

# THE INA QUARTERLY



Spring 2003

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**On the cover:** Archaeology student Deniz Soyarslan raises one of four shallow bowls (*mortaria*) from the upslope section of the sixth-century BCE shipwreck site at Pabuç Burnu, Turkey. Photo: Don Frey.

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The Institute of Nautical Archaeology is a non-profit scientific and educational organization, founded by George F. Bass, Michael Katzev, and Jack Kelly and incorporated in 1972. Since 1976, INA has been affiliated with Texas A&M University, where INA faculty teach in the Nautical Archaeology Program of the Department of Anthropology. The opinions expressed in *Quarterly* articles are those of the authors, and do not necessarily reflect the views of the Institute.

The *INA Quarterly* was formerly the *INA Newsletter* (vols. 1-18).

Editor: Christine A. Powell

# Endless Summer:

## The 2002 Excavation Season at Pabuç Burnu, Turkey

Elizabeth Greene

Among the Institute of Nautical Archaeology's many research goals is the desire to excavate a shipwreck from every century of the past. The discovery of the sixth-century BCE shipwreck at Pabuç Burnu, following closely on the excavation of the Classical wreck at Tektaş Burnu (see *INA Quarterly* 26.4: 3-11; 28.2:3-8; 29.2: 12-14), brings us one step closer to accomplishing this mission.

On the final stage of INA's 2001 shipwreck survey, archaeologists used the submersible *Carolyn* to visit a scatter of amphoras at Pabuç Burnu (or Shoe Point) found by Selim Dincer and reported to INA by local diving instructor Aşkın Cambazoğlu (fig. 1). At Pabuç Burnu, about a forty-five minute sail southeast of Bodrum, the *Carolyn* crew observed a widespread distribution of amphoras, which were subsequently investigated by divers. Some of

the amphoras were partially buried; others lay openly on the seabed at a depth of approximately forty meters. Upon this initial observation, the group debated whether or not the discovery represented a coherent wreck. When team member Mutlu Gunay raised an amphora for dating and recording, he discovered an intact *oinochoe*, or wine pitcher, directly beneath, suggesting that we had found more than a scatter of jettisoned cargo. Mark Lawall, a specialist in Greek transport amphoras at the University of Manitoba, used photographs and drawings to date the Pabuç Burnu amphora to the late sixth century BCE, from the regions around Samos, Ephesus, or Miletus (fig. 2a). The *oinochoe* resembles the common plain wares of Ionian manufacture from the second half of the sixth century (fig. 2b).

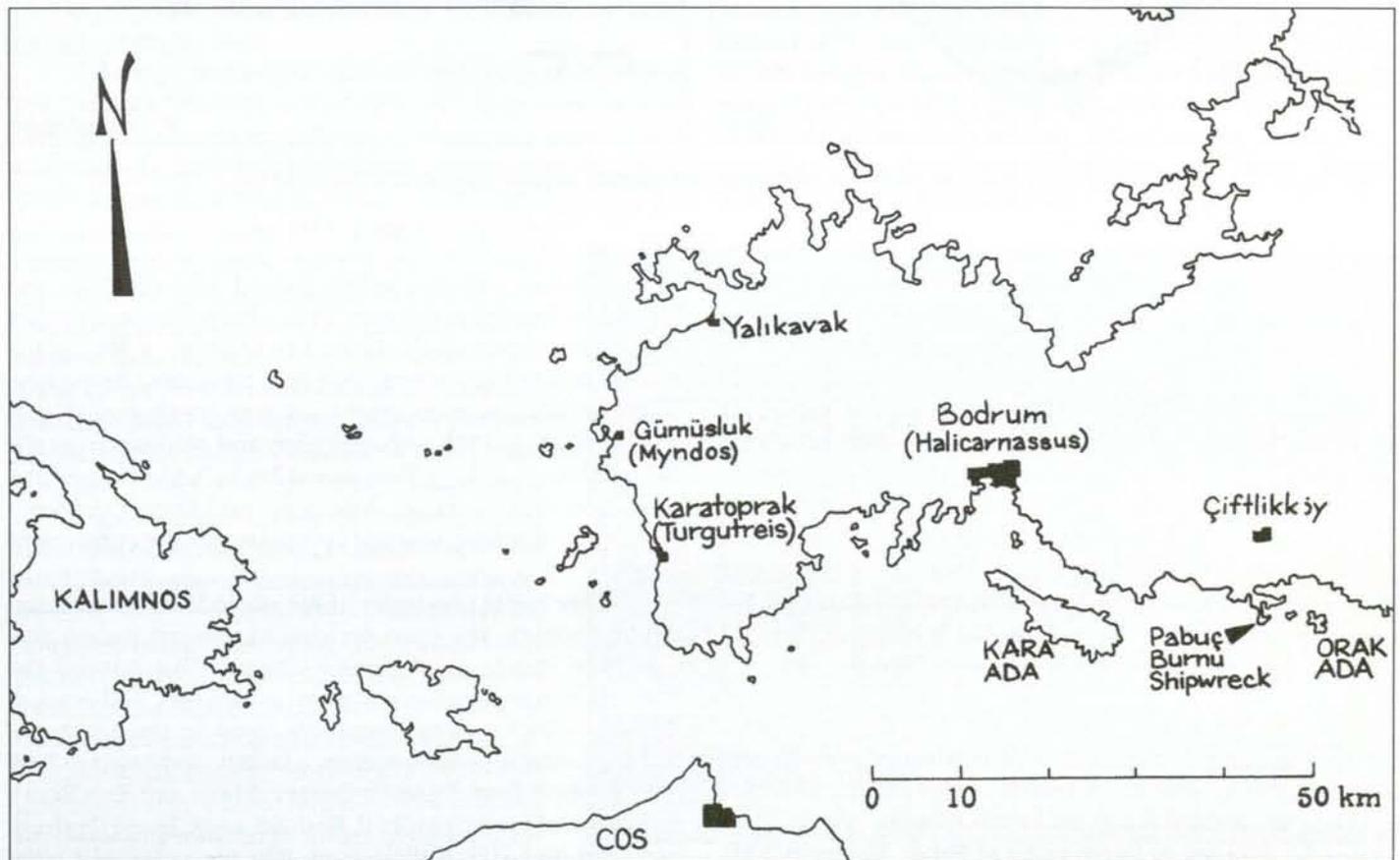


Fig. 1. The Pabuç Burnu shipwreck area.

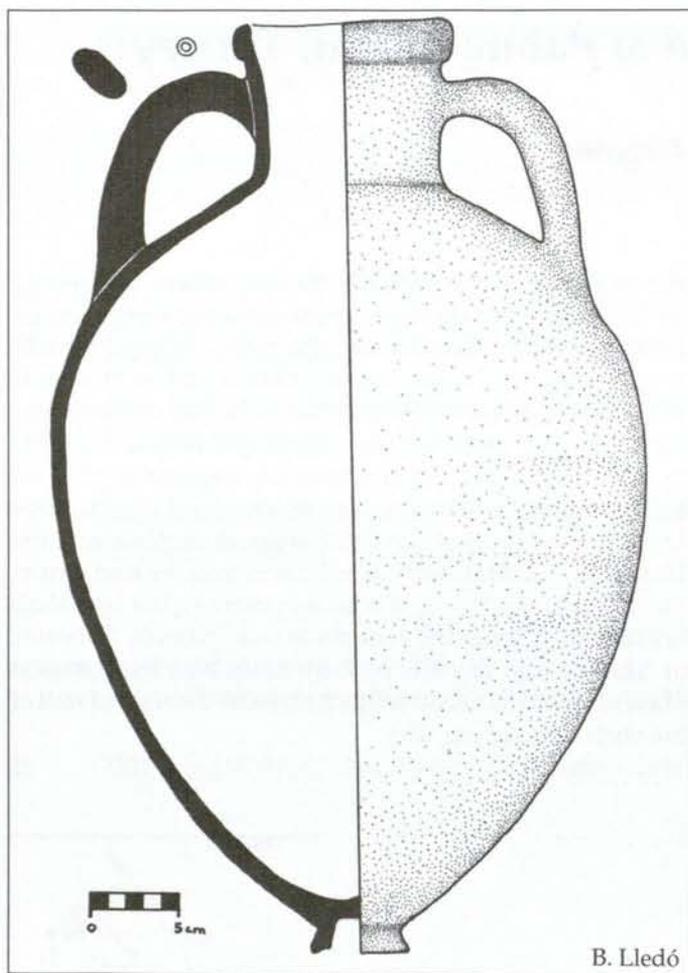


Fig. 2 a, b: An amphora (left) and an *oinochoe*, or wine pitcher (right), raised during the 2001 survey.

For the eastern Mediterranean, the late sixth century marks an important stage of development, as Greek city-states increased their fleets and fortifications for protection against the Persians and cooperated in the Ionian League. The historian Herodotus has documented the expansion of Ionian military works, while scattered references from geographers, poets, and inscriptions describe an area of flourishing trade, focused on specialized regional production. Miletus, for example, was famed for its wool, Chios for its wine, Rhodes for sponges, Knidos for herbs, and Kos for raisins. Land excavations reveal evidence for the distribution of goods throughout the Mediterranean on a large and small scale, from local and distant regions.

#### The Excavation at Pabuç Burnu

Despite the economic and cultural significance of the late Archaic period, no sixth-century shipwreck had been excavated in the eastern Mediterranean. For this reason, INA decided to begin work at Pabuç Burnu in 2002, hoping to answer questions about ship construction and

the mechanics of trade in this period. In early June, the Smothers-Bruni expedition to Pabuç Burnu began a project that continued through the end of October, marking the longest single field season INA has conducted in Turkey. The international excavation team was composed of local INA staff, along with archaeologists and students from the Nautical Archaeology Program at Texas A&M University, as well as other Turkish, American, and British universities, many of whom worked on the site for the entire campaign.

Due to the proximity of the site to INA's headquarters in Bodrum, the team decided to conduct the excavation from our research vessel *Virazon*. This housed the project's recompression chamber, computers, and excavation equipment. Team members lived in the residence building at INA's headquarters, a facility dedicated in 1999 with support from Danielle Feeney, Marja and Ron Bural, Cynthia and Fred Campbell, Barbara and Claude Duthuit, and Jean and Jack Kelley. Each day we sailed out from Bodrum to Pabuç Burnu where we established a perma-



Photo: G. F. Bass

Fig. 3. Malcolm Wiener, founder of INSTAP, prepares to visit the site in INA's submersible Carolyn.

ment mooring above the site that allowed *Virazon* to weather the prevailing northwest *meltem* winds and the occasional southerly *lodos*.

A large number of visitors, including members of the Turkish Ministry of Culture, INA directors, excavation sponsors, and local Bodrum residents, were able to visit the site and watch the excavation in progress from INA's submersible *Carolyn*, carried on *Millawanda*, which tied up alongside *Virazon*. INA Director Claude Duthuit came to work with the team for more than two weeks. Among many visitors who either dived on the site or visited it in *Carolyn* were General İhsan Beriş (ret.), of the Turkish Army Tank Corps; TINA members Sedat Akdemir, Jonathan Beard, and Sezgin Gökmen; Bodrum Harbormaster Ayhan Özdemir; Aykut Özdet, Assistant Director of the Turkish Department of Antiquities; Jeff Hakko of Vakko Clothes; Akın Ongor, former head of Garanti Bank; Selcuk Kolay, former director of the Rahmi Koç Industrial Museum; Knox Key, a director of the Smothers-Bruni Foundation; INA Adjunct Professor Nergis Günsenin of Istanbul University; former ambassador Strobe Talbot, now head of the Brookings Institute and Brooke Shearer, Executive Director of the Yale World Fellows Program; Malcolm Wiener, founder of the Institute for Aegean Prehistory, whose generosity allowed INA to acquire *Carolyn* (fig. 3); Scott Fulmer of Young Broadcasting, Inc.; INA Director

Frederick van Doorninck, Jr.; and INA Associate Director Molly Reily. Visiting celebrities included record producer Ahmet Ertegun along with pop star "Kidd Rock" and Pamela Anderson of *Baywatch* fame.

During the team's preliminary inspection of the site and the removal of the sand overburden, we identified a concentration of intact and partial amphoras approximately ten by twelve meters (fig. 4). Subsequently, these parameters were extended to an area of about fourteen by twenty-two meters. We prepared the site for excavation with the erection of thirty two-by-two meter grid squares and fourteen datum towers, used as reference points for the mapping of artifacts. Grid lines and datum points were mapped on the sea bed with tape measures. From these measurements, coordinates were generated with Site Surveyor, a computer program that produces three-dimensional coordinates for objects by trilateration.

After the establishment of fixed datum points, we obtained all artifact measurements by underwater photographs taken with a calibrated digital camera. Once downloaded, the photographs were processed with the computer program PhotoModeler Pro, which uses photogrammetry to generate three-dimensional coordinates for artifacts in relation to the datum towers. Wire frames for each artifact, which can be rendered to appear solid, were drawn with Rhinoceros, a three-dimensional modeling program (fig. 5). The digitally modeled

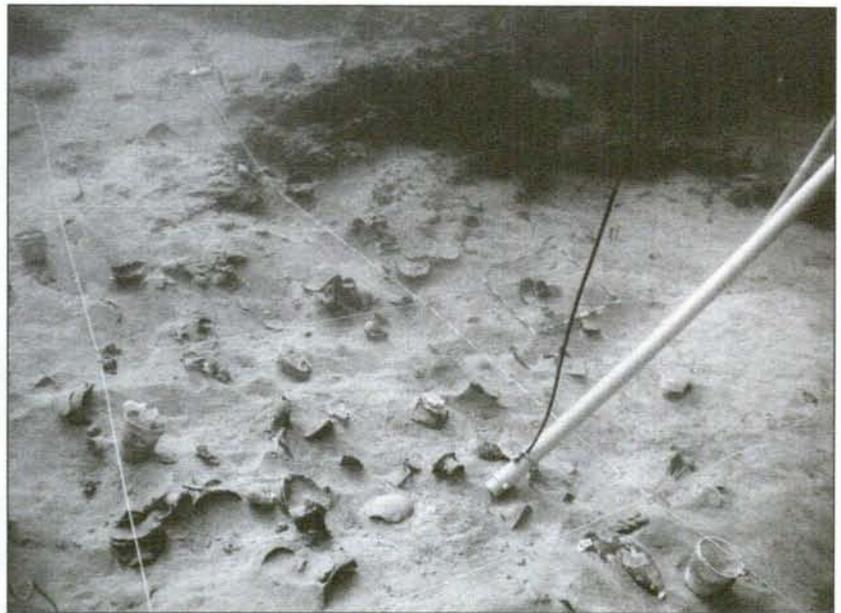


Photo: S. Matthews

Fig. 4. The site toward the beginning of the excavation season.

artifacts were then placed on a computerized plan according to their three-dimensional coordinates. This mapping system, developed by staff members Tufan Turanlı, Berta Lledó, and Sheila Matthews along with INA Research Associate Jeremy Green for the Tektaş Burnu shipwreck excavation, was further refined at Pabuç Burnu.

The combination of digital photography with PhotoModeler and Rhinoceros allowed excavation to proceed swiftly and efficiently. A single photographer can achieve all necessary information for accurate mapping of the artifacts. With this system, less than ten percent of bottom time was devoted to mapping endeavors, a significant reduction from previous underwater excavations conducted by INA, where mapping has occupied as much as forty percent. The use of technology to enhance productivity is critical for underwater excavation; at Pabuç Burnu, the site's depth of thirty-five to forty-five meters means that archaeologists were limited to two working dives daily, each twenty minutes in length.

For excavation of the site, archaeologists relied on four airlifts set up on the seabed, anchored by metal weights that could be moved as grid squares were completely excavated. Deep sand overburden was also removed from the wreck by simple "hand-fanning," in which loose sand is pushed downslope with a sweeping motion of the hand. Individual excavators sketched and recorded the grid locations of the pottery sherds



S. Matthews

Fig. 5. A Rhinoceros model of an amphora from the Pabuç Burnu site shown with wire frames on the left, rendered to appear solid on the right.

and intact artifacts they uncovered (fig. 6); diagnostic objects were then mapped in by digital photography. Once mapped, artifacts were raised from the seabed. On the surface, all objects, from the smallest pottery sherd to intact vessels, were recorded, then brought daily to the Nixon Griffis Conservation Laboratory at INA's headquarters in Bodrum where they were kept in wet storage (fig. 7).

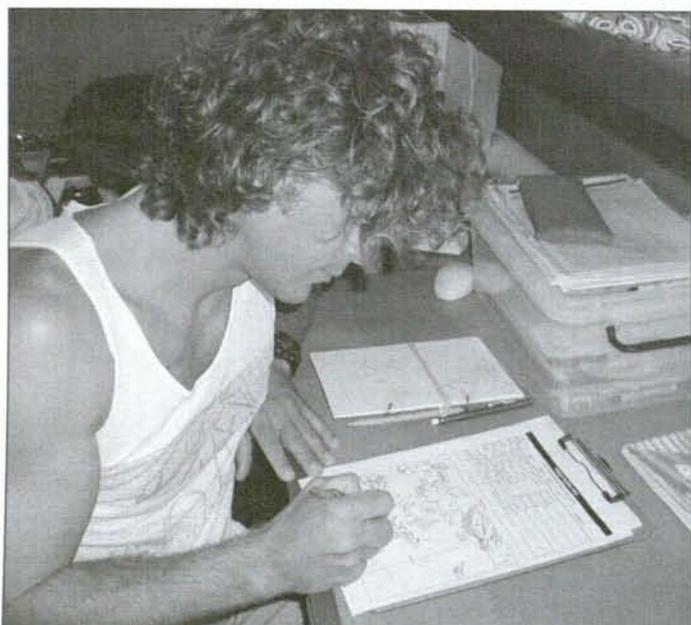


Photo: E. Greene

Fig. 6. Nautical Archaeology Program student Mark Polzer prepares a sketch of his excavation square.



Photo: E. Greene

Fig. 7. During and after the excavation, archaeologists and conservators process artifacts in the Nixon Griffis Conservation Lab.

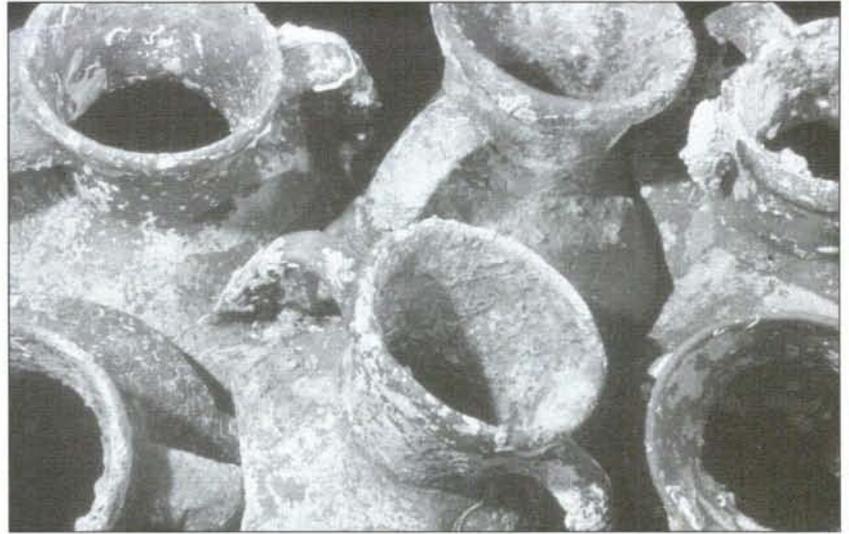


Fig. 8 (top left). INA conservator Asaf Oron raises an amphora from the seabed.

Fig. 9 (above right). Along with the twenty-eight intact amphoras, over 150 partial amphoras were raised from the site.



Fig. 10 (below left). Once raised from the seabed, amphoras were sieved on the surface by team members.

### The Artifacts

The majority of artifacts found on the Pabuç Burnu shipwreck after more than four months of excavation are twenty-eight intact amphoras of probable Samian and Milesian types or local variants and over 150 partial amphoras of similar types, including a few of probable Chian, Knidian, and Klazomenian origin (figs. 8 and 9). The contents of the intact amphoras were sieved on the surface and yielded occasional grape seeds, olive pits, and fragments of tree bark stoppers (fig. 10). A number of the amphoras and body sherds are lined with pitch, suggesting, along with the grape seeds, a primary cargo of wine. We are hopeful that the ceramic collection, which is probably the largest coherent assemblage of East Greek transport amphoras from the late sixth century, will help refine the typologies of these shapes. The diversity of forms and the lack of consistent marking systems on Samian and Milesian amphoras has led to disputed typologies, which the Pabuç Burnu collection may help resolve.

The amphoras have yielded a number of pre-firing stamps, including small "o" stamps on the top or base of the handles, and a

Photos: D. Frey



Fig. 11 (a and b). Stamps on the Pabuç Burnu amphoras include round "o" stamps and a rectangular device that may be a monogram or palmette.



Photos: D. Frey

rectangular device that may be a monogram or palmette (fig. 11a and 11b). These marks, more of which we expect to discover when the amphoras have been fully cleaned, may have served as a means of testing the hardness of the clay before firing, or may be indicative of pottery workshops, content, capacity, producer, or dealer.

While intact and broken amphoras, as well as a number of ballast stones, have been found in virtually all areas of the wreck site, the smaller finds, including four large cooking bowls or mortars (fig. 12a), three of six pitchers (fig. 12b), two smaller bowls (fig. 12c), and a few fineware sherds, some decorated with black slip, are concentrated in an upslope region of the site. This area is tentatively designated as the ship's galley. The galley wares, of local Ionian production, were likely used by members of the

ship's crew for cooking, dining, and shipboard sacrifice, rather than destined for trade.

Around the center of the wreck, excavation revealed a stone anchor stock, approximately 1.7 meters in length (fig. 13). The size of the anchor suggests a relatively large ship, perhaps as long as the twenty-two meter spread of ceramic remains we have uncovered. A cargo of merely 175 amphoras, however, seems rather scanty for a ship of such length. The Tektaş Burnu shipwreck, for example, estimated at ten meters in length or about half the size of the Pabuç Burnu vessel, carried a primary cargo of over two hundred amphoras (see *INA Quarterly* 29.2: 12–14). The relatively small quantity of amphoras on the Pabuç Burnu vessel has led excavators to speculate that the ship originally carried an additional cargo of organic material such

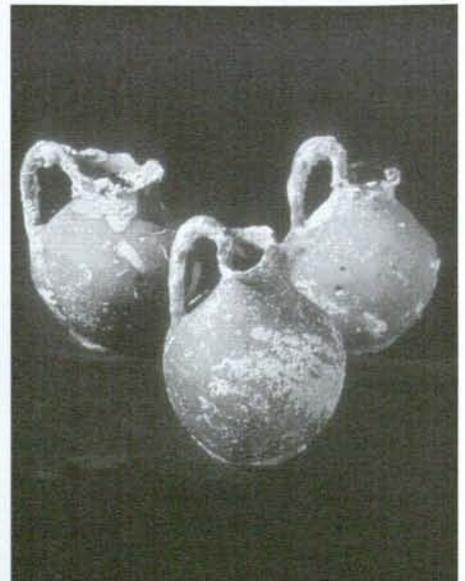


Fig. 12 a, b, c. A number of large shallow bowls or mortars, smaller bowls, and wine pitchers were found in the upslope region of the site designated as the ship's galley.

Photos: D. Frey

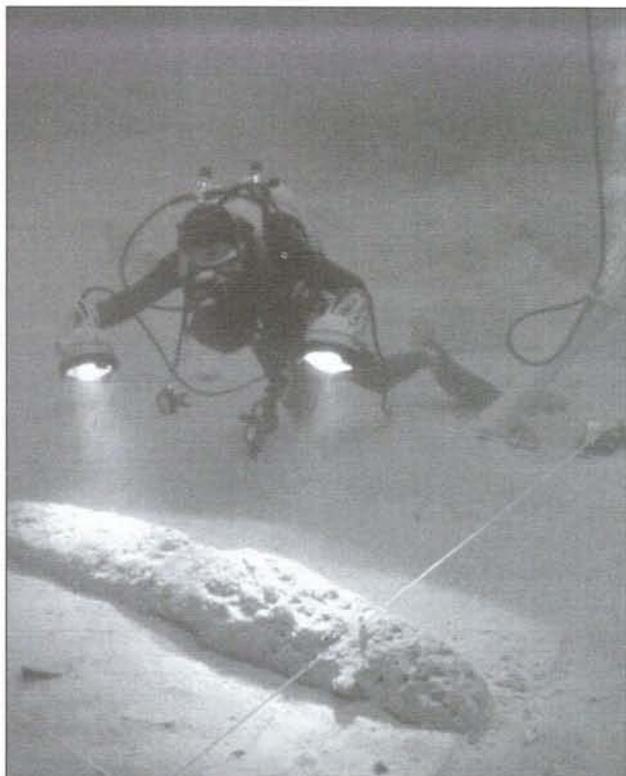


Photo: D. Frey

Fig. 13. *The stone anchor stock in situ.*



Photo: S. Matthews

Fig. 14. *Robin Piercy excavates the hull wood in the downslope area of the wreck.*

as dry goods, timber, cloth, or wool, or that the vessel was sailing only partially laden. A concentration of organic remains in the downslope area of the site, including large quantities of loose grape and olive seeds, supports the notion of an additional cargo of perishable goods. Other possible cargoes, such as the wool or cloth for which the Ionians were well known, are unlikely to have survived underwater.

While the dearth of amphoras on the wreck can be explained by the presence of an organic cargo, an alternate hypothesis may be looting; because of the site's close proximity to Bodrum with its long tradition of sponge and recreational diving, the possibility of theft cannot be ignored, although no amphoras of the Pabuç Burnu type have been noted in the houses, gardens, and public buildings of the Bodrum region. Additionally, older local fishermen suspect that some fishing with dynamite occurred around Pabuç Burnu many decades ago, which may explain the heavy concentration of broken amphoras.

### Hull Remains

With only a few weeks remaining in the excavation season, the team was excited to find wooden hull remains in the downslope area of the wreck (fig. 14). The four planks discovered, two of which measure over two meters in length and about twenty-five centimeters in width, represented a significant discovery. The planks have scattered spots of pitch on their inner surfaces, which represent either caulking or the spilled contents of a nearby amphora that aided their preservation. These planks are especially noteworthy for their construction details: on the upper and lower surfaces of the planks, triangular holes indicative of a "sewn" or laced construction technique have been recorded (fig. 15). According to this method, planks are joined longitudinally by ligatures laced through prefashioned holes. Remains of both the ligatures and the wooden pegs that locked them in place survive in the lacing holes of the Pabuç Burnu planks. Additionally, evidence for widely spaced trenails and tenons that held the planks together during the construction of the vessel can be seen on the edges of the planks.

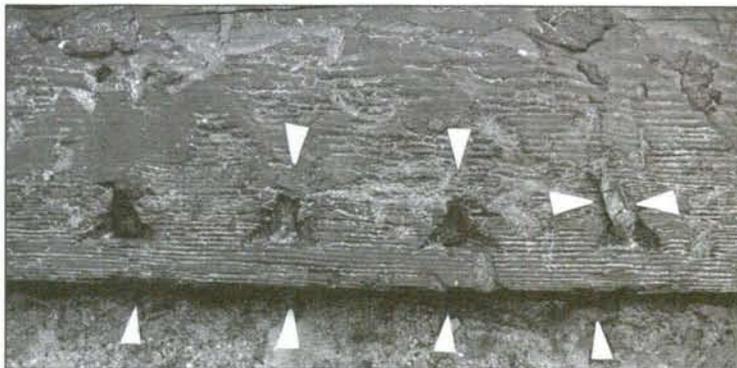


Photo: E. Greene

Fig. 15. *A detail of the wood, with lacing holes marked with white arrows.*

The exact construction details of the Pabuç Burnu wreck cannot be understood until the wooden remains have been drawn and studied by Mark Polzer, Texas A&M Nautical Archaeology Program student and the project's assistant field director (fig. 16). Evidence for a laced construction technique, however, stands in contrast to virtually all other early ships excavated in the eastern Mediterranean. The Bronze Age wrecks at Cape Gelidonya and Uluburun (see *INA Quarterly* 26.4: 16-21), as well as the fourth-century BCE Kyrenia wreck (*INA Newsletter* 13.3: 7), are built with mortise-and-tenon joints. The mortise-and-tenon technique has generally been viewed as traditional for ships in the eastern Mediterranean, while laced vessels are thought to have originated in the west. The Pabuç Burnu shipwreck, with its laced construction and cargo of southeast Aegean amphoras, seems to contradict this thesis, suggesting perhaps that laced construction was a Greek technique, while mortise-and-tenon construction may have been Phoenician in origin, adopted only later by the Ionians.

With the exception of these planks and a few small fragments of heavily deteriorated wood, no other hull fragments have yet been discovered. The bottom stratigraphy progresses from loose sand on the surface, to compact sand, to a layer of coral, shell, teredo worm casings, and *poseidonia* grass roots within which the majority of artifacts lie.

This suggests that much of the hull and perhaps some of the organic cargo was consumed by marine organisms as it lay suspended on a rock outcrop in the upslope area of the site. Only further excavation will reveal whether more of the hull remains are preserved, but we are hopeful of finding the keel and framing elements of the vessel buried in the deep sand downslope.

As the weather grew colder at the end of October, we were forced to conclude our excavation. At the end of the campaign, all inventoried artifacts were delivered to the Bodrum Museum of Underwater Archaeology for conservation. Partial amphoras and wood remains are currently being conserved in INA's Nixon Griffis laboratory. Once the conservation processes are finished, the artifacts from the Pabuç Burnu shipwreck will be displayed in the Bodrum Museum. Apart from the possible discovery of additional hull wood, all visible artifacts were removed from the site and we anticipate only a brief campaign in 2003. During this exploratory season, however, we may take the opportunity to investigate a second shipwreck, located only a few hundred meters from the Pabuç Burnu site, that we discovered with the submersible *Carolyn*. A large ceramic cooking pot raised when archaeologists investigated the site should tell us more about the origin and date of the vessel.



Photo: S. Matthews

Fig. 16. Elizabeth Greene examines construction features while Don Frey photographs minute details on the hull remains as they undergo desalination in the Nixon Griffis Conservation Laboratory at INA's Bodrum headquarters.

## Conclusions

Pending the completion of the excavation in 2003 and the continued cleaning and processing of the artifacts and organic remains, the information presented here is necessarily preliminary. Although our research has just begun, it is our expectation that the wreck will yield information about the status of both ship construction and local trade in the eastern Mediterranean during the late sixth century BCE.

The naval prowess of Ionian seafarers in the sixth century is well known. According to the historian Herodotus (3.39, 44), the Samian tyrant Polycrates based his power on his fleet of over one hundred pentekonters; by 525 BCE he had a fleet of triremes large enough to spare forty to assist Cambyses' invasion of Egypt. Indeed, Herodotus (3.122) reports that Polycrates was the first Greek ruler since Minos to aim for total dominion of the seas. Slightly later, Thucydides (1.13.2) explains that the Greeks used "modern" building techniques in the construction of their warships; this new construction method may well be the adoption of the Phoenician system of mortise-and-tenon joinery. To our current knowledge of the naval

prowess of the Ionians in warfare, INA's excavation at Pabuç Burnu should reveal exciting additions about merchant ventures, pottery manufacture and workshops, economic conditions, and the role of East Greek traders in the Archaic Mediterranean.

The Archaic poet Hesiod, whose *Works and Days* gives advice on farming, mentions sailing almost as an afterthought. Although Hesiod himself claims to have traveled by ship over the seas only once, to those men who are tempted by merchant ventures, he advises that they set out in late summer, after the harvest and before the autumn rains (663-70). Hesiod cautions, however, "Do not put all your goods in hollow ships; leave the greater part behind and put the smaller part on board; for it is a bad business to meet with disaster among the waves of the sea" (689-91). With its cargo of wine, olive oil, grapes, and organics, stored in amphoras of local types from a variety of workshops, the wreck at Pabuç Burnu may provide evidence for just such a venture: a moderate-sized merchant vessel carrying goods from a collective of farmers, which met with disaster on the seas.

**Acknowledgements:** This excavation would not have been possible without the support of the Institute of Nautical Archaeology, Texas A&M University, the National Geographic Society, the Smothers-Bruni Foundation, the Eugene McDermott Foundation, and Turkish Airlines. Yaşar Yıldız, of the Bodrum Museum of Underwater Archaeology, represented the Turkish Ministry of Culture for the entire season. Mark Polzer performed above and beyond the call of duty as Assistant Field Director. Thanks are due to all of the team members: Enver Arcaç, Claude Duthuit, Jeremy Green, Faith Hentschel, Volkan Kaya, Orkan Koyasioglu, Angie Mitchell, Selda Ozhan, Corioli Souter, Deniz Soyarslan, Mehmet Yıldız, and Evren Türkmenoğlu. Special thanks go to those stalwarts who tirelessly made it through the entirety of our "endless summer:" Hüseyin Aldemir, Project Director George Bass, Don Frey, Sheila Matthews, Asaf Oron, Robin Piercy, Feyyaz Subay, Murat Tilev, Tufan Turanlı, Yaşar Yıldız, Zafer Gül, and Bayram Kosar. The excavation team is grateful to the Bodrum Museum of Underwater Archaeology and its director Oğuz Alpözen for providing conservation and storage for the artifacts raised in 2002. My own personal thanks go to George Bass, who always knew when to offer advice and when to step back, for entrusting me with the archaeological direction of the Pabuç Burnu excavation. ☞

## Suggested Readings

Cook, R. M. and P. Dupont

1998 *East Greek Pottery*. London.

Greene, E. and G. F. Bass (forthcoming)

"Discovery and Excavation: The 2001 Submersible Survey and the 2002 Excavation at Pabuç Burnu, Turkey," *Tropis VIII: Proceedings of the 8<sup>th</sup> International Symposium on Ship Construction in Antiquity, August 2002*.

Steffy, J. R.

1994 *Wooden Ship Building and the Interpretation of Shipwrecks*. College Station, TX.

Roebuck, C.

1959 *Ionian Trade and Colonization*. New York.

# Morocco Maritime Survey: the 2002 Season

Athena Trakadas

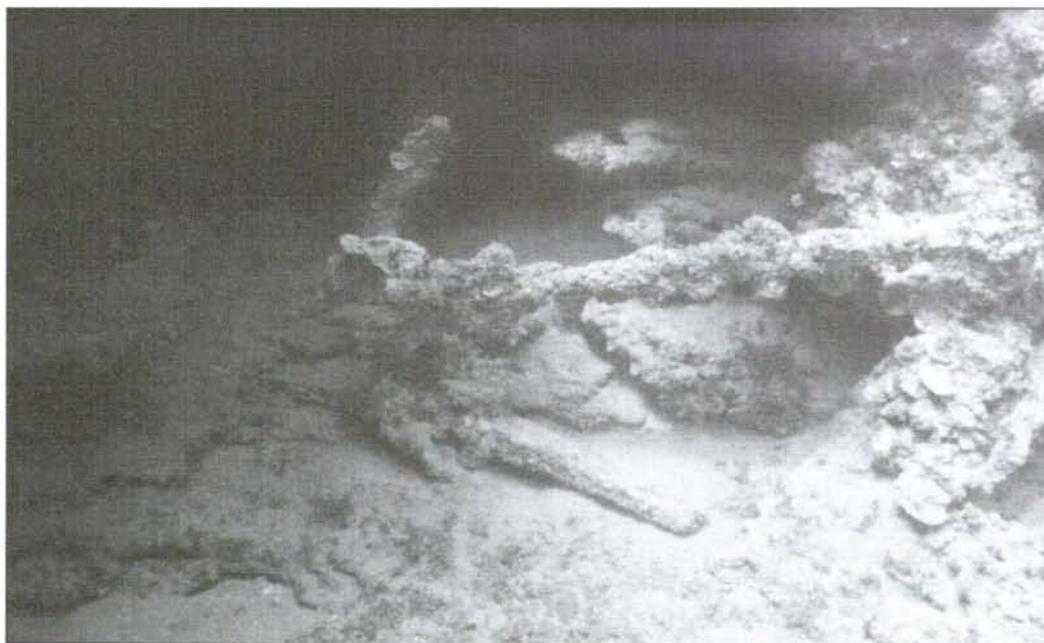


Photo: A. Trakadas

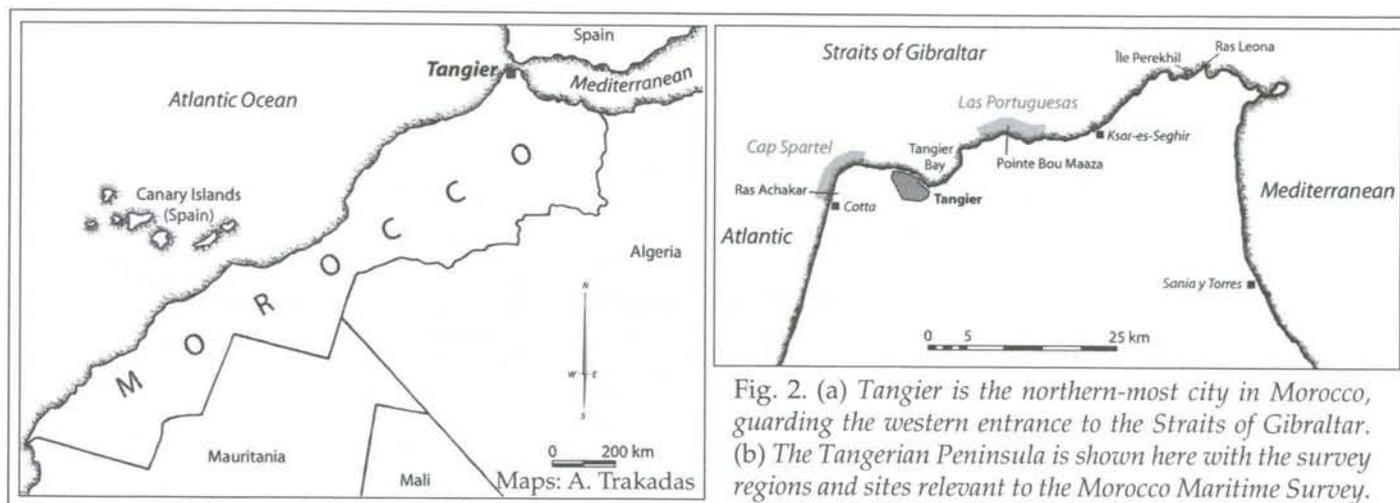
Fig. 1. The anchorage at Cap Spartel, Morocco (CSP062), includes many ancient and modern anchors. Shown here is an ancient lead anchor stock, on top of which is a more modern iron grapnel anchor.

From the initial voyages of the Phoenicians through the Straits of Gibraltar in search of murex dye sources on the Atlantic coast, to later Roman, Islamic, and European vessels, northern Morocco's shores have witnessed a number of foreign cultures vying for control of its natural resources and geographic position. This is shown by the many anchors from diverse times and cultures scattered along the coast (fig. 1). Despite Morocco's prolific maritime-based history, however, exploration of the country's waters has been minimal. Findings from the first systematic underwater survey of Morocco, conducted in 1999 by INA, indicate a varied presence of significant maritime archaeological sites around one of the world's busiest and historically-disputed naval passageways, the Straits of Gibraltar (see *INA Quarterly* 28.3: 3-15). Since the primary focus of the 1999 survey was Tangier Bay, a new project, the *Morocco Maritime Survey*, was initiated in 2002 in order to identify any ancient and historic shipwrecks and ship-related materials along Morocco's Tangerian peninsular coasts. The survey is conducted under the auspices of INA and the Kingdom of Morocco's archaeological department, Institut National des Sciences d'Archéologie et du Patrimoine (INSAP).

The specific goal for the 2002 season of the Morocco Maritime Survey was to investigate further the history and

significance of the region of the Tangerian Peninsula, as reflected through the maritime archaeological record. To this end, survey was to be conducted offshore of various ancient sites; these include the small Roman-period *garum* (fish paste) and fish-salting sites of Sania y Torres on the Mediterranean coast, Ksar-es-Seghir in the Straits of Gibraltar, and Cotta on the north Atlantic coast (fig. 2). Identified as shipwreck sites in 1999, Île Perekhil and adjacent Ras Leona in the Straits of Gibraltar were also to be given considerable priority for mapping and further documentation. Île Perekhil represents a first-century BCE assemblage, and at Ras Leona are probably the remains of the HMS *Courageux*, a British ship-of-the-line that wrecked in 1796.

Unfortunately, during the first week of our survey season in July, a serious dispute over the possession of Île Perekhil erupted between Morocco and Spain. After gaining independence from both Spain and France in 1956, Morocco insists on possession of the island. Spain, however, claims the island and considers it part of its North African territories, like Ceuta and Melilla. Twelve Moroccan soldiers landed on the small, uninhabited island on July 11, in what was called an "act of hostility" by Spain. Back at our hotel in Tangier, our survey team was amazed and frustrated by these developments; we watched the footage on CNN showing seventy-five elite Spanish commandos seizing the island from



the Moroccan soldiers under the protection of several Spanish frigates, helicopters, and F-14s. After a ten-day stand-off that involved U.S. Secretary of State Colin Powell's intervention, Spain removed its troops from the island and both countries agreed to hold bilateral talks on its ownership sometime in the near future.

As a result of this dispute, tensions were obviously high and the Royal Moroccan Navy and INSAP prohibited us from working from Ksar-es-Seghir eastwards. A considerable portion of our proposed survey area was thus suddenly unavailable and we were forced to revise our original survey plan. Therefore, we chose to focus our efforts instead at Las Portuguesas, an area in the Straits not investigated in 1999, as well as at Cap Spartel near Cotta, where the Atlantic Ocean and Straits of Gibraltar meet (see fig. 2).

### Methods and Procedures

Based in Tangier, the 2002 survey took place from July 8–August 7. The project's goals for the season were realized through diver survey, test excavations, terrestrial site reconnaissance, and museum research. Diving surveys were conducted in waters shallower than thirty meters. Most of these dives were visual survey, but on occasion, we also utilized marine metal detectors, which helped considerably in locating slightly buried or heavily encrusted metal artifacts. Survey included a very limited recovery of diagnostic artifacts, as almost all were recorded in situ by scaled photography, digital video, and measured drawings (fig. 3). The few artifacts that were recovered are presently housed

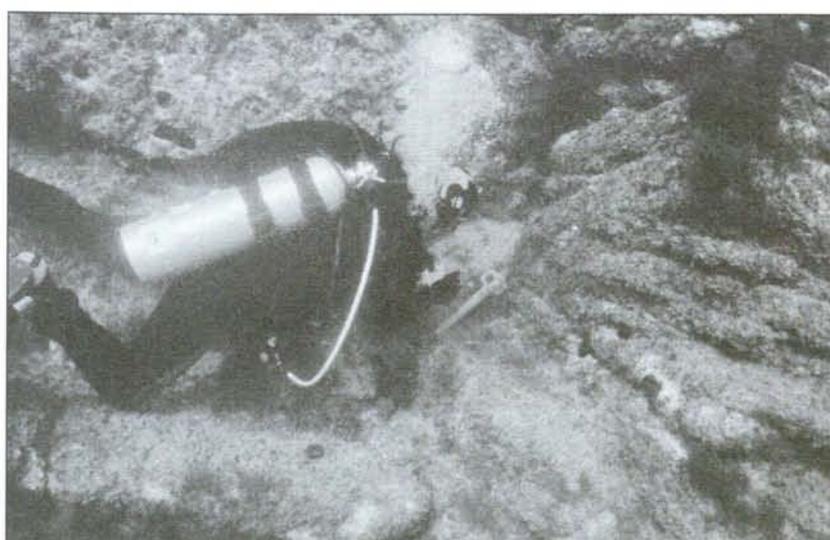


Photo: A. Trakadas

Fig. 3. Jeff Royal records in situ artifact CSP052-114, a Kapitän IIIc-type lead anchor stock found at Cap Spartel.

at a temporary lab established at the Musée de la Kasbah in Tangier, where they remain under conservation supervised by the staff of the Tangier American Legation Museum. Twenty-one days of diving were conducted without incident, and over 135 hours were spent underwater. All dives were conducted on EAN-Nitrox (a breathing mixture with 32% oxygen).

All dive sites were mapped using a GPS (Global Positioning System) receiver. Although there was no feasible base station in the region from which we could utilize Differential GPS (D-GPS), we were able to get a fairly accurate location fix by taking several readings over a particular site. This made it easy for us to return to the same place repeatedly over the course of the survey. A unique site identification code (e.g., CSP062) noted each dive site location and latitude and longitude, depth, and general seafloor characteris-

tics were recorded. Recovered artifacts as well as artifacts recorded in situ were labeled by their dive site identification code as well as an artifact number (e.g., CSP062-115). Recovered artifacts were photographed with a digital camera, and artifacts under water were photographed with a Nikonos 5 (28 mm lens), a Sony digital video camera, or both. All artifact documentation was entered into a Microsoft Access database with links to digitized images.

Our survey operations were based at the Tangier Yacht Club, where two containers served as our project headquarters (fig. 3). One of the containers housed a portable Nitrox system, storage banks for air and Nitrox, and a twenty-five-kw generator that powered adjoining high- and low-pressure compressors. This compact system was designed and built by Bob Olsen, of Nitrox Technologies, Inc., who had built and installed the Nitrox system at Bozburun during the 1998 excavation season (see *INA Quarterly* 25.4: 14-15). The other container served as our dive locker and project workshop. The two dive platforms were custom Duarry rigid inflatable boats (RIB), 8.5 meter-long *Hercules* and 6.0 meter-long *Venus*, docked near our containers at the Tangier Yacht Club. All equipment for this project was generously provided and shipped by RPM Nautical Foundation, Inc. (Key West, Florida).

In order to understand better the topography of the coastal sites that developed when northern Morocco formed the Roman province of *Mauretania Tingitana* (ca. first through fourth centuries CE), walkover surveys of Sania y Torres, Ksar-es-Seghir, Cotta, Tahadart, and Kouass were also undertaken. In addition, other pertinent Phoenician, Punico-Mauretanian and Roman sites were visited, including Zilil, Tamuda, Lixus, Thamusida, Banasa, and Sala Colonia. Our survey crew was able to visit the Archaeological Museum in Tetouan (currently closed for renovations), and during the next survey season, we will have

### Survey Regions

*Las Portuguesas*: The first week of the survey season was spent at Las Portuguesas, located due east of Tangier Bay in the Straits of Gibraltar (see fig. 2). As it is noted on charts, "Banco de las Portuguesas" is a relatively shallow underwater shelf (ca. twenty meters average depth) that extends for several hundred meters out from the Moroccan coastline before the bathymetry plummets considerably in the Straits. On the shelf in this area, there are many submerged rock pinnacles that lie just below the ocean surface and between these are vast stretches of sand. Present are strong, alternating tidal currents that are also affected by the pre-



Photo: A. Trakadas

Fig. 4. Our survey headquarters were two containers at the Tangier Yacht Club, just below the kasbah, or old walled city of Tangier. On the left is the Nitrox system, filling tanks; on the right is the crew in front of our dive locker and workshop.

access to their archives and stored collections. I was also able to visit the Archaeological Museum in Rabat, which houses the National Museum's collections and where the staff kindly allowed me access to their valuable research library.

The 2002 survey team included Athena Trakadas, John McManamon, Jeff Royal, Stefan Claesson, and Craig Jones. John McManamon also served as the project's Diving Safety Officer and Craig Jones and Athena Trakadas served as the project's boat captains. Jeff Royal and Stefan Claesson developed our recording techniques and databases. Dr. Elarbi Erbaty from INSAP is the project's co-director, along with Athena Trakadas from INA. Dr. Abdelatif Elboujaday serves as our regional archaeologist from the Délégation de la Culture (Tangier). Mohammed Hamidi, Rachid Chojaa, and Rashid Lamghafri, generously loaned to the project by the Gendarmerie Royale (Rabat), also constituted our dive team.

vailing westerly surface and deep up-swelling currents of the Straits (from over nine hundred meters depth). These tidal currents flow parallel to the coastline, creating ideal conditions for conducting drift dives.

In this survey area, aside from many modern anchors, the two finds were located at Pointe Bou Maaza, a long promontory of several weathered sandstone pillars that Jeff Royal aptly nicknamed "the Vertebrae." In the shallow eastern lee of the promontory, a modern swivel gun was found situated about five meters from the shoreline and recorded in situ (fig. 5). The small gun's muzzle

had been blown off, and it dates almost certainly to the last century. A heavily encrusted cannon was also found, situated approximately twenty meters from the shoreline and about twenty meters northwest of the modern gun. The 2.44-meter-long cannon is so encrusted that the trunions and cascabel were hard to measure, and if any lifting handles are present on the cannon they are hidden by the encrustation and extensive marine growth.

Both ordnance are isolated finds, as extensive searches in the area revealed no associated artifacts. The presence of these finds in the very shallow lee of Point Bou Maaza is interesting; they are located just offshore of some steep cliffs that have no evidence of permanent man-made structures, historic or modern. This does not exclude the possibility that the modern gun, which is fairly light and found close to the shore, could have been part of a temporary installation on the cliffs above. The cannon's location is more problematic to explain. The depth of the lee at Point Bou Maaza averages two to three meters, so a ship could have run aground here in a storm and inadvertently or purposely jettisoned the cannon, helping it off the rocks. If a vessel did founder here, however, more artifacts would be expected in the vicinity.

*Cap Spartel:* The majority of our survey season focused upon Cap Spartel, the western-most point of Morocco in the Straits of Gibraltar (see fig. 2). Under water here, there is a



Photo: A. Trakadas

Fig. 6. One of our dive boats, Hercules, on its way to a survey location at Cap Spartel. In the background is the historic lighthouse at the point.

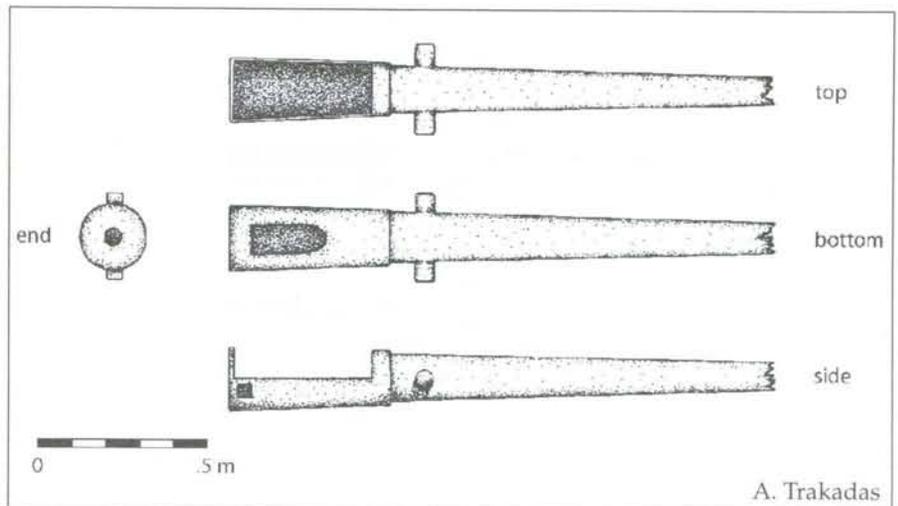


Fig. 5. The modern swivel gun found at Las Portuguesas, POR039-101.

dramatic transition from the extreme depths of the Straits to the shallower, sandy Atlantic coastline. This transition, combined with prevailing westerly currents entering the Straits, create an extremely active hydrographic zone. The alternating tidal current along the Atlantic coast, like at Las Portuguesas, also runs parallel to the shore, and can reach up to five knots, making for some interesting (and speedy) survey drift dives.

At Cap Spartel, steep cliffs along the coast give way to submerged rock pinnacles that are exposed at low tide (fig. 6). These pinnacles are part of rock ridges that extend several hundred meters out from the coastline. South of Cap Spartel, along the Atlantic coast near Ras Achakar, the pinnacles gradually subside and the underwater topography transforms into gently sloping sand fields, with occasional pockets of rock outcrops. Seven sites were identified in the course of the survey at Cap Spartel, with no fewer than two artifacts at each site.

#### Shipwrecks

Two shipwrecks and one possible shipwreck assemblage were located during the course of the survey. The two shipwrecks, identified as sites CSP044 and CSP057, are located on either side of the lighthouse at Cap Spartel, the most dangerous area in the transition between the Atlantic and the Straits. Site CSP044 is a large metal shipwreck; the amount of debris in the water is highly concentrated, but also covers an area of approximately two hundred square meters, extending from the shoreline to 5.7 meters depth. Portions of the wreck are exposed on the rocks at Cap Spartel at low tide. Various parts of the hull, as well as large boilers, chains, and anchors are also visible

under water. These indicate that this wreck is likely the remains of a large cargo ship from the last century.

Site CSP057 is a historic shipwreck site, located to the northeast of the lighthouse at Cap Spartel. Originally, we chose to survey this area in the hopes of finding a second-century CE shipwreck with a cargo of lead ingots that was located in the 1960s. We did not find any traces of this wreck, but at the base of some rock cliffs at 9.9 meters depth, considerable amounts of metal and wood remains were found. One diagnostic artifact, a copper-alloy throughbolt, with some wood attached, was recovered. This artifact, and the type and distribution of remains found underwater, suggest that the site represents a vessel dating to the late nineteenth or early twentieth century.

The fragmentary remains of a possible shipwreck were found further south of Cap Spartel on the Atlantic coast, near Ras Achakar. A smaller assemblage than the first two identified wrecks, site CSP051 is a cluster of historic artifacts at 6.9 meters depth that rests in the saddle of a narrow east-west rock ridge surrounded by sand (fig. 7). A few fragments of wood planking and what are possibly two swivel guns were found. The tentative identification of the ordnance suggests a date from the fifteenth to seventeenth centuries for the assemblage. A cursory, circular search around the site (out to approximately one hundred meters) yielded finds including a historic anchor, a possible cannon, and lead sheathing; it is difficult, however, to conclude whether these finds are associated with the swivel gun assemblage. The underwater topography and shallowness of the site suggest that any other artifacts from this possible shipwreck site, including more hull remains, have not been preserved, were possibly salvaged, or are buried in the sand to the north and/or south of the ridge.

#### Anchors

A total of thirty-one anchors or anchor parts were recorded during the course of the survey at Cap Spartel, distributed amongst four sites. The major concentration of anchors is at site CSP062, where mainly ancient, but also modern anchors and anchor parts were found in a compact area. An overwhelming majority of the anchors found are ancient lead stocks, identified as Kapitän IIIb- and IIIc-types (utilized from the second century BCE to first century CE). These varied in length from 0.72 meters to 1.35 meters. Also found were some ancient lead anchor stock cores, similar to Kapitän IIa-types (in use in the Mediterranean from the fifth to mid-second centuries BCE) (fig. 8). These varied in length from 0.41 meters to 0.74 meters.

At site CSP045, two ancient lead anchor stocks and one ancient lead anchor core with stone inclusions were found in close proximity to each other. At site CSP052, six ancient lead anchor stocks were found scattered among small rock outcrops.

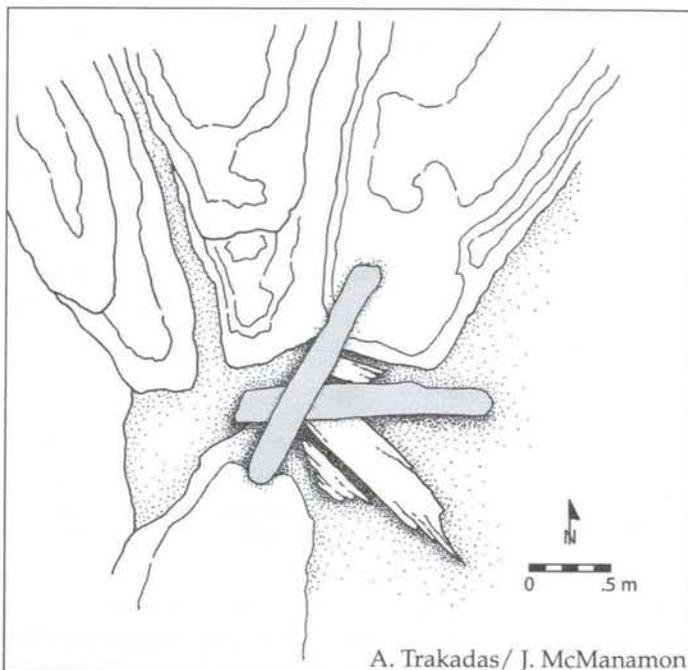


Fig. 7. CSP051, the site at Cap Spartel that includes two tentatively-identified swivel guns and possible hull remains.

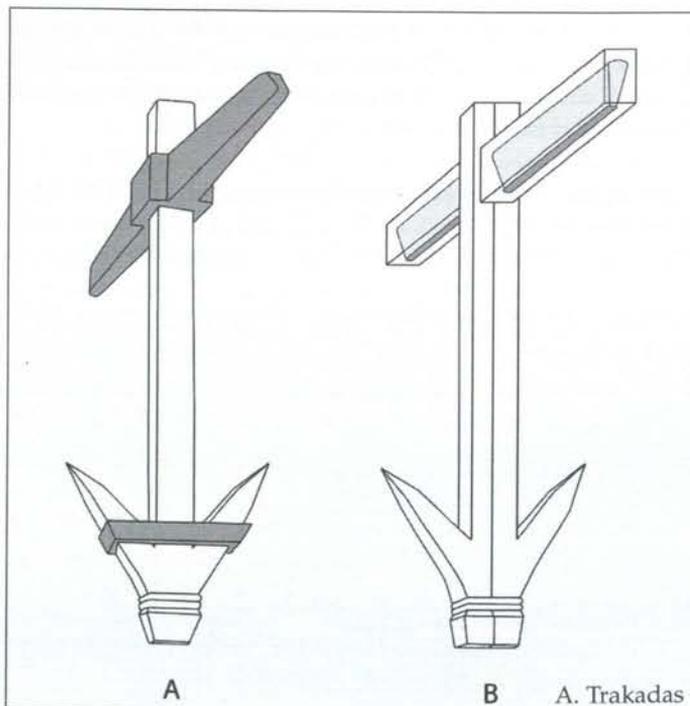


Fig. 8. Reconstructions of some of the lead anchor parts located during the 2002 survey season: A) A wooden anchor with a Kapitän IIIb-/IIIc-type stock, shown here with a lead anchor "collar" bracing its arms (the difference between the two stocks is the presence of a cross-bar in the central shaft box in the IIIc-type). B) A wooden anchor with a pair of Kapitän IIa-type lead cores filling the wooden stock.

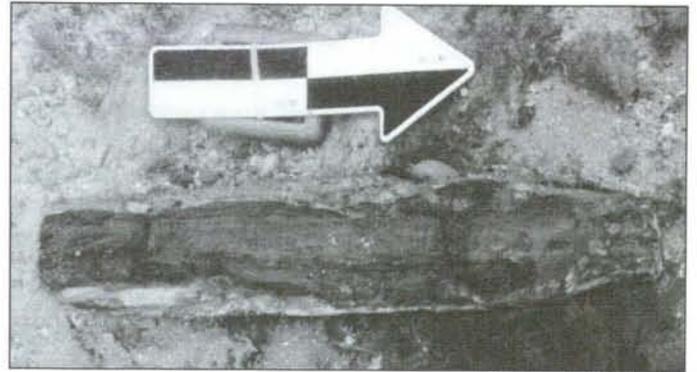
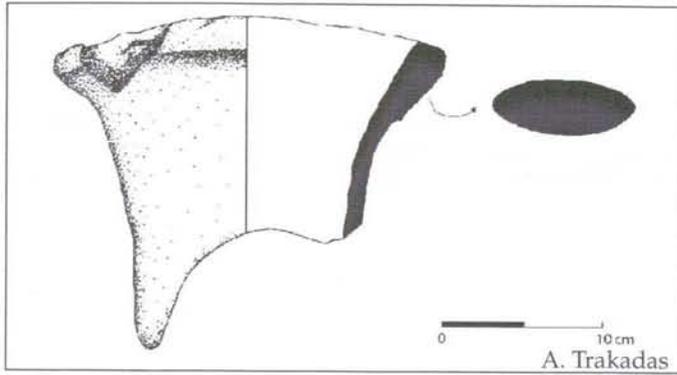
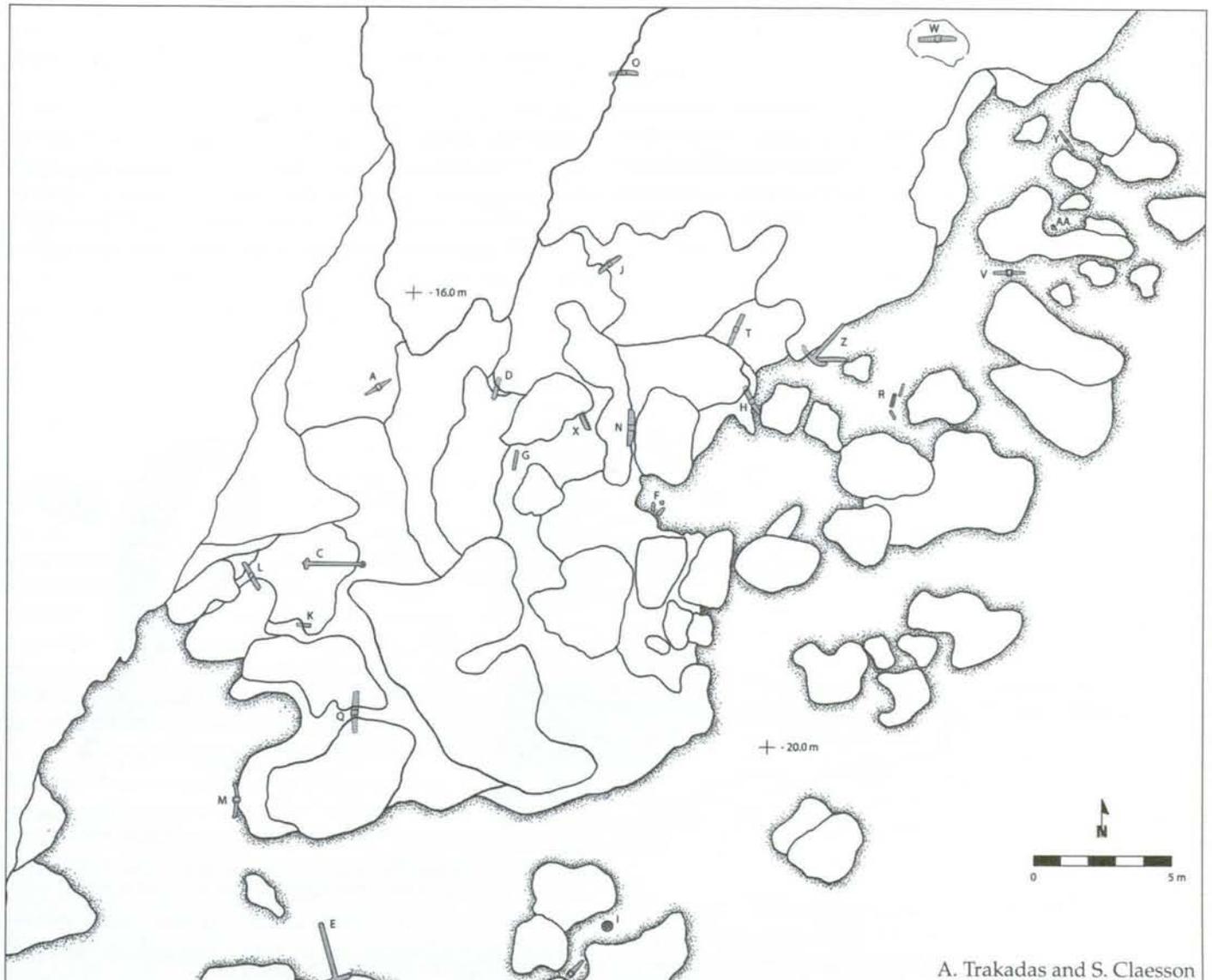


Fig. 9 (left). The fragment of a Beltrán IIB-type amphora found at Cap Spartel (CSP046-113).

Photo: A. Trakadas

Fig. 10 (right). One of a pair of Kapitän Ila-type anchor stock cores found at Cap Spartel (CSP046-109), shown here with the soft wood from the anchor stock still attached to it.

Fig. 11 (below). CSP062, the fifty-square-meter anchorage site located just south of Cap Spartel. The site had twenty-three artifacts, almost all of which were ancient lead anchor parts. The artifacts were recorded individually, and the site itself was documented by triangulation, digital video, and photo mosaics.



At site CSP046, two ancient lead anchor cores, one ancient lead anchor stock, and one stone anchor were found in close proximity to each other. An amphora fragment was also located several meters away from one stock and recovered; it has been identified as part of a Beltrán IIB-type amphora (dating to the first to mid-second centuries CE; fig. 9). The pair of lead anchor stock cores was slightly buried in sand, and a soft piece of wood was found attached to the long side of one core (fig. 10). A small sample of the wood was recovered and has been identified as *Quercus ilex*, holly oak, a wood type well suited for ancient anchors (species identification by Claus Malmros, National Museum of Denmark, Department of Environmental Archaeology and Archaeometry). *Quercus ilex* is a very heavy wood (specific weight 0.90-1.18), with low elasticity and flexibility. It is resistant to insects and is highly durable, even in a wet environment. A radiocarbon age of 2460 BP (+/- 50 years; calibrated to 785-400 BCE) has also been determined for this piece of wood (radiometric tests performed by Beta Laboratories, Inc., Miami, Florida).

Site CSP062 lies south of Cap Spartel just offshore of Ras Achakar and is spread over an area of approximately fifty square meters. The underwater topography here is a combination of rocks and sand; the flat, eroded hardpan rock ledges give the site a varying depth from sixteen to twenty meters. A large sand field delineates the eastern and southern edges of the site, while flat hardpan rock continues to the north and west.

At CSP062, twenty-three artifacts or artifact groups were located and recorded. The high density of anchors found at the site suggests that it is an ancient as well as historic anchorage (fig. 11). Documented finds from this site include two pairs of lead anchor stock cores, one of which was associated with an anchor collar (revealing a complete anchor assemblage, fig. 12), a single, separate anchor stock core, and another lead anchor collar. The fourteen remaining artifacts are lead anchor stocks of the Kapitän IIIb- and IIIc-types. Three encrusted iron anchors were also found; two possibly date to the Late Roman to Byzantine periods. There is one historic iron anchor (Admiralty type) with what appears to be its wooden stock lying near the flukes (see fig. 11, 'Z'). Only one amphora fragment, identified as part of a Pascual 1-type amphora, dating to the mid-first century BCE to the mid-first century CE, was found and recovered from the site (fig. 13).

In the course of our documentation of site CSP062 at the end of the survey season (made a bit difficult by the strong tidal currents), our team located at least ten other ancient lead anchors outside the perimeter of our immediate mapping area. Because of time constraints, however, we chose to focus on the fifty-square-meter area and thoroughly document all artifacts within it. The site CSP062 is also located near a small group of ancient lead anchor parts cursorily examined in 1999, but this new site is shallower in depth and is located closer to the coastline. It is likely that both these sites from the 2002 and 1999 survey seasons are related, and comprise only a part of a much larger anchorage site.

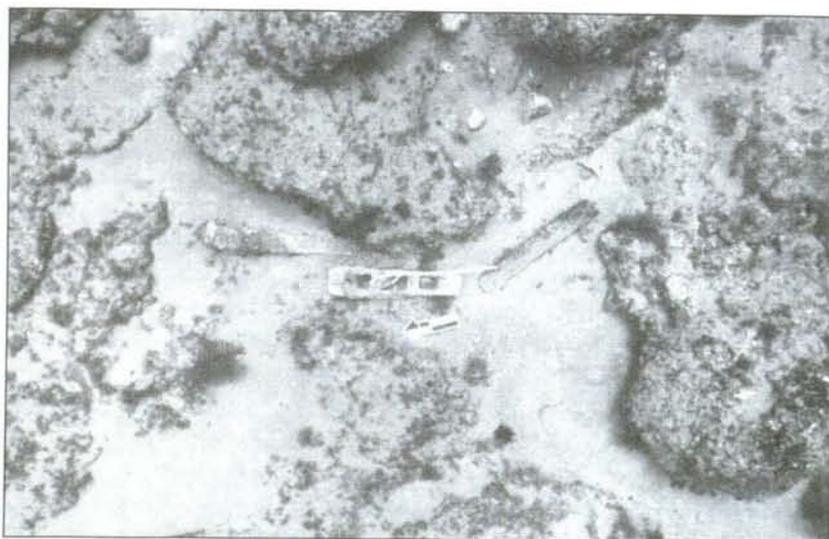


Photo: A. Trakadas

Fig. 12. Two lead anchor stock cores found with an anchor "collar" (CSP062-121). This assemblage represents a complete anchor, and is a combination of the two examples shown in Fig. 8.

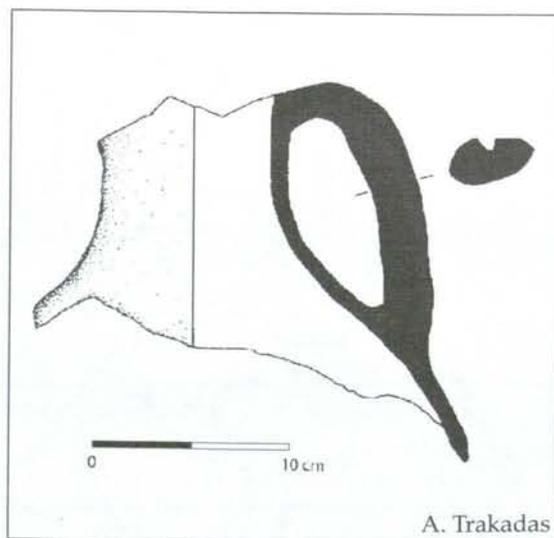


Fig. 13. The fragment of a Pascual 1-type amphora recovered from the anchorage at CSP062 (CSP062-119).



ever, is significant in that it can *broadly* indicate when such lead anchor stock cores were utilized in the western Mediterranean. This type of anchor stock core was utilized as early as the third quarter of the fifth century BCE in the Aegean. We know this thanks to the recent discoveries at the Tektaş Burnu excavation (see *INA Quarterly* 26.4: 9). However, this artifact's radiocarbon-derived date gives a clearer picture as to when vessels from the Mediterranean were present outside the Straits of Gibraltar. Its presence also indicates the possible geographic range of this anchor type. Pre-dating the Roman presence in Morocco, these anchor pieces correspond chronologically from the earliest Phoenician presence at Cap Spartel (an eighth-century BCE Phoenician grave at Ras Achakar) to the Punico-Mauretanian development of terrestrial sites on the Atlantic coast as far south as Essaouria (Mogador), seven hundred km from Cap Spartel.

### Future Work

The Tangerian Peninsula lies at the crossroads of east-west and north-south maritime trade and communication routes that have been utilized for millennia. Even though a handful of sites are located on the coasts of the peninsula, the ancient maritime history of northern Morocco remains relatively undefined. In the broader perspective, the Morocco Maritime Survey seeks to identify significant underwater and coastal archaeological sites in order to define trends in Morocco's maritime history. We hope also to determine more clearly the maritime connection between ancient indigenous cultures and those from the Mediterranean. Therefore, our survey plans for the next season include:

- 1) Further survey and documentation of the large and concentrated anchorage at Cap Spartel (CSP062). By continuing to document the large number of ancient anchors present at Cap Spartel, statistical analyses can be conducted in order to clarify ancient anchor typology, use, manufacture, and possibly chronology.
- 2) Conduct isotope tests on the lead anchor stocks and cores. This would allow us, by comparison, to determine if lead mines in the Rif Mountains of northern Morocco were being exploited in antiquity, or if the lead comes instead from the ancient mines in southern Spain, or from elsewhere. This research could reveal a clearer picture of ancient regional re-

source exploitation and its effects on local and perhaps regional economies.

- 3) Survey offshore zones near other ancient coastal sites. Mainly concentrated around the Tangerian Peninsula at Sania y Torres on the Mediterranean coast, at Ksar-es-Seghir in the Straits, and at Tahadart and Kouass on the Atlantic coast, these sites are Roman-period *garum* and fish-salting production centers. Evidence of port facilities and other land-sea interactions in the area will be sought to clarify the details of the fishing industry that comprised a substantial part of the economic viability of the Roman province of *Mauretania Tingitana*.

- 4) Survey at the islands of Essaouria (Mogador), along the Atlantic coast of Morocco. Essaouria lies far to the south of other Phoenician or Punico-Mauretanian settlements and well beyond the boundaries of the Roman province, but it was a Punico-Mauretanian murex dye installation and a Roman *garum* and fish-salting site. No underwater survey has been conducted in the waters surrounding the islands, and there is potential for locating port facilities, anchorages, and shipwrecks. Discovery of these types of sites could detail the relationship of Mediterranean cultures and their distant outposts, reveal formative aspects of resource exploitation and commerce in the region, and help to examine the nature of contact between colonizing and native cultures.

- 5) If possible, a return to Île Perekhil is warranted for further, thorough investigation and documentation. This site, if the preliminary identification as a shipwreck dating to the first century BCE is correct, could also illuminate pre-Roman contacts, trade routes and cargoes of the region.

The 2002 season of the Morocco Maritime Survey was thoroughly productive, and the hard-working members of the 2002 survey team helped make the project successful in the short period of time allotted to us (fig. 15). In addition, we had the opportunity to use outstanding equipment, and as a result, were able to survey thoroughly a portion of the northern Moroccan coastline. Despite the initial disappointment over the Île Perekhil situation, we were able to focus more intensively on other survey regions, which proved rewarding: a total of forty-one artifacts or artifact groups were located and documented as well as three shipwreck sites. In 2003, a longer survey season is planned that will hopefully allow us to delve further into the vital and interesting information that Morocco's waters are beginning to reveal.

*Acknowledgements:* The 2002 campaign of the Morocco Maritime Survey, or "the summer of the anchors," was made possible by the hard work and dedication of many people on both sides of the Atlantic. I would like to thank first for their permission and assistance the archaeological department of the Kingdom of Morocco, INSAP, and its representative and project co-director, Dr. Elarbi Erbat. Special thanks is extended to Dr. Abdelatif Elboujaday for his help in negotiating the mind-numbing world of Tangier's port customs and taking the time to show all those out-of-the-way archaeological sites to the team. The Gendarme Royale divers, Mohammed Hamidi, Rachid Chojaâ, and Rashid Lamghafri, were all a pleasure to work with during the course of the season. Their hard work surveying, recording, and hauling equipment is much appreciated. Many thanks also to Thor Kunihom of the Tangier American Legation Museum whose

help was only just a phone call away, and to Ahmed Mesbahi for his customs savvy on both sides of the Straits. Claus Malmros' helpful discussion on wood identification is also much appreciated, as are Jeff Royal's ceramic analyses.

Before we even reached Morocco, Mary Johnsen, Dan Davis, Paul Major, Cristian Swanson, and Craig Jones of RPM Nautical Foundation, Inc., had put in many hours negotiating the purchases and shipping of all the necessary equipment, making sure it got from Key West and Barcelona to Tangier in time. It was a pure luxury to rely on equipment that was tailored to the project's needs and always worked flawlessly! I am eternally grateful to all the hard work and long hours of the team members in the field who, despite reoccurring bouts of Tangier tummy, kept their ironic humor: Craig Jones, John McManamon, Jeff Royal, and Stefan Claesson. I am above all eternally indebted to George Robb, Jr., for not only his financial but personal support and unwavering dedication to this project. *Shukran bizef.* ☞

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Photo: J. Jones

Fig. 15. Most of the members of the 2002 Morocco Maritime Survey (from left to right): John McManamon, Mohammed Hamidi, Craig Jones, Rachid Chojaā, Pilé (our dock helper), Stefan Claesson, Rashid Lamghafri and Athena Trakadas. (Missing are Jeff Royal, Dr. Elarbi Erbati, and Dr. Abdelatif Elboujaday).

# Excavation and Recording of the Medieval Hulls at San Marco in Boccalama (Venice)

Marco D'Agostino and Stefano Medas

translated by John McManamon

## Translator's Preface

*On a late winter's day in Venice, I assembled my dive gear at the door of my residence and loaded it onto a luggage cart. Then, I set off across the canals that lace that city toward my appointed destination, the train station. I had carefully scouted the route to reduce the number of bridges to a minimum and avoid the crowds of Venetians shopping for fresh produce in the city's bustling local markets. A brisk twenty minute walk left me along the Grand Canal just beyond the church of Santa Lucia, where I met Dr. Marco D'Agostino and the boat crew from the contract firm IDRA. We loaded the gear into the boat as quickly as possible, since one is only allowed to tie up for ten minutes at that busy dock. Preparations made, we cast off for the day's work and moved along Venice's principal waterway into a thickening fog. Upon reaching the lagoon, the captain at one point judiciously throttled back in order to allow a container ship to pass across our bow. The huge vessel suggestively materialized from the fog, slowly steamed in front of us, and disappeared just as suggestively back into the mist. Only after the fog began to lift were we able to sight the posts that marked our goal: two abandoned medieval hulls covered by the waters of the Venetian lagoon. It was my first—and most memorable—visit to Boccalama.*



Fig. 1. The Venetian lagoon showing the location of the island of San Marco in Boccalama.

San Marco in Boccalama is an island located in the south-central portion of Venice's lagoon (fig. 1). The island itself is now under water, but, for a prolonged period in the Middle Ages, it housed an Augustinian monastery. The rising level of water in the lagoon and the settling of the terrain below forced the abandonment of the island toward the end of the fourteenth century. Maps drawn in the sixteenth century described Boccalama as "destroyed or lost." It is therefore likely that the island had already been submerged by that time. Nonetheless, as recently as twenty years ago, its highest points were occasionally visible at low tide.

For many years, the Venetian Magistrato alle Acque, a local office of the national Ministry for Infrastructures and Transport, and the Consorzio Venezia Nuova, a concessionaire of the government, have conducted archaeological surveys as part of more ambitious projects designed to protect the Venetian lagoon (fig. 2). From 1996 to 1997, as part of those broader efforts, the Consorzio Venezia Nuova surveyed the sunken island and discovered two "shipwrecks" on the site. Thanks to radiocarbon testing and dendrochronological analysis of wood samples, the wrecks were dated to the early fourteenth century. Archaeologists immediately conjectured that one of the two hulls was a galley (see "Hull B" below).

In 2001, therefore, the Magistrato alle Acque launched an undertaking to record the remains as part of a broader effort to understand the peculiarities of the submerged site. The mapping project was awarded to the Consorzio Venezia Nuova. A preliminary excavation of the two hulls using stratigraphy was conducted in coordination with a project of the Consorzio Venezia Ricerche called MURST, meaning "A Plan for Evaluating the Environmental Risk to Archaeological Sites in the Lagoon." The work at Boccalama was designated "Phase A" of the overall project.

Under the general direction of the Office for Underwater Research (NAUSICAA) of the Archaeological Superintendency of the Veneto Region, principal investigator Dr. Marco D'Agostino managed the field operations with the assistance of Stefano Medas. During the recording, the naval historians Mauro Bondioli and Ugo Pizzarello participated in the field work. The contract firm IDRA of Venice also collaborated in the archaeology, while the mapping firm Geosigma of Pordenone executed the photogrammetry.

The archaeological activity at San Marco in Boccalama progressed without interruption from June to October of 2001. The site presents unique characteristics, given that it consists of an architectonic complex (the structures of the monastery that once stood on the island) and the two wrecks directly associated with the monastery. Moreover, the wrecks present their own unique characteristics, based upon their state of conservation and scope of utilization. The hull remains are actually neither shipwrecks nor abandoned vessels, but they comprise derelicts reuti-

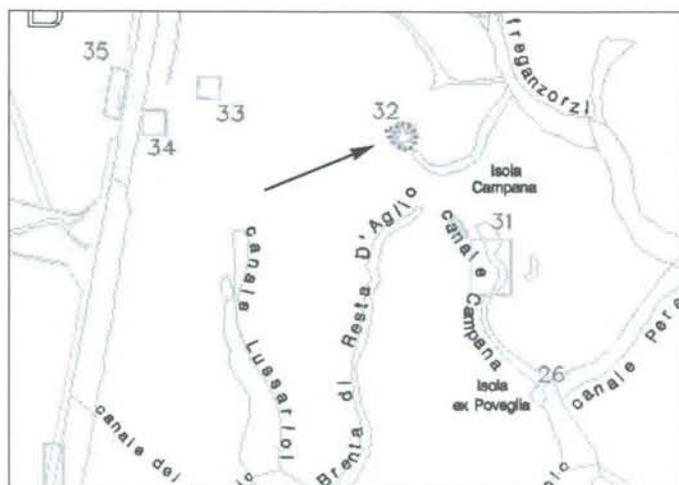


Fig. 2. Technical map of the Veneto region depicting the water level in the lagoon.

lized as the cribbing for an embankment or a land reclamation project or foundational supports of an imposing wood edifice erected between them. On the basis of construction features and the few documents that remain, the structure is thought to have been an extensive covered shed for vessels.

The excavation was programmed in two distinct phases, the first under water and the second on land. Those phases were envisioned as the best way to use the resources available and assure the protection of the derelict hulls. The result was a campaign that was original from a methodological and technical point of view and one that was best suited to the specific environmental conditions of the work.

*Phase A (June-August 2001): underwater excavation of the two wrecks according to stratigraphy*

The decision to conduct an underwater excavation allowed the work on the hulls to proceed as quickly as possible and in the least invasive fashion, eliminating or reducing to a minimum the pressures exerted by the weight and movement of the excavators and their tools. The working depth varied from 1.30 to 2.50 meters, depending upon the intensity of tidal action and the location of one's activity, whether on the exposed upper portions or buried lower portions of the hulls.

The removal of mud from the two hulls confirmed earlier findings from surveys in 1996 and 1997. The mud comprises a fairly homogeneous layer, especially the layer that reaches virtually to the top of the hulls. Those findings support the hypothesis that the two hulls were most likely utilized as cribbing. Further confirmation comes from the fact that the hulls are held in place by a series of large posts sunk into the mud along their perimeter. Likewise,

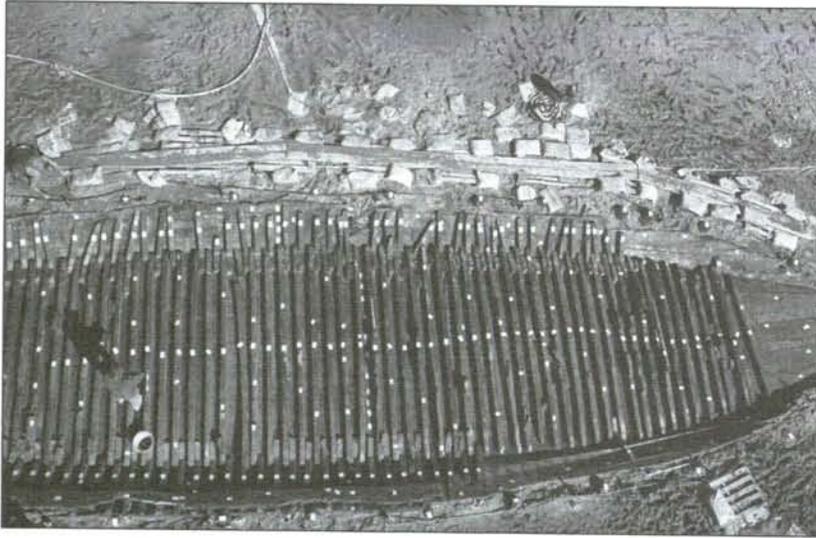


Fig. 3. Overhead view of the rascona during her cleaning in preparation for recording.



Fig. 4. Photogrammetric recording of the galley using a small crane with a lift bucket.

the hypothesis is supported by the fact the hulls were for the most part empty, their superstructures having been removed beforehand. Only the live works survive because only they served a precise purpose. In the interior of Hull B, a tiny proportion of internal structures were found still in place: a few stanchions and partial bulkheads.

Upon conclusion of the underwater excavation, the hulls were covered section by section with pieces of geotextile secured within by sandbags and without by iron stakes. Geotextile is a synthetic woven fabric produced in long sheets and used to control erosion by trapping mud in its weave. The excavators chose to use geotextile in order to protect the hulls from the inevitable re-entry of mud residue carried along by the lagoon's currents.

*Phase B (August-October 2001): erecting a cofferdam of sheet piling around the archaeological area of San Marco in Boccalama, pumping out the water, photogrammetric recording of the two derelict hulls and the island, and adopting measures to protect the hulls*

In an effort to use the limited time most efficiently, the erection of a cofferdam around the entire site had already begun during the final phases of the stratigraphic excavation. Preliminary underwater surveys had carefully fixed the maximal extent of the island and the hulls, and the cofferdam was then driven into place at secure points beyond the extent of the physical remains.

The water was removed from the interior of Hull A by five motorized pumps set up on a barge anchored on the western side of the cofferdam at a point roughly corresponding to the general collection point of the waters. The same pumps were also employed to regulate the level of water remaining inside the cofferdam. At any given moment throughout the course of the work on the site, some pumps were constantly working. In addition, a system for spraying the wood with water was put in place along the perimeter of the two hulls, so that they remained constantly soaked with water during the "land" excavation.

Once the sheets of geotextile which were protecting Hull A had been removed, manual cleaning of the hull timbers began in earnest (fig. 3). Contemporaneously, technical observations and accurate measurements were made. After the timbers were exposed, photogrammetric images of the derelict hulls were taken (fig. 4). The shooting progressed along the sides of the hull, working from strakes at ground level to those higher up. A small crane with a lift bucket was used, allowing the photographer to maintain a constant height as he moved along the hull's side. The photogrammetric images were made in two scales: 1:20 from the lift bucket in order to capture the details of each hull and 1:50 from a helicopter in order to obtain a complete photographic plan of the island.

After the photogrammetry had been completed, the hull was once again covered with sheets of geotextile and completely submerged. The spraying system continued to function in order to assure that the perimeter and the surrounding terrain remained soaked. Work then began on the cleaning of Hull B, following the same methods adopted for Hull A.

Unlike Hull A, Hull B conserves a few vertical and athwartship elements still fixed in their original location (fig.5). There are stanchions notched into the keelson, two transverse planks resting upon the ceiling at the bow (behind one of which is found a bulkhead of vertical boards leaning against the frame), and a bulkhead now broken and lying amidships, just abaft the mast-step. As cleaning proceeded, the archaeologists made the exceptional discovery of a ship graffiti on ceiling at the bow along the starboard side of the hull (figs. 6 and 7). The graffiti schematically reproduces a trireme with a stern-mounted rudder. Nearby, other graffiti and an incision made with a gouge were also found (see the discussion below).

The area between the two hulls was difficult to study, given the presence of such thick mud. Nonetheless, comparable alignments of large posts in parallel rows were identified under the mud. On the eastern side towards the island, the two rows of posts are closed by a third row of transverse posts, which tie together the parallel rows. Within this rectangular area, closed at the island end and open toward the lagoon, a large collection of roof tiles was found, presumably the detritus from a roof's collapse on the spot. As a preliminary hypothesis, the team has posited that those construction elements indicate the presence of a boat hut, called a *cavana* in Venetian dialect. There is a reference to such a structure on the island in a historical document dated 1328.

On the western extreme of the island, another wooden structure was identified that runs in a north-south direction. It is composed of two parallel rows of boards sunk vertically into the ground and of posts fixed along the western (seaward) and eastern (landward) sides. The structure may have served as an embankment or a wall foundation. Its inner segment is filled with pieces of brick and stone as well as mud. Significantly, the structure seems to have been built by utilizing wooden elements scavenged from derelict ship-hulls. Various wooden elements have been identified that seem to have come from a flat-bottomed vessel. However, they do not appear



Fig. 5. The galley (detail of its stern structures).



Fig. 6. The graffiti of a galley found inside the hull of the galley (detail).

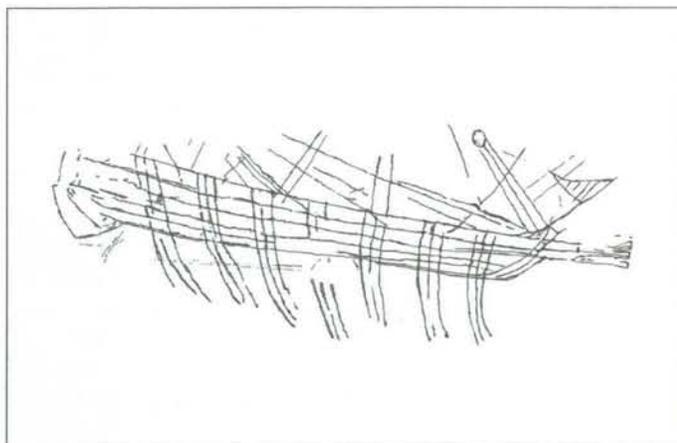


Fig. 7. A schematic reproduction of the graffiti of a galley found inside the hull.

to have a direct relationship to Hull A. Another element, in contrast, could possibly be the loom (*ribolla*) of a quarter-rudder and, in this case, one cannot exclude a direct relationship to Hull A. The investigators therefore believe that elements from the superstructures of the two vessels buried at Boccalama could have been reused in structures for the monastery.

#### Hull A (fig. 3)

The hull measures 23.60 meters in length and approximately 6 m in beam. The two sides are conserved to a height of approximately 80 cm. The seventy-five surviving frames, fastened to the planking by means of treenails, are composed of floors (*piane*) and futtocks (*sanconi*) (fig. 8). The mast-step is found well afore of midships and is held in place by buttressing pieces (*castagnole*) fastened to the floors (fig. 9).

The vessel is identifiable as a *rascona*, a boat typically used for transport of goods on rivers and the lagoon. She had a flat bottom and was widely diffused in the Po River valley, as is amply documented in medieval and modern iconography. The vessel type survived in the Po region, especially on the river itself, into the first decades of the twentieth century. It is characterized by a low freeboard, recurving posts that rise to a significant height above the rail, two quarter-rudders fastened at the sides of the stern, and two vertical beams (*montanti*) used to support a frame for mounting the rudders. One of the reasons for identifying the hull as a *rascona* derives from finding a large, shaped wooden beam, measuring 5.15 m in length, lying loose inside the hull. The timber almost certainly comprises one of the two support beams for the rudder frame.

#### Hull B (figs. 10 and 11)

Hull B is without doubt a galley, and she is the first example of a galley ever found by archaeologists. In fact, the so-called "galley of Lazise" sunk in Lake Garda has properly been recategorized as a *fusta*, a type of smaller rowed vessel. The Catalan wreck known as Culip VI, initially identified as a fourteenth-century galley, actually belongs to the category of coast-round ship.

The Boccalama galley has a maximum length of approximately thirty-eight m, a beam



Fig. 8. The *rascona* (detail of the central portion of her hull).



Fig. 9. The *rascona* (detail of the buttressing for the mast-step).



Fig. 10. View of the galley during the cleaning and recording.

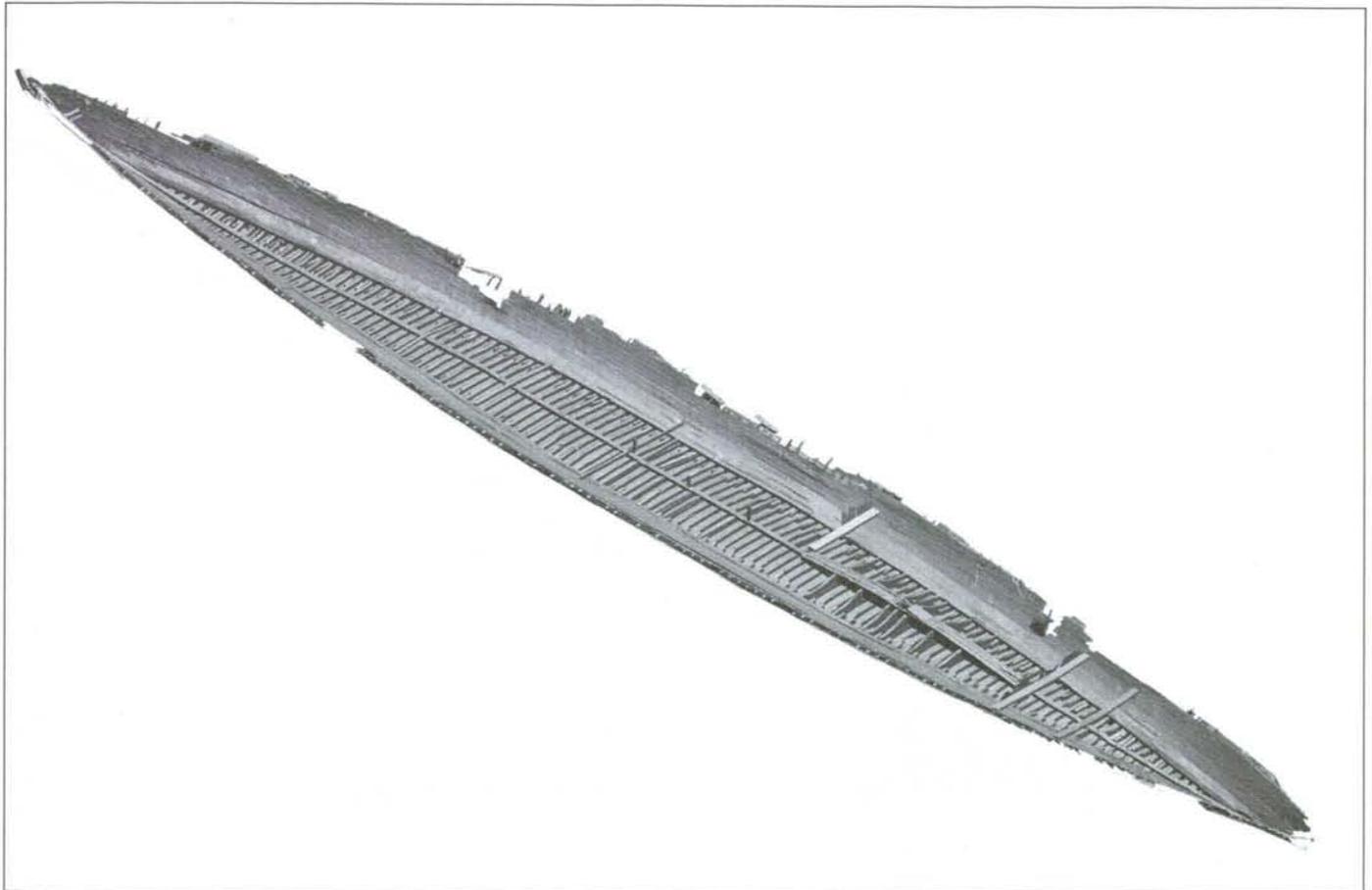


Fig. 11. Three-dimensional computer model of the galley derived from the photogrammetric recording.

of approximately five m, and still conserves virtually the entire live works of the hull. The posts fixed along the perimeter held the vessel in a stable position and prevented the structural elements from collapsing into the surrounding terrain. It is obvious that such a discovery figures among the most important archaeological finds in recent years and may well be the definitive clue to unlocking the so-called "secret building method" of the foremen shipwrights employed at the Venetian Arsenal.

As already noted, a series of graffiti were found incised into the first and second ceiling planks in the bow, if one numbers the strakes from the top down. The most interesting subject would appear to be the design of a vessel, unquestionably a galley, on which the hull and a portion of the rigging are visible (figs. 6 and 7). The graffiti was rendered with a light stroke using a pointed instrument; it is approximately thirty cm long and has the bow of the vessel pointing slightly down when compared to the axis of the plank on which it is cut. The hull is portrayed as having five strakes, while the keel is clearly visible from the point where it meets the apron. The galley's ram was sketched using a series of well-delineated cuts, and it emerges in clear re-

lief. One can infer the presence of the mast, and it may actually be traced through a pair of vertical strokes rising from the hull. Several oblique strokes, representing the lines, rise toward a logical conjunction at the masthead. Among the rigging elements, one can seemingly identify a triple block carrying shrouds. The galley is clearly a trireme with seven of her rowing stations portrayed. Finally, a stern-mounted rudder is visible. The author of the graffiti, as is often the case, was trying to synthesize a personal impression rather than depict a real object.

Historically, the third oar seems to have been introduced on galley benches at the end of the thirteenth century, as already suggested by the Venetian historian Marin Sanuto (1466-1536). If the radiocarbon and dendrochronological analyses yield a more exact date for the derelict hulls, the Boccalama graffiti would have a date in close proximity to their introduction and would confirm conclusions accepted till now by historians with a certain reservation.

There are two possible explanations for the likely origins of the graffiti found in the galley of Boccalama:

1) The graffiti were incised by a crew member (the carpen-

ter on board?) curled up inside a cramped compartment below the galley's deck. Acting in a moment of leisure, he perforce would have worked by candlelight in far less than optimal conditions.

2) The graffiti derive from the activity of one of the shipwrights (*squerarioli*) in the yard and were executed during the construction of the vessel. Acting in much more favorable conditions, the carpenter would have left his mark on the ceiling before they were fastened in place.

In terms of the motivation that led an unknown hand to trace those designs, similar suppositions can be advanced. It is possible that the design represents the galley of Boccalama herself. Or the graffiti's author may have noticed—either at sea or in port—a galley of innovative design, with her rudder mounted directly on the sternpost and with three oars per bank. The sight of such an unusual vessel would have made a profound impression. Only further study of all the assembled evidence will clarify these questions.

*Acknowledgments:* Marco D'Agostino and Stefano Medas would like to thank the contract firm IDRA snc located in Venice for assisting the archaeologists throughout the period of excavation and mapping. The firm of Geosigma srl executed the photogrammetry of the two hulls and the island itself. During the recording phase, the naval historians Mauro Bondioli and Ugo Pizzarello participated in the field work. John McManamon would like to thank the Gladys Kriebel Delmas Foundation, which financed his participation in the preliminary work on the hulls, the Institute of Nautical Archaeology, which awarded him research associate status during that work, and Fred Hocker, who supplied expert guidance on the translation. ✍

#### Suggested Reading

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## Highlights from the Annual Meeting 2003



Fig. 1 (above). *The Executive Committee of the INA Board of Directors. From left to right: Edward O. Boshell, Jr., George F. Bass, Donald A. Frey, Peter M. Way, Robert L. Walker, Frederick H. van Doorninck, Jr., and Danielle J. Feeney.*

Fig. 2 (right). *Robert L. Walker talking to Emeritus Faculty member and Director Frederick H. van Doorninck, Jr. at the INA Board cocktail party.*



Fig. 3 (left). *INA President Donny L. Hamilton and Director George E. Robb, Jr., in the Nautical Archeology Program Conservation Laboratory.*

Fig. 4 (below). *James A. Goold, Carol Allen, George F. Bass, and William L. Allen sharing a light moment during the tour of the A&M campus.*





Fig. 5 (left). Nautical Archeology Program student Sam Lin with William L. Allen, Danielle J. Feeney, Warren Jacques, George E. Robb, Jr., Cemal Pulak, Faith D. Hentschel, Ayhan Sicimoğlu, and Ann Bass studying an experiment that will help to determine how the Uluburun vessel was loaded

Fig. 6 (right). Danielle J. Feeney with Faculty member Kevin Crisman reviewing the sonar image of the Red River Wreck.



Fig. 7 (left). Director Joe Ballew, Chairman Edward O. Boshell, Jr., Kevin Crisman, Director Lynn Baird Shaw with her husband Russell Shaw, Director Allen Campbell, and student Sarah Hoskins.



Fig. 8 (above, left). William and Carol Allen, Associate Director Faith D. Hentschel, and Faculty member Felipe Castro in the Ship Construction Laboratory.

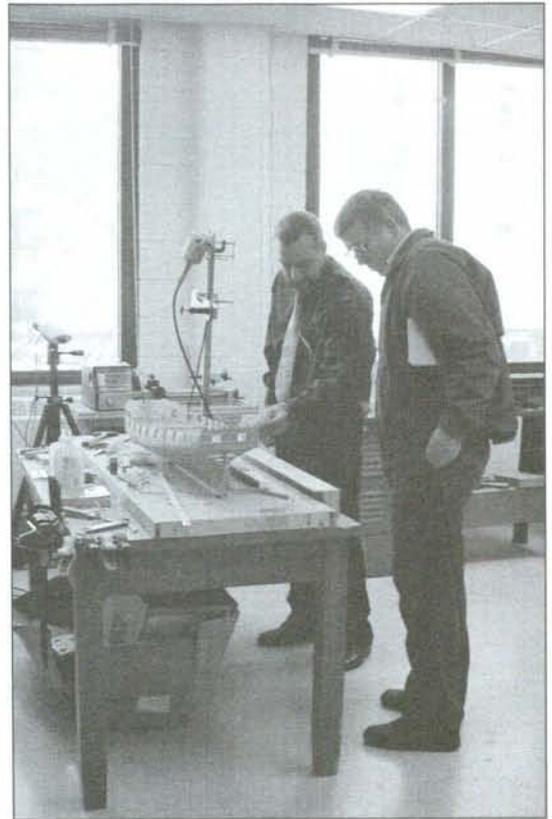
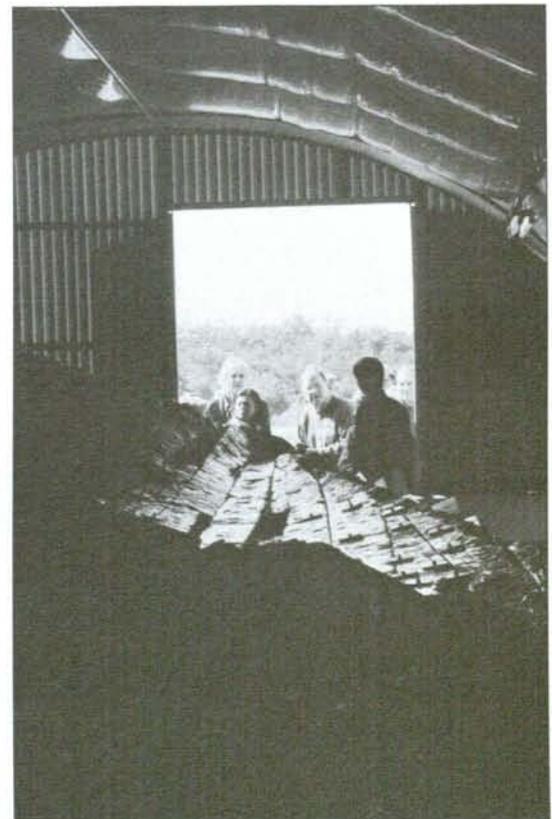


Fig. 9 (above, right). Nautical Archeology student Glenn Grieco showing a model he is constructing to William C. Culp.

Fig. 10 (below, left). George F. Bass, Faith D. Hentschel, Donald A. Frey, conservator Jim Jobling, and Edward O. Boshell, Jr., examining the unopened chest from La Belle.

Fig. 11 (below, right). Vice President Donald A. Frey, Nina Cassils, George F. Bass, student Peter Fix (in silhouette) and J. Richard Steffy, studying the La Belle timbers.



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