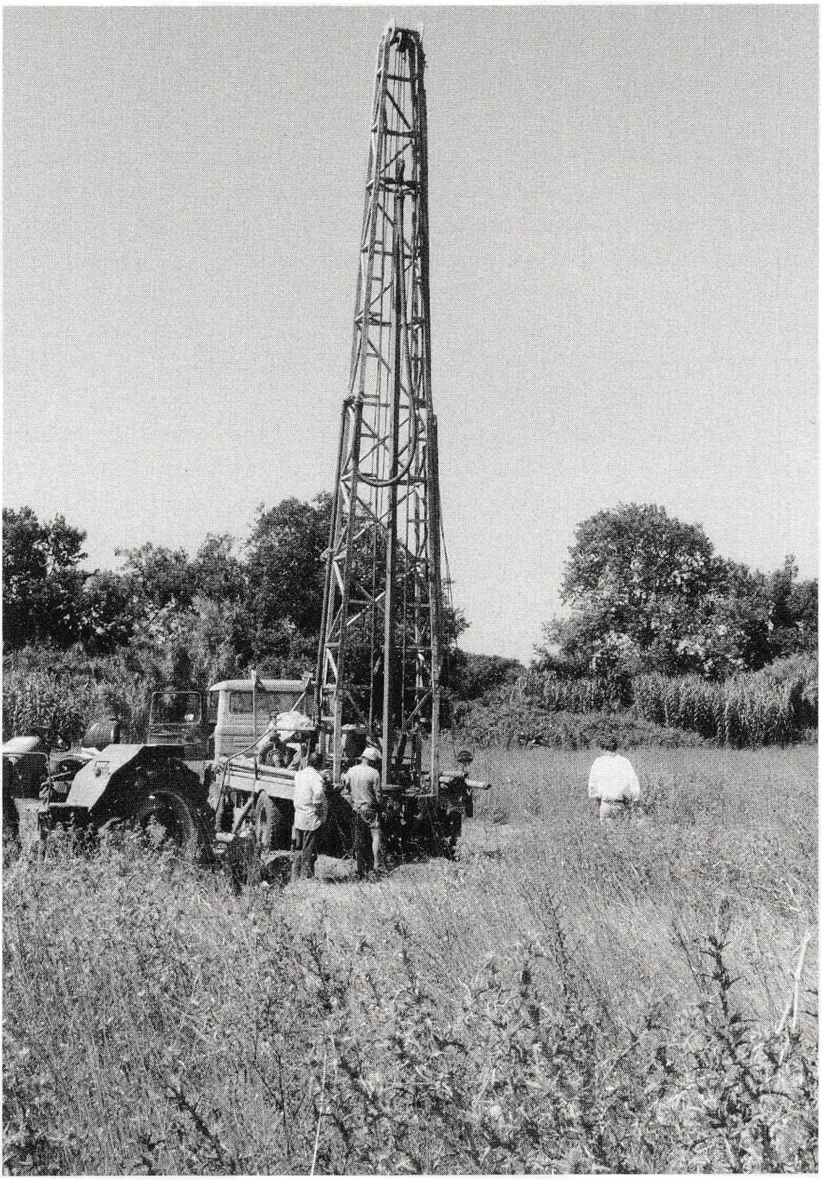

FIGURE 38
Mechanized drilling equipment at the site of the Mycenaean port. Eberhard Zangger on right. PRAP Archive. J. Bennet.

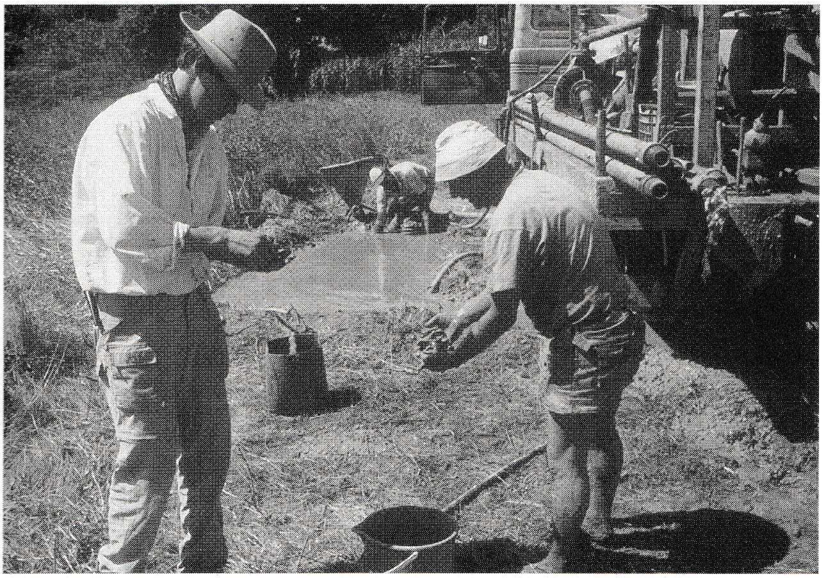

FIGURE 39
Eberhard Zangger (left) examining cores extracted by the mechanized drill. PRAP Archive. J. Bennet.

want to direct a river through such a basin, because the sediment carried by the stream, mainly during its winter floods, would fill up the basin within just a few years.

Since the basin was undoubtedly man-made, we began to doubt that the change in riverbeds was due to human interference as well. But there were many strong arguments in favor of an artificial redirection, probably the most important one being that the new course of the stream traverses the middle of a bedrock knoll. At this point we felt that advice was needed from an expert in Mycenaean hydroengineering, and we therefore invited Jost Knauss from the Polytechnical University of Munich to participate in our project. Knauss has investigated all the known hydraulic systems created by Mycenaean engineers, for instance at Gla, Tiryns, Mycenae, and in central Arcadia, and has written four books and three dozen articles about the subject.

During the fieldwork, Knauss first noticed sediments of an extensive lake that existed inland of the artificial basin. Lake and basin were separated by the knoll; but they were also connected by the narrow channel that cuts through this knoll. But this new revelation did not really explain the system behind the whole construction either. Maintaining a lake above a man-made port greatly increases the risk that the port might become filled in by sediment when the lake spills over its shores after an unusually heavy rain. With the help of the detailed observations, maps, and diagrams made by Jost Knauss—and a hint by his colleague, Daniel Vischer, from the Eigenoessische Technische Hochschule in Zurich—a plausible explanation for the whole system (and its demise) finally materialized after the end of the 1995 field season.

It all has to do with the epithet "sandy" Pylos. Today, deserted sand beaches several kilometers long stretch north of Romanou. Very likely some, or even much, of this sand used to cover the beach, even during the Late Bronze Age. Under these circumstances, it would have been virtually impossible to keep the entrance to the port basin sediment-free. The seawater that penetrated into the basin would have carried sand with it, and this sand would have soon blocked the port entrance. Thus, the whole construction of the port only made sense when it could be kept free of sediment. In order to achieve this, it had to be flushed with a small but permanent flow of clean water. As long as the basin was filled with so much sediment-free water that there was a steady stream of it flowing out to the sea, no sediment-rich marine water could get into the basin.

Hence, the stream had been diverted simply to flush the port basin. Since river water tends to contain even more sediment than seawater, however, the Mycenaean engineers had to construct a sediment trap first—and that is where the lake comes in. When the sediment-rich river water entered the lake, it lost most of its energy and therefore dropped its sediment. Then, a small current of clean water derived from the surface of the lake ran through the artificial canal into the port basin, while the remaining water left the lake through the original streambed that exited at Osmanaga Lagoon. This system obviously demanded that somebody control how much clean water was directed into the basin and how much dirty water was allowed to escape into Osmanaga Lagoon. When this control was abandoned after the Mycenaean demise, the river was left to itself and chose the shorter course through the former port basin.

This port basin at Romanou not only ranks as the first and thus far only known artificial port in prehistoric Europe, it also—for the first time—demonstrates that Mycenaean hydraulic skills were not limited to domestic drainage and irrigation systems, but also applied to naval installations. This discovery sheds a new light on seafaring and naval trade during the Late Bronze Age. Thus far, many scholars have assumed that during Mycenaean times, vessels were simply pulled ashore, probably because this is the procedure described by Homer. Now we know that we have to look carefully for traces of artificial ports—no matter how concealed they might be under several meters of gravel.

EBERHARD ZANGGER