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Sea Levels and Ancient Seafaring

The last two issues of the AINA Newsletter featured articles about work of AINA staff members away from the excavation site. These activities are a vital extension of field work, for through such efforts, data gathered in the field is studied and interpreted, as in the case of Mr. Steffy's model shop, for a better understanding of ancient technology. Dr. Borgin's research in conservation will help archaeologists better to preserve wooden hulls recovered from the sea bed.

In this issue, we continue to report on activities of AINA staff members that do not involve shipwreck excavation, but are nevertheless essential contributions to the study of nautical history and archaeology.

AINA Research Associate John A. Gifford holds degrees in geology and marine sciences. He has participated in the excavation of the Roman shipwreck at Yassi Ada, Turkey, and was a staff member of AINA's 1973 survey for new wrecks along the southern coast of Turkey. At present he is working toward a Ph.D. degree in archaeology at the University of Minnesota. In the following article, Mr. Gifford reports on the project he has undertaken for his doctoral thesis.



John Gifford takes a coring sample near the 4th century Roman shipwreck at Yassi Ada, Turkey. Sampling was done to identify sedimentary environmental changes that might have been caused by the introduction of the shipwreck into the area.

Ludwig Beckman

result from sediment deposited by rivers as they empty into the sea: the now landlocked port of Ephesus on the Meander River in western Turkey is a well-known example, as is, on a smaller scale, the Roman port of Leptis Magna on the north African coast. Again in the Mediterranean region, the rising or sinking of coastlines caused by earthquakes or volcanoes is another mechanism for local shoreline change. Roman villas around the Bay of Naples show signs of movement in both vertical directions caused by earthquakes as recent as the sixteenth century A.D. The Hellenistic-Roman port of Phalasarna on the west coast of Crete is now perched 25 feet above the sea, a casualty of the earth's crustal instability in the southern Aegean island arc.

These isolated and discontinuous shoreline changes, however, are essentially independent of the position of sea level; they can occur even if level never varies. Over the past 20 thousand years, since the end of the most recent series of world glaciations, a much more important mechanism has affected the Mediterranean and all other seas and oceans: the fluctuating but continuous rise in world sea level from 400 to 500 feet below its present position.

For about ten thousand years (18,000 to 8,000 B.C.) meltwater from continental glaciers in the northern and southern hemispheres flooded the world's continental shelves, ultimately submerging an area equivalent to the continent of Africa. This event, certainly of great, but as yet unknown importance to the evolu-

The study of anchorages, harbors, and ports, both natural and man-made, is clearly part of the history of seafaring. But few such features older than the fifth or sixth century B.C. are known from around the coasts of the relatively well-surveyed Mediterranean. This stems not

only from the fact that earlier harbors were presumably simple anchorages—gently sloping sandy beaches with no offshore obstructions, naturally protected from prevailing winds and waves—but also because the older the site, the more likely it is that major changes have occurred in the position of the shoreline.

Local but drastic shoreline changes can

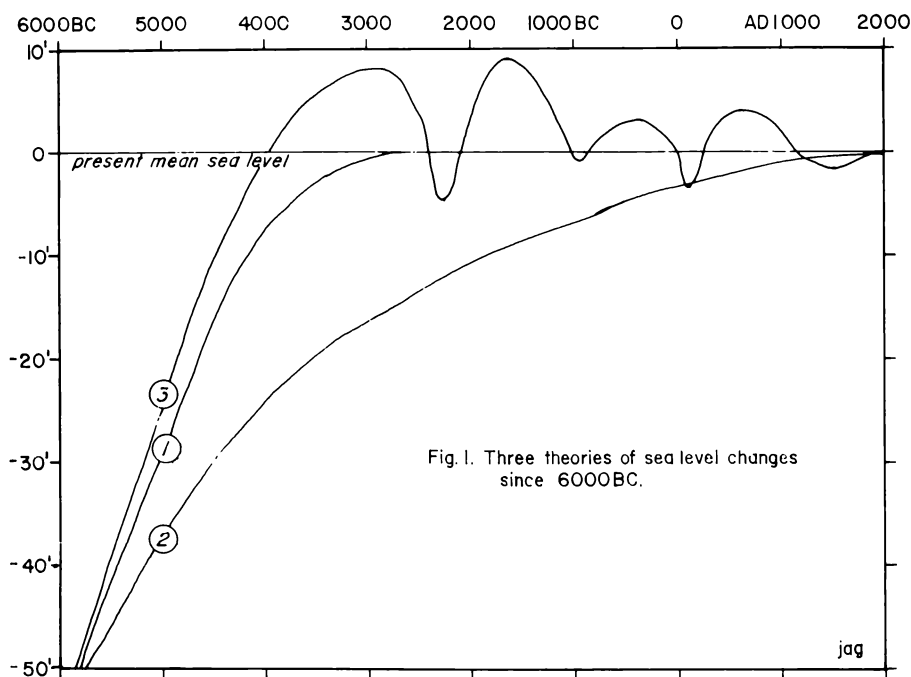


Fig. 1. Three theories of sea level changes since 6000 B.C.

tion of upper Paleolithic and Mesolithic cultures, is broadly known as the Flandrian Transgression.

Marine sediments deposited during this period of flooding have been sampled in drillholes on coastlines all over the world. Of those samples rich in organic material, many have been dated by radiocarbon analysis, thus giving an absolute time for the death and burial of the plants or animals furnishing the carbon. When the ages of these samples are plotted against their depth below present sea level, as measured during drilling, the resulting curve graphically illustrates the post-glacial rise of world sea level. However, all the dated samples plotted on a single graph do not produce a single sea level curve (Figure 1).

Among the dozen or so published sea level curves, there is general agreement on the course of sea level rise from about 18,000 to 5,000 B.C. In archaeological terms the curves all indicate, for example, that the Neolithic villagers of Jericho in the early eighth millennium B.C. would have looked out over a Mediterranean Sea almost 100 feet lower than at present, but rising very rapidly—about 20 feet every thousand years.

As we move forward in time toward the present, both the accuracy and precision of such sea level curves must improve if they are to be of real archaeological value. It is helpful to know that sea level was somewhere between 90 and 110 feet lower in the Neolithic, but it

becomes critical to know if the sea stood at 9 feet rather than 6 feet below its present level in 3,000 B.C., if one is looking for a shipwreck of that period around a reef presently at a depth of 10 feet. Similarly, on a level, sandy coastline a difference of only a few feet in an estimate of sea level position might steer the search for a harbor hundreds of feet in the wrong direction. Obviously, archaeologists need more detail in sea level curves from about 5,000 B.C. onward than do geologists. But it is at about this time that theories and therefore curves, of the course of sea level rise begin to diverge.

There are presently three schools of thought on where world sea level has been since 5,000 B.C. In Figure 1, the curve labeled (1) suggests that by approximately 3,000 B.C. sea level had reached its present position, and has remained there. Curve (2) reflects a decrease in the rate of sea level rise after 3,000 B.C., but assumes that its present position was only reached within the last 500 years or so. This is the most widely accepted theory among geologists.

Curve (3) shows a totally different interpretation of world sea level changes in the past few thousand years. Proponents of this theory, who have incorporated into their curve much archaeological data from coastal shell middens all over the world, believe that sea level has fluctuated both above and below its present position; they believe as recently

as A.D. 7-800 it was four feet higher than at present, dropping to about three feet below the present level around A.D. 1400.

It may seem strange that the absolute position of sea level is disputed for periods as recent as Medieval times, given all the contemporaneous written records and excavated sites, but this is the case. The idea of absolute or mean sea level is taken for granted by nearly all of us; it has been accurately enough determined to serve presently as a universal datum for most of the world's maps, charts, and engineering and construction projects. But in fact, mean sea level is nothing more nor less than a collection of continuous records of tide heights at many localities, each record being referred to a fixed and stable datum point. From these records are subtracted the various tidal and other oceanographic and meteorological contributing factors in order to arrive at a "mean" sea level. Since the earliest continuous record of tidal observations begins only at the end of the 17th century in the Netherlands, all conclusions about where mean sea level stood before then are really theories deduced from a number of scientific disciplines.

Some of these studies are directly relevant to the history of seafaring. A statistical investigation of the present position of all known ancient harbor works in the western Mediterranean by the British geologist N.C. Flemming has led him to conclude that mean sea level has not varied by more than one or two feet either up or down over the past 2,000 years. This is an important study, with a valuable main conclusion, but the approach is necessarily limited to those areas and periods of identifiable and datable coastal structures. Thus it cannot be applied as successfully to the Bronze Age and earlier periods.

An alternate approach to studying sea level changes over the past few thousand years assumes first that such changes are recorded in some detail in characteristics of marine sediments themselves. This seems to be true, since modern marine sediments faithfully reflect the particular type of environment where they were deposited—whether a tidal channel, mud flat, ocean beach or whatever. The second assumption is that the best place to drill for these sediments would be in a small bay or lagoon (1) that was unaffected by major river deposition or earthquake

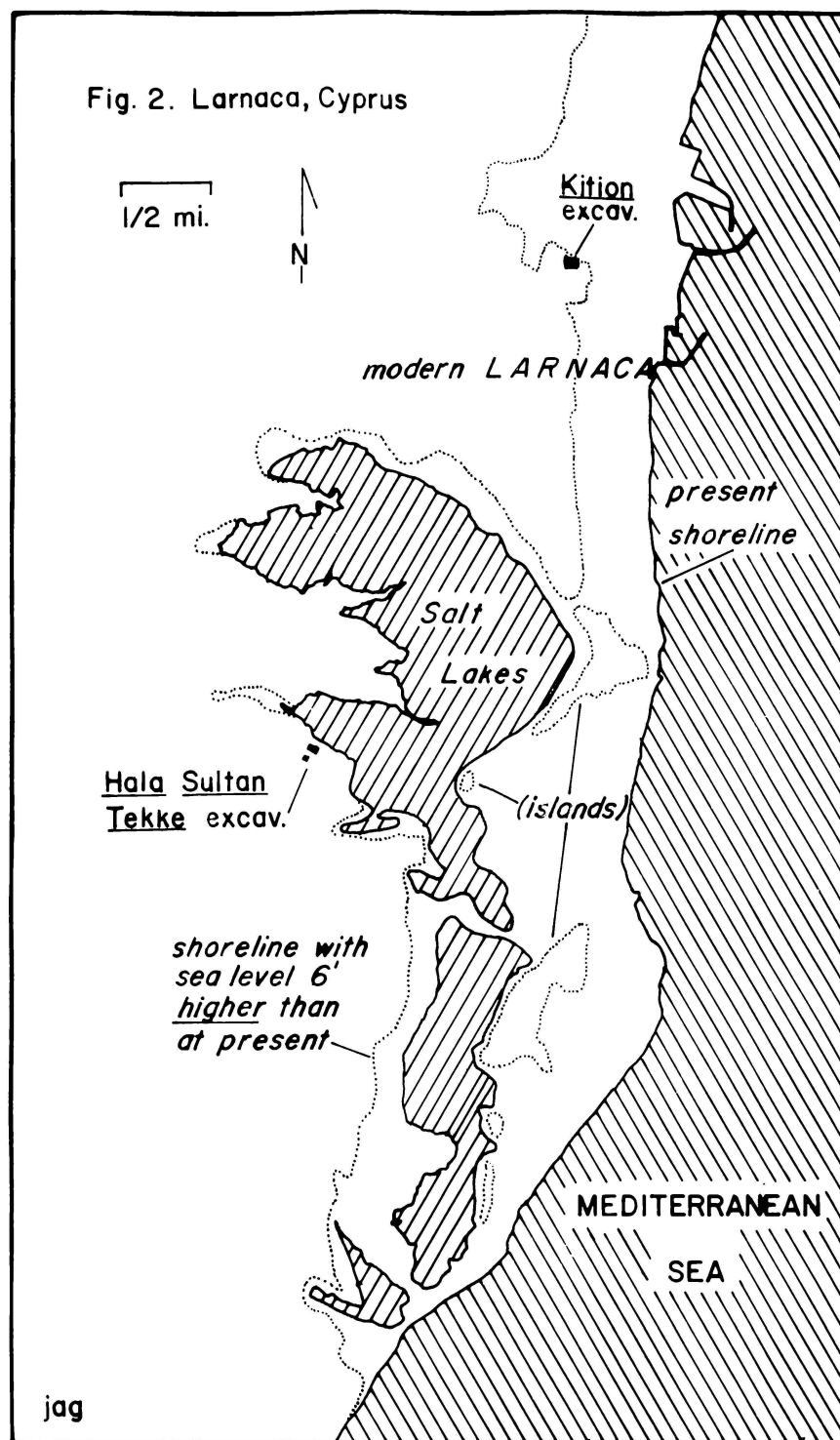
activity, which would confuse the sedimentary record; (2) that had begun to fill with sediments only since the end of the last ice age, so that the complete record of sediment layers could be sampled by shallow drilling; and (3) that there exist some early archaeological sites in the vicinity of, though not necessarily on, the shoreline; the archaeological information could provide an independent check on the environmental conclusions derived from the sedimentological study of sea level changes.

All these criteria are met by the area around Larnaca, on the southeast coast of Cyprus (see Figure 2). The Salt Lakes southwest of the town are a chain of shallow basins separated from the Mediterranean Sea by beaches and dune fields that narrow to less than 100 yards at the south end of the chain. The 20- to 30-foot thickness of sediments that fills the basin of the Salt Lakes has come mainly from wind-blown topsoil and local runoff of winter rains from the surrounding low hills; presently there are no rivers or streams emptying into the lakes. Earthquakes and associated rising or sinking of the shore seem not to have affected this section of Cyprus as much as the north and east coasts of the island.

But the most important advantage of the Larnaca area for a study of sea level changes is the great number of archaeological remains in the vicinity, including two major towns of the Late Cypriot Bronze Age (1600-1050 B.C.), both currently under excavation (see Figure 2).

The earlier of these two town sites, called Hala Sultan Tekke after a nearby Moslem shrine, faces eastward over the flat expanse of the northern Salt Lake. The site has revealed much evidence of the smelting of copper, an export commodity for which Cyprus was renowned in the Bronze Age. From these and other facts, archaeologists have theorized that in the Bronze Age the Salt Lakes were an arm or bay of the Mediterranean, and Hala Sultan Tekke was a port town located on the shore of an excellent natural harbor. A hypothetical reconstruction of this coastline is shown in Figure 2.

This theory may be expanded to include further archaeological evidence: the Late Bronze Age town of Kition (Chittim of the Old Testament), located about three miles northeast of Hala Sultan



Tekke in the middle of modern Larnaca, seems to have grown in size and importance just when Hala Sultan Tekke suffered a decline and abandonment. Could this have been caused by a drop in sea level, rendering Hala Sultan Tekke's natural harbor unusable, and causing a relocation of population at the coastal (at that time) site of Kition? An ongoing

interdisciplinary study of this area, in cooperation with the Department of Antiquity and the Geological Survey Department of the Republic of Cyprus, should produce a conclusive answer to these intriguing questions, plus some clues as to where sea level really was when men began to sail on it.

— John Gifford

AINA Moves to Texas

AINA has moved its headquarters to College Station, Texas, and has affiliated with Texas A&M University as an independent research institute. Texas A&M University, through its Geography Department, now offers a unique degree of Master of Science with a specialization in nautical archaeology.

More than a year of negotiations has led to an agreement whereby AINA and the new program at Texas A&M will have separate offices in an off-campus building devoted to nautical archaeology. Three AINA staff members join the faculty of Texas A&M in an arrangement which gives them time free from teaching to devote to research funded by AINA; future AINA research projects may be independent of the university, or jointly conducted with it, as circumstances dictate. The affiliation, first suggested by AINA adjunct Professor Carl J. Clausen, is of obvious benefit to both institutions.

At Texas A&M University, Dr. George F. Bass and Dr. Frederick H. van Doorninck, Jr., in alternate years, offer a seminar on the history of ancient seafaring; Mr. J. Richard Steffy gives a course on the theory and history of wooden hull construction, and a laboratory course in which students can receive practical experience in lofting, building, and testing models, and participating in the full-scale reconstruction of parts of ancient vessels excavated by

the staff; and Dr. Edwin Doran offers a course on the cultural history of watercraft, covering both Western and Far Eastern traditions. Dr. Doran becomes, at the same time, an Adjunct Professor of AINA.

Courses of study are tailored to suit the specialized aims of students: those wishing to work mostly in the New World, for example, may take courses offered by the History Department in Colonial and Revolutionary War history, or in early Spanish trade and colonization in the New World; those wishing to work mostly in the Old World, however, might better take courses in ancient history and art history. The Department of Sociology and Anthropology offers a wide range of courses in anthropology and archaeology.

A course in diving physiology and chamber operations can be taken in the Department of Biology, and the Department of Physical Education offers both basic and advanced diver training.

Knowledge of one modern language is required for the degree, and German, French, Spanish and other languages may be studied in the Department of Modern Languages.

Some students may be able to take a course in archaeological conservation given at the University of Texas at Austin, where a specialized laboratory treats artifacts and hull remains from shipwrecks.

It is anticipated that most students

will continue their studies toward a Ph.D. in Anthropology, Classical Archaeology, Classics, American History or some other related field, either at Texas A&M University, where possible, or elsewhere. In special cases, more advanced degrees might be pursued at Texas A&M University with nautical archaeology as a part of the program of study; for example, a student might be able to work toward a Ph.D. in American History with a certain amount of work concentrated on American naval history and nautical archaeology.

Selected students from both Texas A&M University and AINA's Supporting Institutes will have opportunities to participate in field projects conducted by both AINA and Texas A&M staff members; AINA is now active in field research on four continents.

Two representatives of Texas A&M University have recently been elected to AINA's Board of Directors, and the Texas A&M Research Foundation, also independent of the university, will manage much of AINA's business affairs. The move, however, causes AINA to lose the valuable services of Philadelphians Cynthia J. Eiseman, Executive Director, and James Eiseman, Jr., Counsel; Mrs. Eiseman will continue to play an active role in AINA as a Research Associate and as Editor of the AINA Newsletter.

— George F. Bass



Edwin Doran, Jr., newly appointed Adjunct Professor of Nautical Culture History, teaches at Texas A&M University. His Ph.D. degree in Geography was conferred by the University of California

Edwin Doran Joins AINA

at Berkeley in 1953.

Professor Doran has taught at the University of Texas, Louisiana State University, the University of South Carolina, and was a Geographer Consultant for the Navy before taking his present post in 1960. He served four years as the Assistant Dean of College of Geosciences, then six years as Head of the Department of Geography before resuming full-time teaching and research in 1974.

For about fifteen years Professor Doran's research interest, which has resulted in more than 30 substantive papers and monographs and some two dozen

notes and reviews, has focused on the culture history of watercraft. He has pursued extensive field studies of boats in the Caribbean, particularly in the Caymans, Bahamas, and British Virgin Islands, and in the western Pacific, in Sulu, Taiwan, and the central Caroline Islands. He has sailed on all types of Pacific watercraft, from rafts to outriggers to double canoes, and in his spare time builds and sails experimental modern multihulls.

As a specialist in the watercraft of Oceania, Professor Doran adds a new dimension to the widely varied expertise of AINA's staff and adjunct professors.

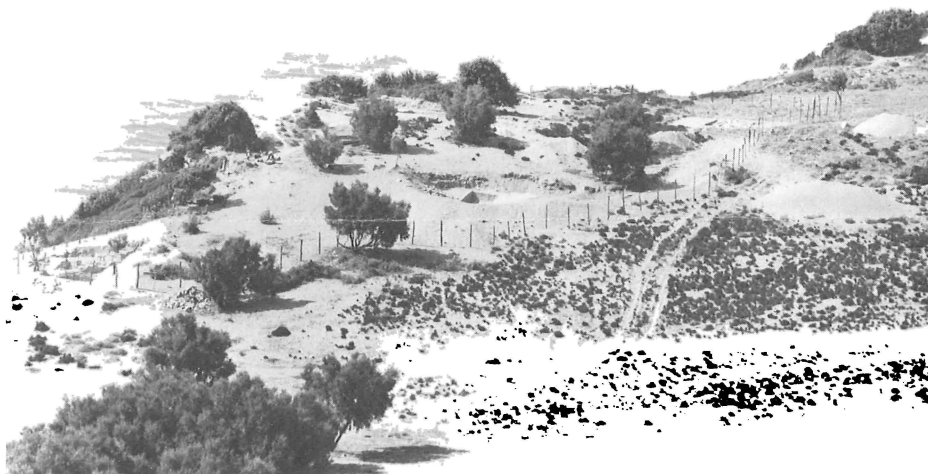
Excavations Begin at Kommos

AINA Adjunct Professor Joseph W. Shaw reports that, after years of negotiations, excavations at the site of Kommos, Crete, began in July of 1976. The work was conducted under the auspices of the American School of Classical Studies in Athens, through arrangements with the Greek Archaeological Service. Support for the project came from the University of Toronto, the Royal Ontario Museum, the Canada Council, and SCM Corporation.

The aim of the first campaign was to investigate by means of trial-trenching the chronological range, relative size, and state of preservation of the Minoan settlement, first observed by Sir Arthur Evans.

Kommos lies along the shore of the Messara Plain, southwest of the important Minoan sites of Hagia Triadha and Phaistos. It borders a wide, picturesque strip of open, still undeveloped shoreline. Excavation was concentrated in three major areas along the edge of the high, steep slope above the wide beach; three large and four small areas were opened by trenching. Structures uncovered thus far are probably all houses, some of appreciable size.

Dr. Shaw, director of the project, feels that the work at Kommos done in 1976 indicates that the remains there are of a



prosperous, perhaps large, and certainly relatively well preserved town. It was inhabited from early in the Middle Minoan period through the Late Minoan IIIB period. The extensive habitation of the Late Minoan III A-B period at the site, unique so far among published archaeological sites in the Messara, should provide valuable comparative material reflecting the historical vicissitudes of the region. It is reasonable to expect that further study and excavation will con-

tinue to clarify the varied phases of architecture and building relationships in time and space. Excavation in the southern part of the property may also provide information about maritime activities of this seaside town, perhaps the main link between Phaistos and the sea. Imported pottery, probably from Knossos, Chania, the Cyclades and the mainland, found during the first season, already suggests that Kommos was hardly isolated from her more distant neighbors.

Devil Creek Yields Oldest Excavated Cargo

At the end of his report on Sheytan Deresi (Devil Creek) in AINA Newsletter vol. 2, no. 3, George Bass wrote that an eventual interpretation of the site, based on research, would prove as exciting as its discovery and excavation. This has now been confirmed. In AINA Reports No. 2,

to be published soon in the *International Journal of Nautical Archaeology*, he has concluded that naval disaster took place around 1600 B.C., making the cargo the oldest yet excavated in the Mediterranean—some four centuries older than that Dr. Bass had earlier excavated off

Cape Gelidonya, Turkey. The pottery shows influences from both western Anatolia and Crete, shedding new light on a period when Cretan Minoans were reaching the mainland of Asia Minor. A copy of the report will be sent to AINA members.



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The American Institute of Nautical Archaeology is a nonprofit scientific/educational organization whose purpose is to gather knowledge of man's past as left in the physical remains of his maritime activities and to disseminate this knowledge through scientific and popular publications, seminars, and lectures. The AINA Newsletter is published periodically by AINA and is distributed to its members and Supporting Institutions to inform them of AINA's current activities.

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