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On the cover: *Kim Rash excavates an amphora made in the eastern Black Sea from the site of a Roman marble carrier wrecked at Kızılburun, Turkey in the first century BC. Photo: Don Frey.*

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The *INA Quarterly* was formerly the *INA Newsletter* (vols. 1–18). Editor: Courtney R. Higgins

An Uplifting Summer: The 2006 Excavation Season at Kızılburun, Turkey

Deborah N. Carlson

During the summer of 2006, a combined team of Texas A&M University graduate students, visiting archaeologists, and staff of INA's Bodrum Research Center continued the excavation of a Roman ship wrecked off the coast of Turkey at Kızılburun in the 1st century BC. The three-month long season, which was the second consecutive and most productive campaign on the site, was generously supported by the National Geographic Society, the Samuel H. Kress Foundation, Texas A&M University, the Center for Maritime Archaeology and Conservation (CMAC), and the directors and supporters of the Institute of Nautical Archaeology. The success of the Challenge Grant initiated by INA Director John Baird made it possible to update much of the equipment that we rely on for an excavation of this scale, including new dive gear, scuba tanks, generators, and computer equipment.

The Roman shipwreck is one of at least five ancient wrecks discovered in the bay at Kızılburun during the 1993 INA survey directed by Cemal Pulak (*INA Quarterly* 21.4). The ship was transporting all the elements of a single monumental marble column, comprised of eight massive column drums and a roughly-worked capital that appears to belong to the Doric style. When the wreck was discovered in 1993, at a depth of between 140 and 150 feet, one of the only diagnostic artifacts visible on the seabed was an amphora of the Lamboglia 2 type, produced in the Adriatic in the second or first century BC. This jar provided the first indication that the column wreck dated from the Hellenistic period (323-31 BC), though at the time it was not clear whether the amphora was unequivocally associated with the wreck or represented a later, intrusive find.

Excavation of the column wreck began during the summer of 2005 (*INA Quarterly* 33.1), and resulted in the recovery of almost 1,000 artifacts, among them a number of Lamboglia 2 amphoras and other ceramics that support a date in the early first century BC. Our 2005 team also uncovered and raised various pieces of the ship's secondary marble cargo, including large architectural blocks likely intended to complete some portion of a building façade, pedestalled wash basins for use either in a private home or sanctuary, and an unfinished headstone or grave *stele*.

Our return to Kızılburun in 2006 necessitated the rebuilding of several vital camp structures constructed the previous summer but subsequently

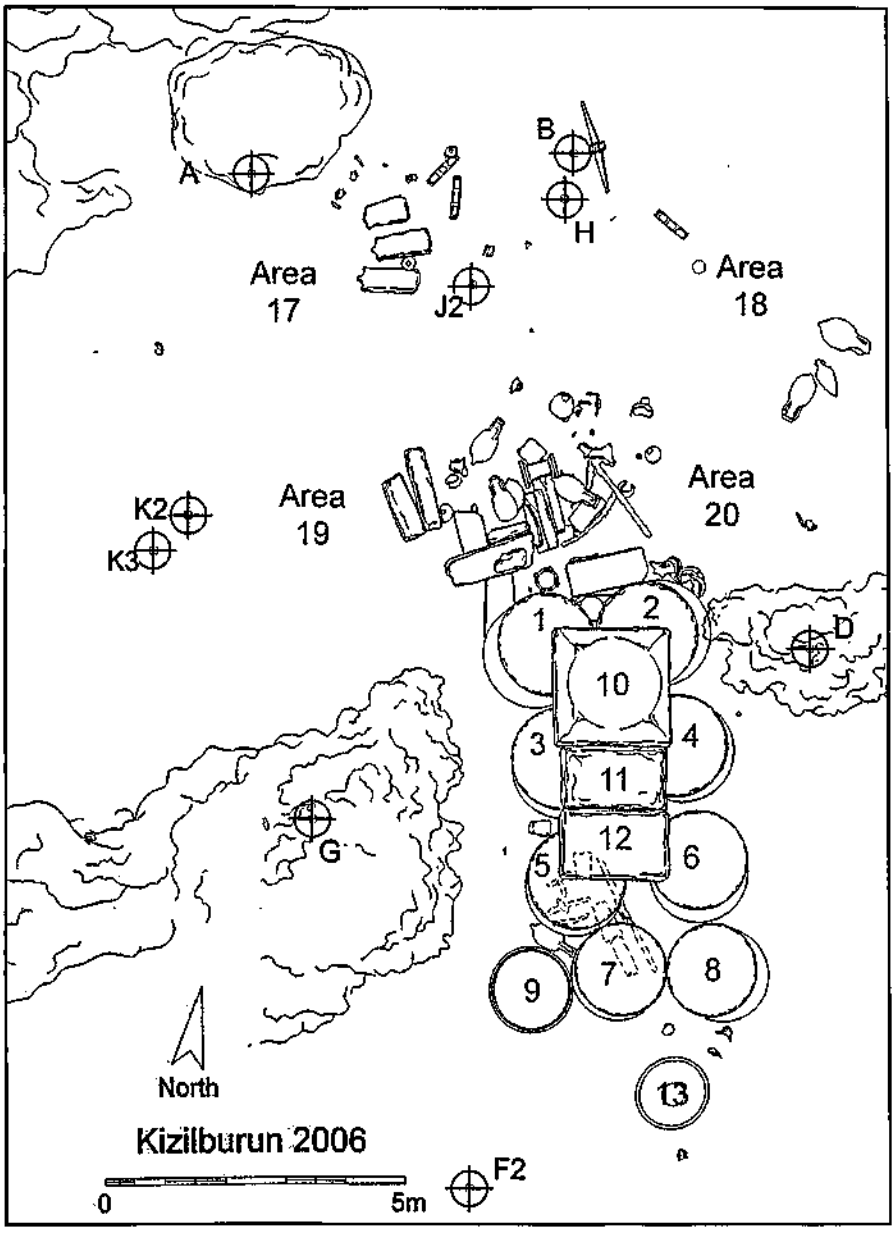
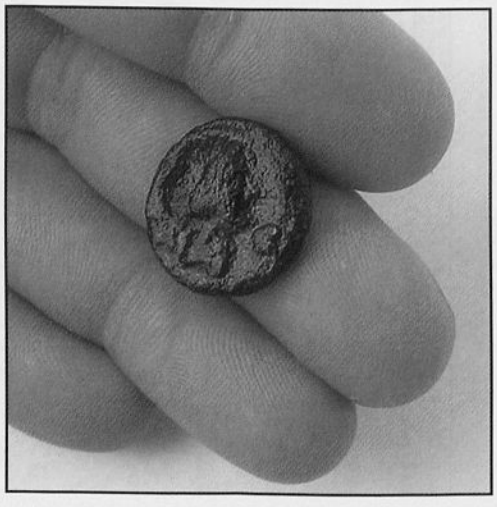


Fig. 1. *2006 Kızılburun site plan. Image: Sheila Matthews*

destroyed during the winter months by rough seas and an isolated cyclone. In early June 2006 a small group of local carpenters and Turkish staff of INA's Bodrum Research Center spent four days constructing the dock, two dorms, commissioner's cabana, artifact storage area, and various platforms that would serve our team of about 20 people all season.

Archaeological efforts during the 2006 season were focused on two specific tasks: (a) completing the excavation of the area upslope of the central drum pile, home to the ship's secondary marble cargo and various other artifacts, and (b) the raising and relocation off site of the drums themselves. Working excavation dives began on June 20, following the installation of the spare safety tanks, telephone booth, datum towers, and airlift pipes. For the next month, we directed our attention to the four quadrants – each approximately 5m x 5m square – upslope of the drum pile: zones 17, 18, 19, and 20 (Fig. 1).

Zone 17, which is characterized by a thin layer of coarse sand lying directly atop bedrock, was initially explored in 2005 and was not expected to yield extensive archaeological material in 2006. One interesting feature of this zone is a large boulder which had concealed from view numerous artifacts, most of them likely pulled off of the wreck and dragged under the boulder by the nets of local fishermen, small pieces of which were found still snagged on the boulder's edge. Several objects from this context that deserve mention are the remains of a large metal cauldron, an intact ceramic jug, and a wonderful terracotta herm figurine (Fig. 2). A herm – whose name comes from the Greek god Hermes, protector of travelers – was a kind of personified pillar with a portrait head and phallus. The ancients utilized herms as boundary markers in transitional areas such as crossroads and doorways, places where underworld spirits were believed to congregate. In this capacity, herms had a magical, protective function, and it may be that the Kızılburun herm served a similar purpose as the ship's good-luck icon.



Another intriguing find from zone 17 is a worn and rather corroded bronze coin, which features on the obverse a male (or perhaps female?) head facing right, perhaps wearing a triumphal fillet or headband (Fig. 3). The coin's reverse is too poorly preserved to yield much information, but the overall style and thickness of the coin suggest that it is Greek, which is not surprising given the fact that the Greek city-states of Hellenistic Turkey continued to mint their own coinage even after the area came firmly under Roman control following Pompey's defeat of the Pontic king Mithridates in 63 BC.

Zone 18 is similarly composed of coarse, loose sand, but systematic excavation of this area only began in 2006 and will have to be continued in 2007. Several surprises awaited us in the deepest sand of zone 18, where days of patient airlifting suddenly revealed a cluster of three intact transport amphoras. Two of these belong to the Lamboglia 2 type (Fig. 4), which represents the largest group of a single type from the wreck, with almost a dozen examples, some of which carry Latin names stamped on the rim. The third intact amphora excavated in 2006 represents a type believed to have been produced in ancient Colchis (modern Georgia) on the eastern shores of the Black Sea. This jar can be grouped with a handful of other amphoras made in Rhodes, Knidos, Kos, Erythrae, and Alexandria that are represented by only one or two examples, and were probably picked up at various ports throughout the vessel's fateful, last voyage.

An early and important find from zone 18 is that of the ship's anchor, comprised of a massive lead anchor stock weighing 230 lbs. (Fig. 5) and associated lead collar, though nothing of the anchor's wooden shaft appears to have survived. The discovery, in 2005, of a conical lead sounding weight not far from the anchor stock, seems to suggest that the Kızılburun ship came to rest with her bow in the shallower waters upslope.

Fig. 2. *(above) The terracotta herm figurine, just over seven inches tall. Photo: Don Frey*

Fig. 3. *(left) The bronze coin, obverse. Photo: Joshua Daniel*

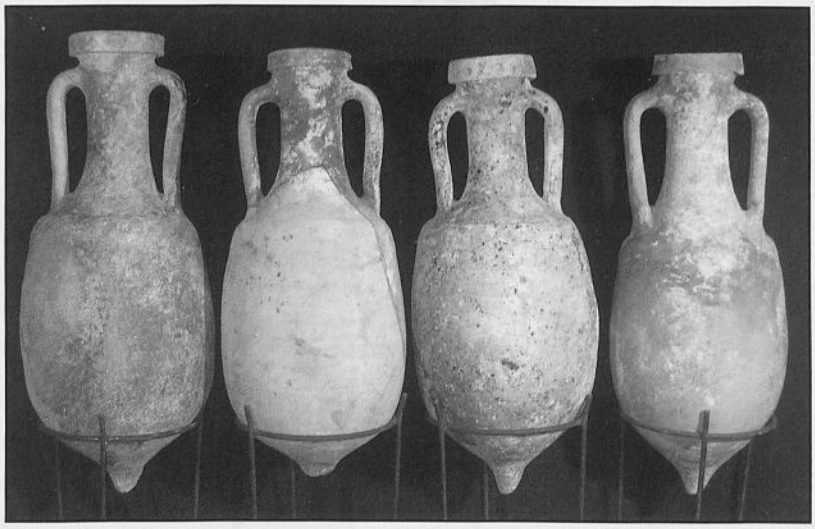
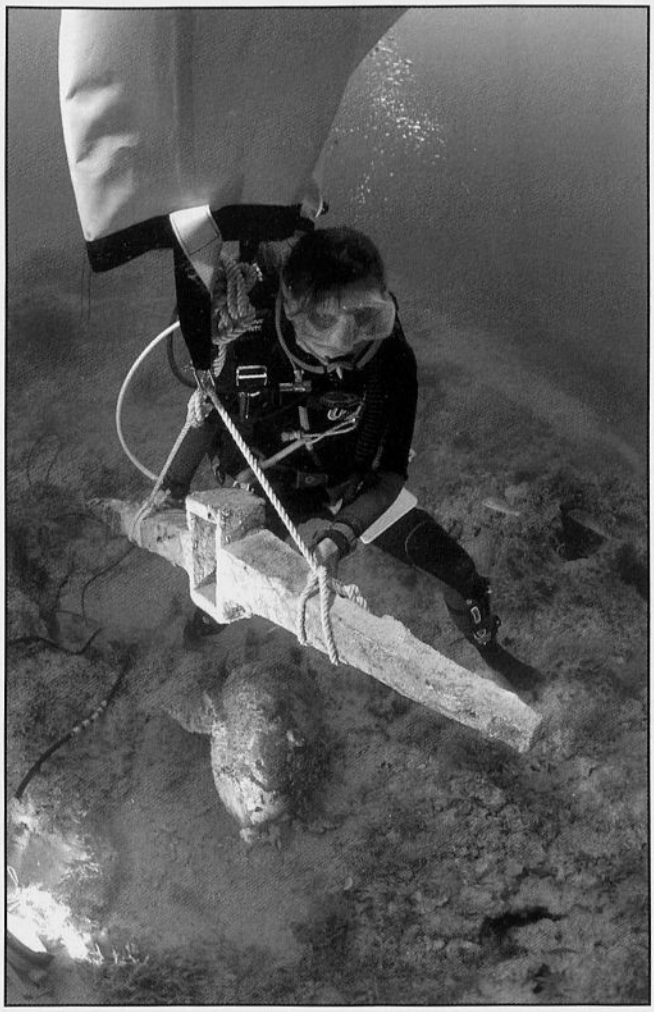


Fig. 4. *(above) Four Lamboglia 2 amphoras from the Kızılburun shipwreck. Photo: Asaf Oron*

Fig. 5. *Kris Trego raises the lead anchor stock. Photo: Don Frey*

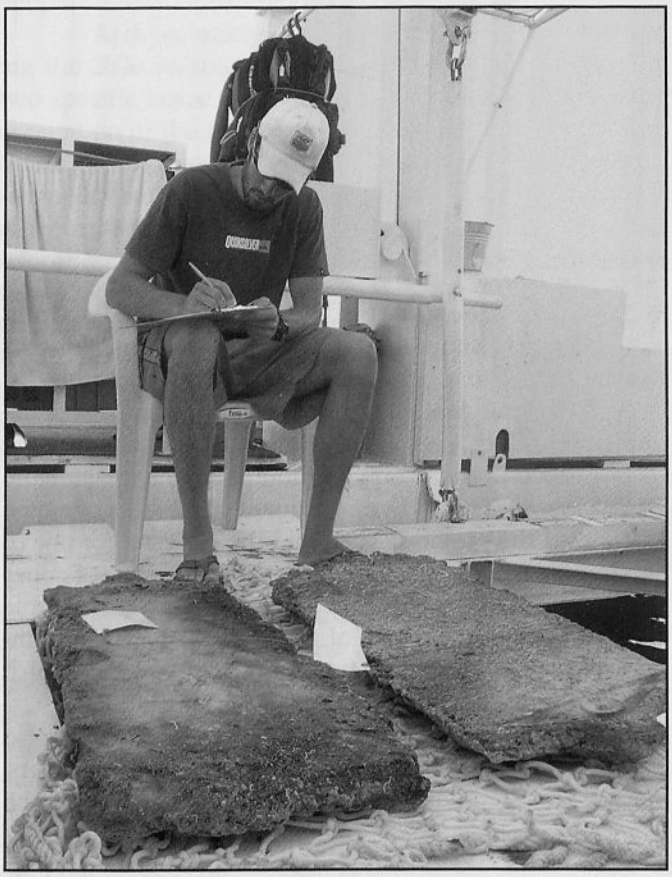


Zones 19 and 20 lie directly adjacent to the drum pile and form something of an integrated unit, in that they are home to a large number of architectural blocks, grave *stelai* and other marble objects that make up the ship's secondary cargo. Excavation of this area during 2006 resulted in the raising of more than one dozen large marble blocks (Fig. 6), five additional grave *stelai* of a type discovered the previous year, and the pedestal for one of two marble basins raised in 2005. In some parts of zones 19 and 20, the orientation and weight of the large marble blocks preserved portions of the ship's substructure, including copper nails and thin wooden planking, which may have once lined the interior of the ship's hold.

Two seasons of excavation at Kızılburun have also produced an interesting assemblage of ceramic artifacts, most of which come from the upslope area adjacent to the drum pile. The present corpus includes finewares in a wide range of fabrics and shapes such as wine jugs (Fig. 7), drinking cups (Fig. 8), plates, moldmade bowls, small bowls or salt cellars, and a single oil lamp, as well as fragments of coarseware pans, lidded casseroles, and braziers. Several of the cooking pans belong to a distinctly Italian type which, when taken together with the Lamboglia 2 amphoras, may suggest that the ship originated in a western Mediterranean port.

As work continued into early July, the Kızılburun team bid farewell to one of its most valuable team members, Sheila Matthews, who traveled to Istanbul to assist INA Vice President and Texas A&M University Professor Cemal Pulak with the excavation and recording of four Byzantine shipwrecks at Yenikapı. Here, over a dozen ships have now been discovered as a result of a project to create an underground tunnel to connect the European and Asian sides of the city. Back at Kızılburun, TAMU graduate student and *INA Quarterly* editor Courtney Higgins stepped into Sheila's big shoes to supervise the

Fig. 6. *Vince Valenti catalogs two marble grave* stelai *raised in 2006. Photo by Heather Brown*



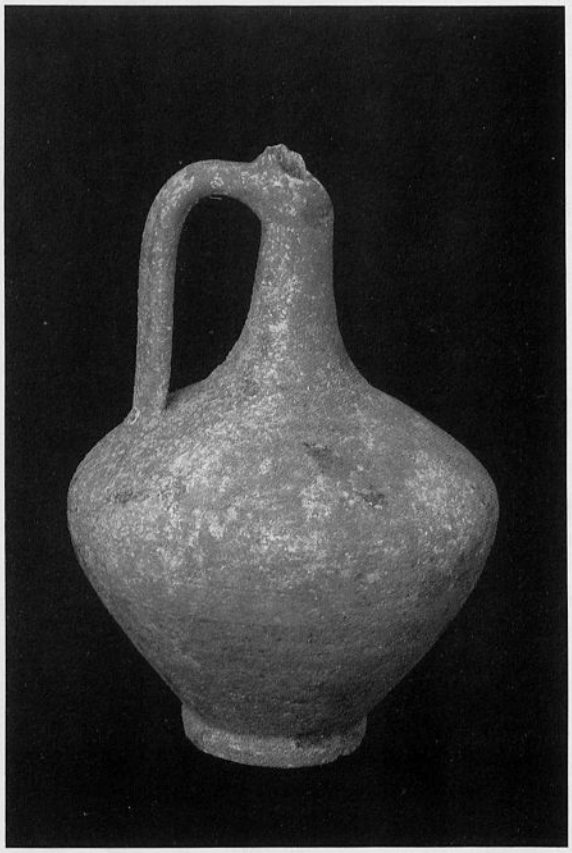


Fig. 7. *One of at least six Hellenistic wine jugs, or* lagynoi, *from the wreck. Photo: Don Frey*

Fig. 8. *A drinking cup (*kylix*), likely made in the eastern Aegean in the 2nd or 1st century BC. Photo: Don Frey*

digital mapping of the Kızılburun artifacts. Courtney was assisted in part by a visit from Peter Holt of Sonardyne, a UK-based company specializing in the manufacture of underwater navigation and positioning equipment. Peter designed the *Site Surveyor* software employed on INA projects at Tektaş Burnu, Pabuç Burnu, and now Kızılburun, and recently released the *Site Recorder 4* program, which is designed specifically for mapping shipwrecks by enabling the user to integrate artifact records, dive logs, photographs, and geophysical data into one database.

On July 22, with the arrival of Richard Fryburg, President of Subsalve, Inc., we turned our attention to the raising and relocation off site of the wreck's massive marble column drums, which weigh between 6 ½ and 7 ½ tons each. Richard brought with him a set of four custom-manufactured stainless steel brackets which we employed successfully on our first attempt, column drum 8. Ultimately, however, these brackets proved too small and insecure to complete additional lifts with confidence, so for subsequent lifts we adopted a system whereby each drum was outfitted with three nylon lifting straps, sandwiched into place under the bottom of the drum. This delicate procedure progressed slowly and required caution, since in some cases, the massive drum was situated directly atop the ship's fragile wooden hull remains.

Perhaps the greatest benefit of Richard's participation was his many years of experience with large lift balloons. Once the lifting straps had been positioned under the drum, we gathered the ends and attached them to a chain more than 100 feet long. To this chain we fastened two 4000-pound lift balloons directly above each drum, while two other "control balloons" were secured to the top of the chain in approximately 30 feet. of water (Fig. 9). The two deeper balloons were filled first, and then the shallower two were filled remotely, via a hose supplied with air from tanks in a dinghy at the surface. This use of control balloons near the surface ensures that when all balloons are filled and the drum has been lifted from the seabed, there is no chance of the balloon (and the object attached to it) becoming overly buoyant and shooting to the surface. Thus, when the upper balloons broke the surface of the water, a recovery dive team was dispatched to the wreck to complete the repositioning of the drum (in less than 20 minutes!). This was achieved by filling smaller balloons attached to the drum

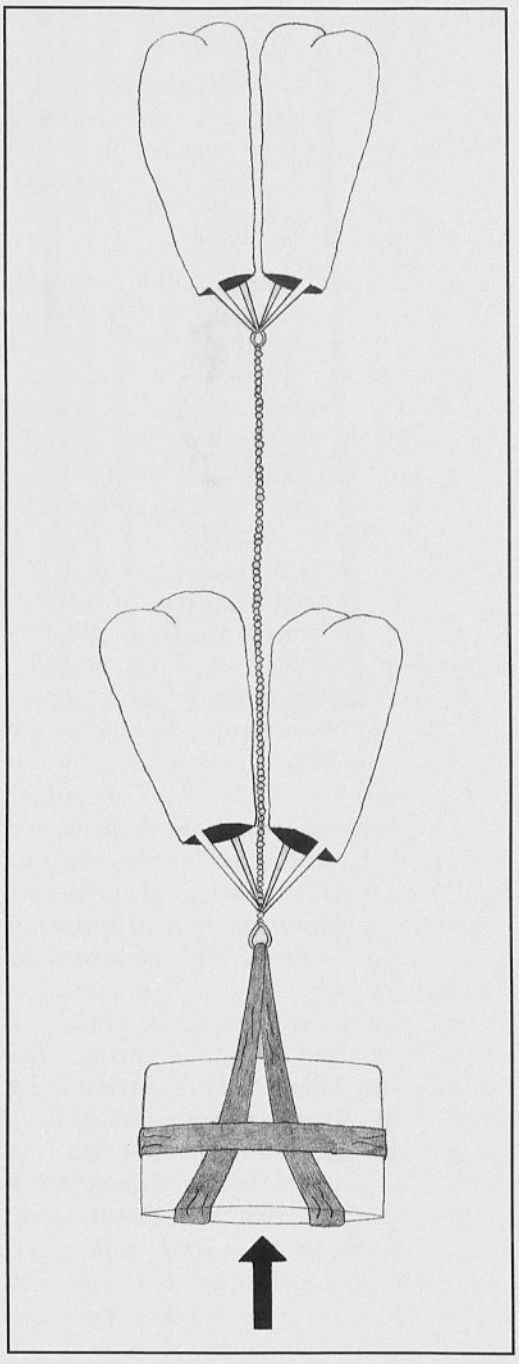


Fig. 9. *The rigging system employed in 2006 to raise four of the eight marble drums. Drawing: Vince Valenti*

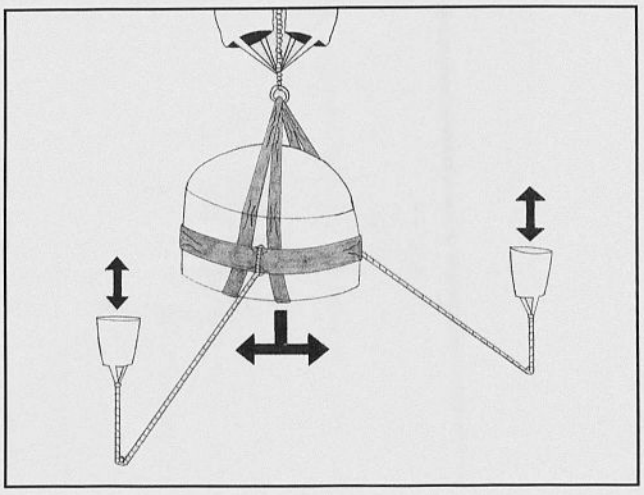


Fig. 10. *The winch system used to reposition each of the four drums moved off-site in 2006. Drawing: Vince Valenti*

with lines that ran through pulleys secured to the seabed. When the smaller balloons are inflated, they pull on the lines that guide the drum downward onto the seabed (Fig. 10). With this ingenious system, designed by *Virazon* captain Feyyaz Subay, we were able to pinpoint the final off site location of each drum within several feet.

Over the next four weeks our modest team of just under 20 divers succeeded in safely relocating off site a total of four of the eight marble drums (nos. 5, 6, 7, 8). Though there was not sufficient time in 2006 to excavate completely the area exposed by the drum-lifting (approximately 6 square meters), the wooden timbers preserved beneath drum 5 provide an interesting glimpse of the ship's hull remains, which include ceiling planking, four frames, and a six-foot-long timber that may be a stringer or keelson. We were especially intrigued to find directly under both drum 5 and drum 7, which lie adjacent to one another along the ship's longitudinal axis, three small, thick, roughly finished rectangular marble slabs (Fig. 11). Situated on one side of the ship only, these slabs could have served as ballast to adjust the trim of the vessel. Or perhaps they were intended to facilitate the loading or off-loading of the marble drums, which show no evidence of lifting devices like cuttings for tongs or hoisting bosses (protruding outcroppings of marble). Presumably, in order to deliver the drums, the ancients had to secure lifting ropes beneath them (just as we did on four separate occasions this summer), and perhaps the marble slabs provided the surface necessary for a gang of men with pry-bars to generate enough space to slide a lifting rope beneath the drum.

The hull remains exposed in 2006 are insufficient to allow us to draft definitive conclusions about how this ship was built, but two of the surviving frames appear to have been installed so as to accommodate one of the three marble slabs, suggesting that the slab was an early and purposeful feature of the ship's construction. In short, we are more optimistic than ever that the continued excavation and careful study, in 2007, of the ship's timbers and their relationship to the marble slabs, will make it possible to determine if this vessel was a purpose-built stone carrier like the *navis lapidaria* mentioned by Petronius (*Satyricon* 117). No artistic depictions of such ships survive, and the remains of more than a dozen ancient marble cargoes in the Mediterranean have been only superficially explored, their stones partly or wholly salvaged, so archaeologists know virtually nothing about the construction details of this important ancient ship type.

We continue to learn more, too, about the probable final route of the Kızılburun ship and its cargo (Fig. 12). The results of isotopic and maximum grain size analyses, conducted by Scott Pike of the Environmental and Earth Science Department at Willamette University and performed on a sample from one of the eight marble drums,

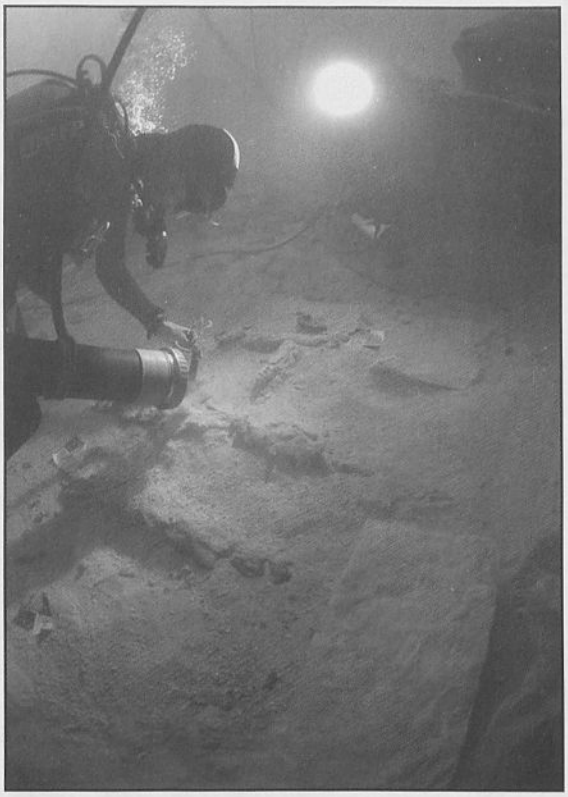
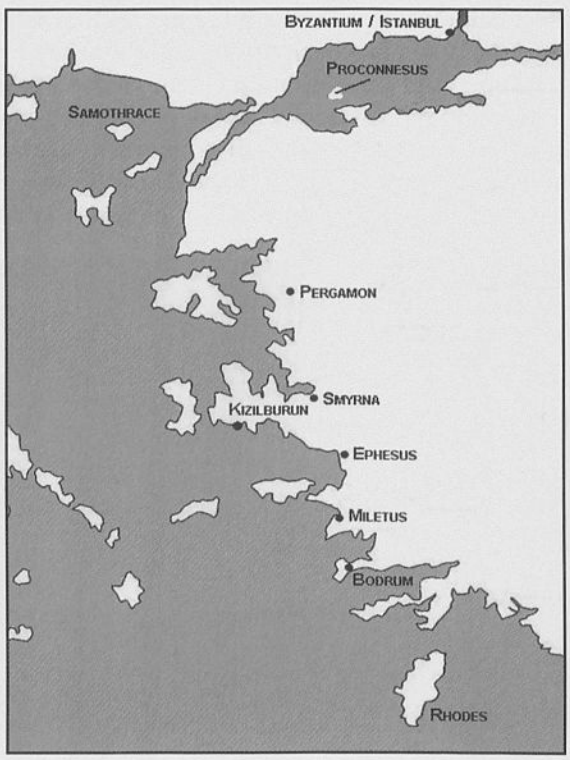


Fig. 11. *Two of the three marble slabs, and wood remains, under drum 5. Photo: Don Frey*

Fig. 12. *Map of western Asia Minor, with some of the sites mentioned in the text. Map: Deborah Carlson*



indicates that the island of Proconnesus in the Sea of Marmara was the probable source of the drum(s). Hellenistic pottery expert Susan Rotroff of Washington University, who was a delightful addition to our 2006 team, pointed out the presence of a ΘE (Theta – Epsilon) graffito on one partial amphora, which called to her mind similar examples from the sanctuary of the Great Gods (Megalon THEon) on the northern Greek island of Samothrace, near the Dardanelles. Furthermore, the closest parallels for the six grave *stelai* from the wreck have been found close by, in ancient Smyrna (modern Izmir), which implies that the ship's crew, working their way southward along the Aegean coast of Turkey, probably intended to call at a nearby port such as Ephesus, Miletus, or even Smyrna itself.

Fig. 13. *The wreck as it appeared at the close of the 2006 season. Photo: Heather Brown*

One of the most intriguing questions about this shipwreck concerns the final destination of the marble drums and capital, since a column of this magnitude was almost certainly meant to complete the façade of a monumental building like a temple. But Doric architecture on a monumental scale is practically unknown in the first century BC, which suggests that this orphaned column was either intended as a replacement for an earlier building damaged by earthquake, or represents a benevolent effort to complete a previously-initiated but unfinished project. For most large-scale building projects, the ancients relied on stone from local or regional quarries whenever possible, and so the expense of transporting such enormous pieces over considerable distances may imply that the Kızılburun marbles had been commissioned for a project under civic or imperial sponsorship.

With the exception of the largest marble blocks and the lead anchor stock, which were stored temporarily in the shallow waters near camp, directly beneath INA's two research vessels, the 1000+ artifacts raised in 2006 were registered, cataloged, photographed and stored in a small processing area in camp before being transferred, on September 6, to the Conservation Laboratory at the Bodrum Museum of Underwater Archaeology.

The Kızılburun 2006 excavation team included graduate students from the Nautical Archaeology Program at Texas A&M University, the University of Cincinnati, the University of Durham (England), Southampton University, and Ca' Foscari University in Venice, Italy, all of whom received valuable training in underwater excavation methods. One of our own Texas A&M graduate students, Catherine Sincich, was selected by the Divers Alert Network (DAN) to serve as a research intern, gathering data for DAN's Project Dive Exploration, an ongoing and long-term study of dive profiles spearheaded by Vice President for Research Richard Vann, who also designed the oxygen-decompression dive tables that INA has been using for almost 20 years.

Divemasters Feyyaz Subay and Ken Trethewey ensured that the 2006 team carried on INA's excellent safety record, logging over 1,500 dives to the site without a single incidence of decompression sickness (DCS). Our accomplishments this season were recorded in HD-TV by a three-man film crew from Spiegel TV in Germany (for a documentary scheduled to appear in 2008), and on film by a British team producing an episode on super ships for the History Channel. INA's Don Frey captured hundreds of still photos for National Geographic, who not only funded the project but generously agreed to let two outside film crews shoot our work for production in other countries.

With the successful relocation of four of the eight column drums, and the excavation of the upslope area nearly complete, the Kızılburun shipwreck project is approximately 60% complete. We aim to begin the 2007 season with the removal of the remaining drums and capital (Fig. 13), giving our INA team sufficient time to record and raise all hull remains preserved beneath, bringing the excavation of the Kızılburun column wreck into its final phase.

Acknowledgments
The entire Kızılburun excavation team extends our deep appreciation to the Turkish Ministry of Culture, INA president and project permit holder Donny L. Hamilton, our capable Turkish commissioner Sinem Özongan, and Yaşar Yıldız, Director of the Bodrum Museum of Underwater Archaeology, as well as the many staff members of INA's Bodrum headquarters.

Our 2006 group was tended by team physicians Boris Breivogel and Cameron Gillespie, who were an indispensable resource for our numerous minor (and a few major) lacerations, aches, and infections. Richard Fryburg very kindly donated his time and various pieces of equipment to help us achieve our summer goal of moving the column drums. Antonio Cressi and David Avallone of Cressi-Sub in Italy made it possible for us acquire new dive gear and scuba tanks at a significant discount.

Team spirits were buoyed on several occasions by visits from INA supporters Danielle Feeney, Jeff Hakko, Oğuz Aydemir, Gabby Pratt, and Ron Vandehey, as well as INA Executive Director Jim Delgado and his wife Ann Goodhart. Newcomer Fran White did a superb job as our resident chef, and never ceased to provide our weary group with hot, delicious, restorative meals as well as the occasional birthday pastry.

This annual field report was submitted later than usual owing to the fact that I had the good fortune to spend the fall semester in Bodrum finalizing my research on the artifacts from the Tektaş Burnu shipwreck (440-425 BC), courtesy of a fellowship from the American Research Institute in Turkey (ARIT), which I am honored to have received. While in Bodrum I learned that the local Özel Hastanesi routinely provides x-rays of metal concretions from INA shipwreck excavations (including Kızılburun) at no cost, and I would like thank the hospital staff for their support and generosity in affording us this service.

The 2006 Kızılburun team, left to right: Front: Feyyaz Subay, Sinem Özongan, Kim Rash, Catherine Sincich, Zafer Gül, Faith Hentschel, Heather Brown, Courtney Higgins, Kris Trego, Murat Tilev, Boris Breivogel. Back: Vince Valenti, Donny Hamilton, Joshua Daniel, Piotr Bojakowski, Bayram Kosar, Fran White. Not pictured: Debbie Carlson, Alexis Catsambis, Don Frey, Cameron Gillespie, Sheila Matthews, Mariangela Nicolardi, Giles Richardson, Ken Trethewey, Jeroen Vermeersch. Photo: Deborah Carlson

Learning How to Map a 70-Ton Ship

Courtney R. Higgins

A summer working on the Roman shipwreck at Kızılburun, Turkey, was an opportunity that I was not able to turn down. While coping with the challenges of diving to a depth of 150 feet twice per day, I was simultaneously exposed to the art of excavating under water, the transport of artifacts from the seafloor to the field conservation lab, and the various levels of recording. Even before the first fin hit the water, I was interested in the mapping techniques utilized on previous INA shipwreck excavations in Turkey, and was eager to learn how underwater procedures compared with my experiences in terrestrial site recording. INA staff member Sheila Matthews, who has employed and refined digital mapping techniques for the shipwreck excavations at Tektaş Burnu, Pabuç Burnu, and now Kızılburun, became my instructor.

Fig. 1. *Team member Courtney Higgins takes mapping photographs of the Kızılburun shipwreck's zone 17. Photo: Deborah Carlson*

For the past seven years, INA archaeologists have been using two software programs, *Site Surveyor* and *PhotoModeler*, in tandem to map a given site. The first step in this process is to establish "control points," or fixed datum points, around the site; at Kızılburun they are either freestanding weighted steel towers or metal spikes driven into the surrounding rocks. One of the control points is established as the primary control point; heights of the other control points are determined in relationship to this main point of reference. Divers also record the distances between points with measuring tapes. These data are uploaded into *Site Surveyor*, a computer program which calculates the positions of the points using trilateration. If the distances between the control points are inaccurate or problematic, the program highlights it and the divers re-measure it. Since the relative provenience of all artifacts is based on the network of control points produced by *Site Surveyor*, the accuracy of the measurements is of prime importance.

In order to map artifacts with *Site Surveyor* all of the artifacts would have to be measured to the control points. Since this is a time consuming process, artifact provenience is plotted in *PhotoModeler*. By using digital photos of the site taken by divers every one or two days the artifact sizes and relative distances between them is calculated by the program (Fig. 1). The lengthy process of plotting the artifacts consists of identifying and marking several discrete points on a given artifact in at least three photos taken from various angles. In order to easily identify the same discrete point in each photo, brightly colored mapping pin flags are placed at the center of each artifact prior to mapping photos being taken (Fig. 2). Each photo must include at least two of the one dozen control points (either towers or stakes), which are also marked and correlated among a selection of different photos. As stated earlier, *PhotoModeler* only provides relative distances. In order to obtain the artifact coridnates, the distances generated by *Site Survyer* are assigned to the plotted control points. Every artifact was mapped in *PhotoModeler* and numerous rough maps were created for each zone of the site as the excavation progressed. Eventually, the smaller maps, comprised of artifact points, are combined to create an overall site map that appears on page 3. The artifacts that appear on the site map were

Fig. 2. *Colored metal grids and mapping flags mark artifacts making it easier to identify them in mappping photographs. Photo: Catherine Sincich*

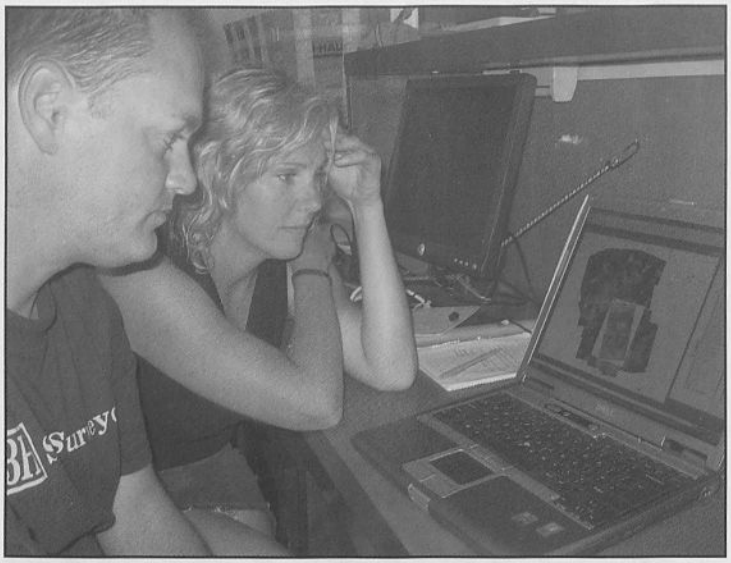


Fig. 3. *Peter Holt and Sarah Ward process the data collected from Kızılburun in* Site Recorder 4. *Photo: Courtney Higgins*

created by means of a 3-D modeling program called *Rhinoceros®*.

Among the professionals who visited us at The Kızılburun last summer was the creator of *Site Surveyor* program, Peter Holt of 3H Consulting Ltd. Peter and 3H's chief trainer Sarah Ward dived with us for one week at the beginning of August to observe our techniques and introduce the newest version of the program, *Site Recorder 4*, to our project (Fig. 3). The new version is the next level of mapping after *Site Surveyor*, produced by 3H Consulting Ltd. It is a Geographic Information System (GIS) specially designed for underwater and intertidal sites, and features not only mapping capabilities, but also the possibility of storing, retrieving, and linking artifact and personnel records associated with the project. Previous versions, specifically *Site Recorder 3*, were used on numerous projects including the 2003 *Mary Rose* excavation project. *Site Recorder 4* is the first version which is designed specifically to be able to record a site in its entirety.

Some of the features of *Site Recorder 4* were demonstrated to team members using the data we had gathered to date. We were able to transfer not only our control points from *Site Surveyor*, but also the artifact coordinates produced in *PhotoModeler*, photo mosaics, and hand-drawn sketches of environmental features. By placing different types of data on different layers, viewing them individually was as simple as a click of the mouse; we were able to see the results of two seasons of excavation simultaneously as well as independently. Overlaying the 2005 photo mosaic with one taken in 2006 made it possible to appreciate how much the site had changed, owing to the absence of the stelai and marble blocks upslope as well as the four column drums removed in the course of the summer.

In order to organize the thousands of digital photographs, dive logs, a daily journal, team member profiles, and artifact records that accompany a project of this scope, the Kızılburun team relies on a relational database designed by TAMU graduate student Heather Brown using the *FileMakerPro* software. *Site Recorder 4* not only has the capability to store this information, but also the ability to associate or link it to other data or artifacts and the site plan. By selecting the artifact's location on the map layer, all of the associated information can be viewed, such as photos, date of discovery, the diver who found it and the like. While the Kızılburun project is currently using two different programs to store these data, *Site Recorder 4* should make it possible to have all the data in the same program.

For me, working on mapping every day for hours at a time highlighted the importance of looking at the site as a whole, as well as relationships of individual artifacts within it. The meticulous and time-sensitive nature of underwater work often makes it difficult to appreciate what others are uncovering or how the environment might be affecting the artifacts found. When I looked at the whole map with its layers married together, patterns and questions arose relating to topography, the orientation of the drums, and artifact distribution, both vertically and horizontally. As the Kızılburun excavation continues in the summer of 2007, I look forward to learning more about these spatial relationships and theorizing about the reasons for their existence.

To see more on the Kızılburun site visit http://ina.tamu.edu/kizilburun/ or to learn more about the use of *Site Recorder 4* at Kızılburun check out http://www.3hconsulting.com/SitesKızılburunMain.htm.

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Acknowledgements:
I would like to thank Drs Deborah Carlson and Donny Hamilton for the opportunity to work on such an exceptional shipwreck. I also appreciate their support and encouragement in all aspects of the INA Quarterly, especially this issue. In addition to being an inspiration to me, I am deeply indebted to Sheila Matthews for the time and patience she gave during my mapping training. I would also like to thank Peter Holt and Sarah Ward, for I found the knowledge they shared invaluable. I am appreciative to Dr Deborah Carlson, Peter Holt, Heather Brown, and Alexis Catsambis for their time and guidance in the writing of this article.

Portugal- The Lagos Project: 2006 Survey

Letter from the President of the Lagos Municipality

If it is true that the soul of a city is the sum of its memories with its present qualities and its plans for the future, then Lagos is a great city. Although more often than not real estate pressure makes it difficult to be overly optimistic about the future of any seashore city in the south of Portugal, Lagos is preparing itself to grow and develop as a tourist center having in mind its amazing past.

Many tourists come to Lagos every summer to enjoy the magnificent beaches – among the most beautiful of the whole Algarve region – as well as the marvelous climate, culture and food. But Lagos has a lot more to offer, and not only on a seasonal basis. Its mild winters, golden springs and warm autumns, together with the city's rich past, constitute an asset that must not be overlooked. After all, Lagos is the capital of the Portuguese Discoveries of the 15th century! Prince Henry the Navigator lived and died here, and Lagos saw many *barcas*, caravels, and *naus* leave to explore the southern seas and return loaded with exotic cargoes that often times were exchanged for small fortunes.

As it is today, during the 15th and 16th centuries Lagos was a cosmopolitan city from where expeditions, of both war and commerce, were sent by Portuguese and foreign merchants, "showing new worlds to the world" as it is sometimes said. The inhabitants of Lagos played a very important historic role in the European Discoveries, making possible the contact between cultures and populations that had been separated for thousands of years.

This is why during the last four years I have invested important resources in the study of the city's past, which in Lagos does not begin at the time of Prince Henry the Navigator but is around 7,000 years old.

Land excavations are progressing at a good pace under the competent orientation of Elena Morán, and now I felt that it was time to start assessing the importance of the city's underwater cultural heritage. This is a daunting task, entailing a long-term commitment that I cannot undertake since I am only an elected officer, but I decided to do it the best possible way, by hiring Tiago Fraga, a graduate student at Texas A&M University, and by enlisting the help of the Institute of Nautical Archaeology and a team of students from the same university.

The City of Lagos has signed a Memorandum of Agreement with Texas A&M University to secure long-term cooperation in order to assess, study, protect, and publish the city's underwater cultural heritage in coordination with the land archaeology team, in order to reconstruct and publicize the city's rich seafaring tradition.

This first year was very promising. Although no shipwrecks have been precisely located so far, Tiago Fraga has compiled an enormous amount of data and selected a number of areas of great archaeological interest.

During the month of June, under the orientation of Texas A&M University Professor Filipe Castro, and Dr. Rui Loureiro, the Head of the Municipality's Centre for the Study of the Portuguese Discoveries, the Nautical Archaeology Program at Texas A&M University offered a summer school at Lagos to its students. Financially supported by the Municipality, Dr. Castro and his students hosted a series of lectures in the Public Library.

Both course and conferences were a success. I hope that this is the beginning of a long-term project that may one day be at least as exciting and important as the Institute of Nautical Archaeology's center in Bodrum.

- Dr. Julio Barroso

Letter from the Minister of Culture

A decade ago the Portuguese Ministry of Science launched the Program "Ciência Viva", which could be translated as "Living Science", through the foundation of a National Agency for Living Science. This project aims at strengthening the scientific education of the Portuguese primary and secondary student population, through the creation of didactic centers throughout the country, where scientific principles can be diffused. Centers for Living Science have been built in many Portuguese cities, each one different from the next, but all united in their aim to create a 'taste for science' among the Portuguese youth.

Each Center for Living Science is organized around a specific theme, such as 'water', 'astronomy', 'the human body', 'mathematical games', 'urbanism', etc. And each center is equipped with didactic installations, graphic information and experimental modules, adapted to their main theme. Even though each center is autonomous from the others, though usually dependent on local municipalities, they all coordinated by the National Agency for Living Science.

The Municipality of Lagos, a beautiful city in the South Portugal, is now building its own Center for Living Science, dedicated to the "Science and Technology of the Discoveries".

The port of Lagos was the strategic base of Prince Henry the Navigator, when, in the early 15th century, he launched the first voyages of geographic exploration, which initiated the globalization process we are still witnessing today.

Lagos wants to use this historical memory to promote the city as the "Capital of the Discoveries", through a

series of projects that are aimed at exploring the cultural and tourist potentialities of this unique period in Portuguese history. The Lagos Center for Living Science will explore the scientific principles related to the 15th and 16th century art of navigation, shipbuilding and cartography. How were the caravels built? Based on what principles did they sail? What kinds of instruments were used in astronomical navigation? How did an astrolabe work? Was it accurate? What kinds of maps did Prince Henry's sailors use? How did these men perfect their maps? These and many other questions will give rise to a series of equipments and modules—graphic, mechanical and electronic- that will use the history of the Discoveries to promote scientific education.

-Dr. Rui Loureiro

Lagos and Algarve: Three Millennia of Seafaring History

Filipe Castro

Algarve is the southernmost region of Portugal. Its name derives from *al Gharb*, the Arab designation of the western part of the al-Andaluz province. Algarve's culture is both a result of its isolation – it is physically separated from the rest of the country by a chain of mountains – and its diverse contacts with the seafaring peoples of the Mediterranean and the North of Europe during at least the last three millennia.

Its continuous contact with the Mediterranean made it a part of that world, or at least a part of a larger Mediterranean world, one that encompasses the regions away from its shores, but where the Mediterranean culture still resonates with considerable intensity.

Lagos is perhaps the best preserved and most beautiful of the older known settlements in Algarve. Its history is well known, even if its rocky soil did not preserve all its archaeological wealth. When it is mentioned by Classical authors it bears a Celtic name: *Lacobriga*. With or without extensive archaeological remains, Lagos is a cultural treasure with an amazing history. Let us take a quick look at the historical context.

Algarve's archaeological record is rich, and its most important archaeological sites span a period of over five millennia. Evidence for early seafaring activities is indirect, but it is clear that there were intense contacts between the inhabitants of its early settlements – near today's Castro Marim, Tavira, Faro, Silves, Lagos and Aljezur – and the Mediterranean seafarers, such as the Phoenicians, Greeks, and Tartessic and Punic peoples, from at least the beginning of the 1st millennium BC.

We know almost nothing about the settlements of the first half of the 1st millennium BC, but around the middle of that millennium there were a number of cities in Algarve (Fig. 1). The prevalent form of social organization in this area was almost certainly the city-state. The ruins of their defensive stone houses, built predominantly in a Mediterranean style, still remain. During the 7th century, it is believed that writing, the potter's wheel, and iron technology all arrived in Algarve, probably introduced by Phoenician visitors.

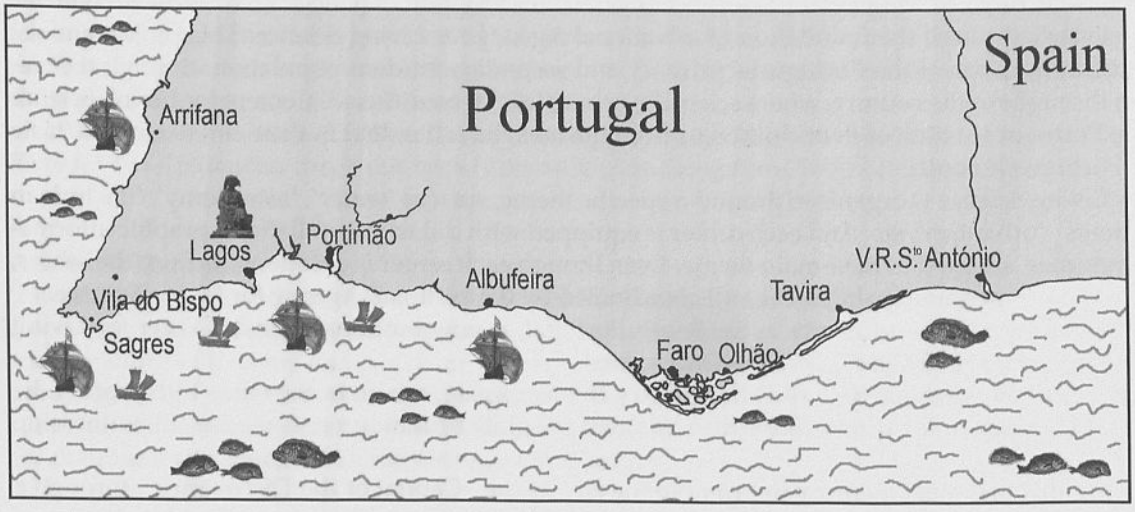

Fig. 1. *Map of the Algave region of Portugal. Map: Filipe Castro*

Classical authors refer to five pre-Roman cities from east to west: *Baesuris, Balsa, Ossonoba, Portus Hannibalis* and *Lacobriga*. Traveling west past *Lacobriga* there was the city of *Promotorium Sacrum* (today's Sagres) and the sea. Evidence suggests that the settlement of *Lacobriga* is located near today's city of Lagos. The earliest settlement was around the nearby village of Bensafrim, and a later one was at Monte Molião.

After the fall of the Roman Empire, the Byzantines conquered the eastern and southern part of the Iberian Peninsula and kept control of *Ossonoba* (presently the city of Faro) until AD 624. Subsequently Algarve fell under Visigoth rule, beginning with the reign of King Suintila (AD 621-631) and continuing until the death of King Wamba (AD 672-680). During the second half of the 7th century this region experienced the chaotic situations generated by a number of civil wars that shook the Iberian Peninsula. The diocese of *Ossonoba* included more or less the territory that forms Algarve today.

In 711, supported by one of the Visigoth factions, Algarve was invaded by an Umayyad force, largely composed of Barber Muslims, under Tariq ibn Ziyad. The 12,000-man army did not encounter much resistance. The following year the governor of North Africa, Musa bin Nusair (640-716), sent a reinforcement of 18,000 men, and Tariq completed the conquest of the entire Iberian Peninsula between 714 and 716. Algarve remained under Arab domination until 1249, when the last Muslim city in what is today Portugal fell to the Christian armies. In Spain, Granada was the last city to fall to the Christian rulers in 1492.

Information about the first two centuries of Arab rule is scarce. Evidence suggests the existence of Christian and Muslim communities living together in peace, and a functional organized society working the fields, fishing, trading, and paying taxes to the Umayyad caliph in the East until 750. After the advent of the Abbasid dynasty in the Middle East, Umayyad princes took over the empire in the West, with primary cities in what is today Silves, Faro, Tavira and Loulé.

During the 9th century the territory was attacked by the Vikings, which resulted in an important naval battle near Lagos in 966. Chroniclers reported that a fleet of 28 Viking ships was sighted off the coast of Portugal. An Arab fleet left Seville, engaging the "infidels" in the Arade River. Many Vikings are said to have been killed, and many of their vessels were sunk. The surviving enemies fled, leaving behind the Arab prisoners that had been taken during the raid.

In the late 11th century, Algarve was invaded by the Almoravid Berbers and again, less than a century later by another Berber tribe, the Almohads. During the 12th century the Christian *reconquista*, started by Charlemagne with the conquest of Catalonia four centuries earlier, gained momentum with the spirit of the crusades. The Algarve region was attacked several times by Christian armies. However, in spite of the political turmoil of the Berber fights and the increasing Christian harassment, Algarve seems to have thrived economically until the full conquest of the region, in 1249, by the army of King Afonso III (1247-1279).

After the *reconquista*, Algarve populations endured a crisis that stemmed from the disruption of maritime commerce with Muslim-controlled Mediterranean harbors, followed by a short period of demographic and economic growth in the late 13th and early 14th centuries. Then the region suffered the Black Death of 1348-1351, the wars with Castile (1369-1371, 1372, 1373, and 1381-1382) and the Portuguese war of succession of 1383-1385.

During the late 14th and early 15th centuries Algarve experienced an important phase of economic growth, and Lagos became a critically important city, tightly connected to the process of maritime expansion whose beginnings historians place in 1415, with the conquest of the North African city of Ceuta by King João I.

Lagos played an important role in the support of military incursions into the north of Africa led by King João I (1385-1433) between 1415 and 1433, and later by kings Duarte (1433-1438) and Afonso V (1438-1481).

Lagos seafaring traditions are widely known and commented on by historians and archaeologists, mostly due to Prince Henry the Navigaor, who lived there in the 15th century. He was the third son of King João I and after 1413 based himself in the western part of Algarve – at both Vila do Infante and Lagos – from where he launched the maritime expeditions that led to the colonization of the Madeira, Azores, and Cape Verde archipelagos, and the exploration of the western coast of Africa as far as present-day Sierra Leone. Henry's seafaring venture eventually led to the discovery of the India Route, which connected Portugal to India and a portion of the South American continent.

Under the influence of the discoveries movement Lagos city saw a period of impressive seafaring activity, starting in the 15th century and continuing throughout the following centuries. Naturally, some of the ships sailing to and from Lagos were lost in or around its bay.

Tiago Fraga, a Texas A&M student and the underwater archaeologist responsible for the inventory and assessment of the underwater cultural heritage of Lagos, has amassed an impressive list of historic shipwrecks and is now working on an underwater archaeological chart of the region. At his suggestion and with an invitation extended by Dr. Rui Loureiro, the Nautical Archaeology Program of the Department of Anthropology at Texas A&M University started

Fig. 2. *Lagos group: George Schwarz, Pearce Paul Creasman, Alexis Catambis, Tiago Fraga, Filipe Castro, Bryana DuBard, Samuel Koepnick. Photo courtesy of INA.*

a long-term cooperation with the Municipality of Lagos with the signing of the Memorandum of Agreement in 2006.

After the memorandum was signed I organized a summer school for the entire month of June 2006 (Fig. 2). Five students from the Nautical Archaeology Program – Bryana DuBard, Alexis Catsambis, Pearce Paul Creasman, Samuel Koepnick and George Schwarz – traveled, dived, visited museums and monuments, made friends and established professional contacts, looked for shipwrecks worth excavating. So far our search for shipwrecks has been in vain. We found anchors, guns, and concretions, and compiled many stories of shipwreck sites that were exposed in particularly harsh winters. The following three articles describe a few of the projects conducted by the Texas A&M team during the summer school.

To find shipwrecks in Lagos' waters is the ultimate objective of this project. The prospects are good, mostly due to Tiago Fraga's work of inquiry and archival research. We hope that this is a long-term project and that we can find and excavate shipwrecks that will tell us new things about the rich history of Portugal's seafaring.

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A Preliminary Shipwreck Survey in the Bay of Meia Praia

George Schwarz

The bay of Meia Praia, a long stretch of beach situated between Lagos and Portimão Portugal was one of the areas surveyed by Texas A&M University students during the 2006 summer field school in Lagos. The waters off this popular beach are reportedly replete with artifacts that span many centuries. In August 2005, Guilherme Neves, a Meia Praia lifeguard and long-time volunteer of underwater archaeological surveys, was informed by a local fisherman of the existence of a possible Roman vessel (based on ceramics) lying submerged in the bay of Meia Praia. At a depth of 12 meters, Mr. Neves and another diver discovered ceramic fragments and a piece of charred timber, possibly from a shipwreck. Mr. Neves informed the Centro de Estudos Marítimos e Arqueológicos de Lagos (CEMAL), and a professional investigation of the site was planned by nautical archaeologists from the Municipality of Lagos and Texas A&M University.

Historical documents show that seamen of different nationalities frequented the bay of Meia Praia for the purposes of ship repair, victualling, trade, and warfare. There have been numerous claims to archaeological finds in this area, similar to the case mentioned above. Since the bay of Meia Praia is a high-energy surf zone, many of the artifacts are normally buried under deep deposits of sand. Fortunately, summer of 2006 was an excellent opportunity to survey the bay with divers because much of the sand receded further than it had in many years. Due to extreme wave action, however, there is no clearly distinguishable matrix in which the ceramics and other artifacts were deposited. Moreover, it is probable that the deposition had been further disturbed from the tsunami that resulted from the 1755 earthquake, which was driven from its epicenter near Lisbon. Since Lagos was reported to have been hit by 30-meter waves that cleared the city walls, it is likely that objects from the shore were deposited into the sandy bottom of the bay. The results of the survey were analyzed and interpreted with this historical perspective in mind.

Although a preliminary search to relocate the potential Roman shipwreck sites was conducted by archaeologists from Lagos, the lack of clear references prevented the team from finding the exact locations. Since the area was known to contain submerged material culture, a further search was deemed necessary and organized through the Municipality of Lagos and Texas A&M University. The ensuing survey included a team comprised of divers, archaeologists, and technical assistants. The main objective was to relocate the area described by Mr. Neves and sketch, record, photograph, and recover any artifacts that were discovered (Fig.1).

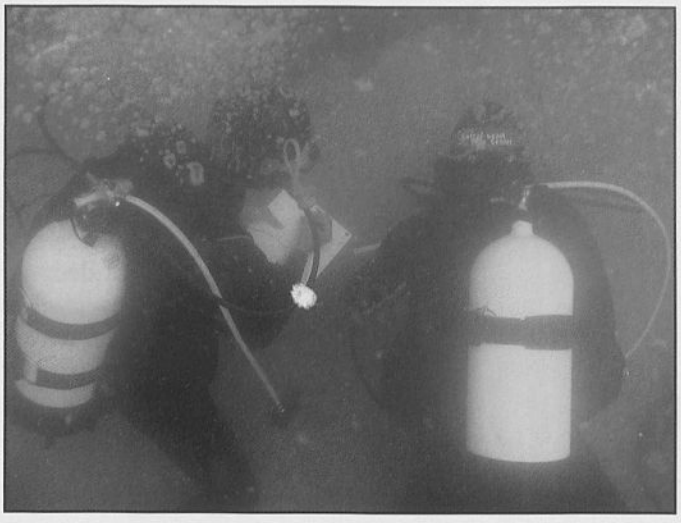

Fig. 1. *Bryana DuBard and George Schwarz record artifacts in situ. Photo: Pearce Paul Creasman*

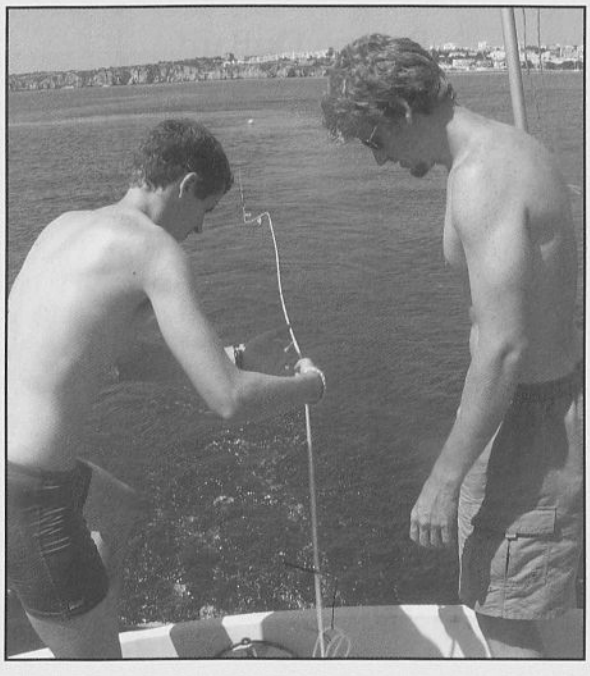

Fig. 2. *Pearce Paul Creasman and George Schwarz deploy the survey baseline. Photo: Samuel Koepnick*

Using previously obtained coordinates that were marked on a hand-held GPS device, the team made a baseline from which to conduct swim-line surveys of the area with scuba divers. Once the research vessel was positioned directly over the first GPS coordinate, one end of the line, which was attached to a cement weight, was dropped into the water (Fig. 2). So that this end could be located on the surface, another length of rope attached a buoy to the weight. The boat then proceeded in the direction of the next GPS coordinate, and upon reaching a distance of 100 meters, the other end of the baseline was released. Once divers searched this trajectory, the rope was lifted and another set of coordinates was used to lay

another baseline. This technique was employed in a zig-zag type pattern until the survey area was completely investigated by the divers.

For two weeks, the bay was explored using this approach. During that time, archaeologists from the team recovered several artifacts. When an object was discovered, it was sketched and photographed in situ, then gently brought to the surface for further examination and conservation, which was largely conducted afterwards by the archaeologists from Lagos. Among the artifacts recovered during the survey were a decorative ceramic cup fragment, a plate fragment, a nail concretion, a possible axe fragment, a soup plate, and a millstone (Fig. 3). While many of these artifacts could have come from one or more shipwrecks, their actual provenience is unknown. Several objects could easily have been washed into the bay during the tsunami of 1755. Although no conclusive evidence of a wreck has yet been discovered, the project was a good preliminary investigation of the area. The students and other participants learned a good deal about surveying techniques using baselines and scuba to perform controlled searches for submerged material culture.

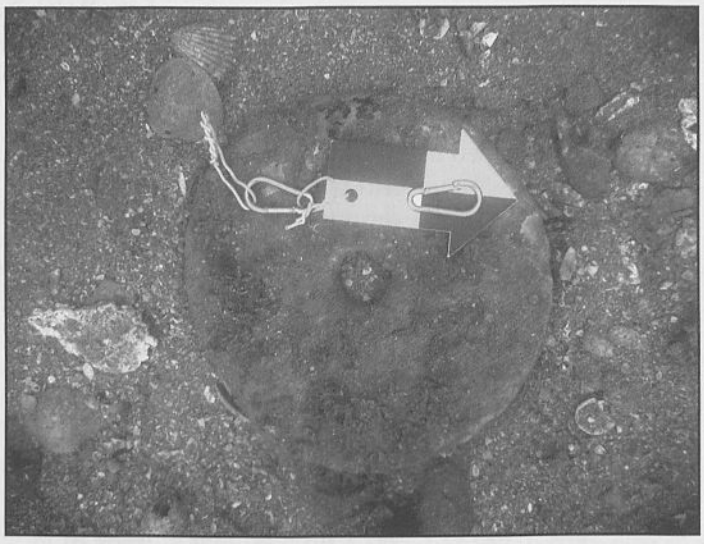

Fig. 3. *Millstone in situ. Photo: Pearce Paul Creasman*

Despite the assortment of objects listed above, no ship timbers were discovered during the survey. Neither was there any other direct evidence of shipwrecks in this area, other than the scattered artifacts found from this and previous swim-line surveys. A more intensive search using specialized equipment such as sub-bottom profiler, magnetometer, and side-scan sonar devices would be more appropriate to locate ship timbers buried beneath the sand in the bay of Meia Praia. This project did, however, provide useful information about the geography and wave action of the area, as well as provide focus points for future surveys. Due to its location and maritime history, this culturally rich area undoubtedly contains submerged remains of wooden ships, and only needs to be explored in greater detail and with more advanced equipment.

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The Mysterious Iron Cannon at Ponta da Cama da Vaca

Bryana DuBard

During the 2006 field school season, Ponta da Cama da Vaca was surveyed by students from the Nautical Archaeology Program at Texas A&M University in conjunction with the Municipality of Lagos. The site became of interest through information provided by the Centro de Estudos Marítimos e Arqueológicos de Lagos (CEMAL), which reported the presence of either one or two iron cannon at Ponta da Cama da Vaca. Based on this information, Tiago Fraga decided to visit the site at the end of May 2006, accompanied by Brett Ringsell, owner and operator of OSMOSIS Dive Center, and two technicians employed by the Municipality. Following this initial assessment, a small team from Texas A&M conducted a follow-up investigation on June 29, 2006, with the intent of relocating and recording the cannon previously reported while conducting survey of the surrounding area. This team included Tiago Fraga, George Schwarz, Alexis Catsambis, Bryana DuBard, Brett Ringsell, and Mr. Simão, a local sport fisherman and informant for the project.

The site is located within an inlet approximately 10 kilometers west of Lagos. The cliff that shapes the shoreline has eroded directly into the sea resulting in a rocky subsurface terrain. Due to the shallow depth of just 1 meter, only snorkeling gear was necessary for the initial search for the cannon. Two of the four divers (Team 1) entered the water equipped with mask, snorkel, and fins while Team 2 conducted a visual surface scan of the seafloor from the boat. Mr. Simão sighted a corroded cylindrical object in the shallows near the west side of the inlet. Upon confirmation of the presence of trunnions and a cascable, Team 2 entered the water with scuba equipment to begin the recording process (Fig. 1).

The cannon was found lying upside down amidst large boulders and slabs of rock. Measurements yielded an overall length of 2 meters, a diameter of about 26 centimeters at the breech, and a circumference of roughly 78 centimeters at the muzzle. Due to heavy concretion, however, it was not possible to measure the diameter of the bore. The cascabel, or extension at the breech of the cannon, had a circumference of 39.5 centimeters and a length of 18 centimeters. The trunnions, used to elevate the gun vertically on its carriage, were located below the centerline at half the overall length of the cannon and measured 13-14 centimeters in diameter.

While Team 2 recorded the cannon, Team 1 continued to canvass the surrounding area using the natural parameters of the inlet as a guide. Due to its small size as well as the exploratory nature of the survey, no defined swim-line corridors were followed. Still, a few finds were documented, including a stone object with possible man-made features, an oblong iron concretion with a rectangular indentation extending its entire length, and a multitude of small to medium-sized ballast stones scattered throughout the site. Despite the presence of ballast, however, no clear concentration of the stones was apparent.

Lastly, trilateration was used to map the area containing the iron cannon and the other two objects of interest. This was undertaken by both teams and was accomplished by measuring the distance between the ends of each of the three artifacts mentioned. The entire site amounted to an area of approximately 30 square meters. Regrettably, the survey of this location took place on the last day of the field school, and therefore the team was unable to thoroughly explore the greater site area.

Fig. 1. *Tiago Fraga measures the distance to the cannon. Photo: Alexis Catsambis*

Subsequent to the dive, further analysis and research was carried out. First, Tiago used the sketches and photographs to digitally render the cannon in the software program *Rhinoceros®*, which allows for a more comprehensive view of the gun (Fig. 2). In determining the object's date, the horizontal position and shape of the trunnions are important. As stated previously, the trunnions of the Ponta da Cama da Vaca cannon were located below the centerline. This indicates a date of foundry sometime during the 16th or 17th centuries, as it was common practice from the 18th century onward to place the trunnions at the centerline. Unfortunately the shape of the trunnions, also critical to dat-

Fig. 2. *Photograph and 3-dimensional overlay of the cannon at Ponta da Cama da Vaca. Photo and graphics: Tiago* Fraga

ing, remains undetermined due to the concreted state of the cannon. If the earlier date based on the placement of the trunnions is correct, it is likely that the shape will be found to be that of a truncated cone, as the cylindrical type did not appear until the 18th century. Without supplementary information from associated artifacts or the uncovering of markings currently concealed by the thick encrustation, an exact date is unattainable.

In conclusion, the future of this particular site and the cannon is dependent on a number of precursors. First, because no reference regarding the sinking of any vessel in or near this location has yet been found within historical documents, investigations must be initiated with regard to the region's history and its maritime activity. Additionally, since this dive was primarily for the purposes of locating the cannon, future surveys utilizing more controlled surveying techniques may be required to facilitate the discovery of other artifacts. It would also be advantageous to revisit the site with oceanographic surveying equipment such as a magnetometer, side-scan sonar system and/or a sub-bottom profiler. The exact equipment used depends on the subsurface terrain outside of the area previously explored, as each piece of equipment has a limited range of application and requires a specific environment. Therefore the topography of the seafloor outside of the inlet must first be identified before supplementary surveying can be organized and the history and origin of the cannon revealed. Until this preliminary research is completed and the investigation continued, the story of Ponta da Cama da Vaca will remain a mystery.

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Technology in the Field: 3-Dimensional Modeling of an Anchor *in situ*

Samuel Koepnick

Unless an excavation or survey team has an unlimited budget, three-dimensional modeling in the field by means of direct measurement by imaging devices can be a very difficult proposition. In addition to funding the equipment, obtaining a power supply as well as a computer powerful enough to handle the gathered data can be near impossible. One of the projects completed during the 2006 Lagos season was measuring and 3-D modeling a large anchor at the site of the Motel Anchora. The team took over 150 discreet measurements over the course of one hour. These measurements were more than enough to create a basic reconstruction.

Software Used

- *Rhinoceros*® 3D 3.0 SR4
- Adobe® *Photoshop CS2*
- Microsoft® *Excel*

The initial step was to convert the data collected into a form usable by the modeling software. All of the measurements along the cylindrical sec-

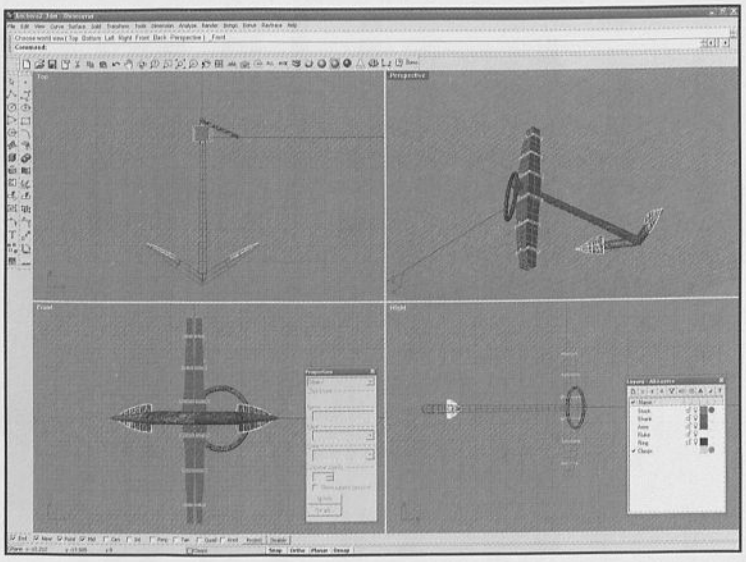

Fig. 1. *Screenshot of the workspace of* Rhinoceros ® *3D showing the anchor from the Motel Anchora. Image: Samuel Koepnick*

tions of the anchor were taken as circumferences. It is a simple matter to divide these measurements by π (pi) to obtain the diameter. The next step was to convert the numbers temporarily from centimeters to decimeters. Creating the model in decimeters was advantageous because the amount of memory needed to edit the model was less then the amount centimeters would have required. Secondly, decimeters provided more detail than meters.

Two different methods of modeling were used to ensure that all aspects of the artifact were recoded; consequently, since the two techniques slightly overlapped the margin of error was reduced. The first method involved converting the measurements into discreet Cartesian points in relation to an arbitrary datum point located next to the artifact. These points were then connected, creating an outline of the general shape of the object. The second method did not use a datum, but involved taking relative measurements on the artifact itself and plotting them in order to create the object's shape (Fig. 1 and 2). This technique is the one preferred by modelers because it allows for flexibility if a certain shape doesn't resemble its corresponding photograph as would be the case if the measurements were incorrect because of human error. Fortunately in the case of the Motel Anchora anchor both methods created shapes that matched the other without significant deviation.

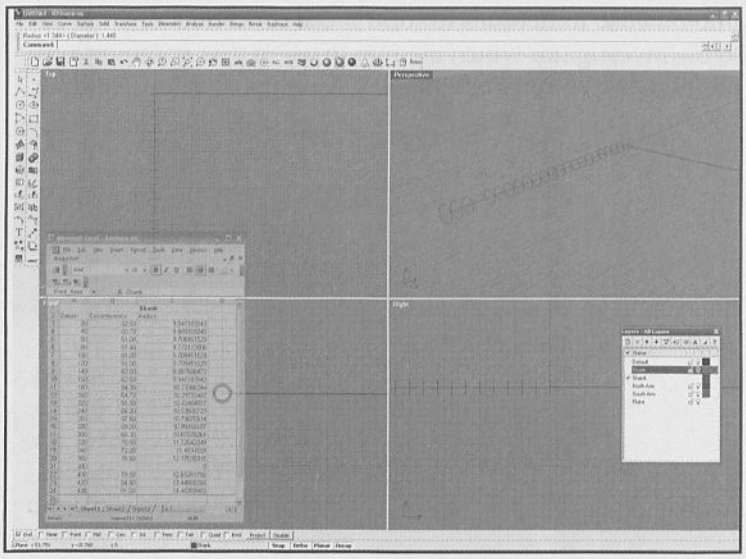

Fig. 2. *Measurements of circumference applied to the model. Image: Samuel Koepnick*

The model, along with its corresponding table of measurements, was sufficient for most scientific questions regarding measurements, form and function. However, of prime importance to conservators is the state of the surface of the artifact. During this project, several high resolution photos were taken of the surface of the anchor at various places. Areas exhibiting wildly divergent color and markings were photographed, but it was also important to represent the gradations in between in order to produce a more realistic model. Each photo was taken on the same scale so the images could be stitched together to form contiguous strips which could then be imposed onto the model (Fig. 3).

This project used several software programs, each having an important role to play. The modeling software was probably the most important choice and would greatly affect the rest of the software used. In graphics and modeling the de facto standards are Alias Maya and 3D Studio Max, both produced by Autodesk®; although these programs would have been immensely useful, the modeling software used was *Rhinoceros*® 3D. *Rhinoceros*® was preferable both because of its simple and intuitive CAD-like interface as well as the low system requirements necessary for it to run. The program worked flawlessly on a PC running a 750 MHz Pentium III processor; with the same conditions the other modeling possibilities would have run prohibitively slow, if at all. The operating system used was *Windows*® *XP Service Pack 2* running in a 32 bit environment. Three options are generally available, namely Windows®, Apple®, and various distributions of Linux. Windows® was chosen for ease of use, a vast library of software, and cost. The other options each claim to surpass Windows® in different areas; the cost however was deemed to be too high for the slight increase in performance.

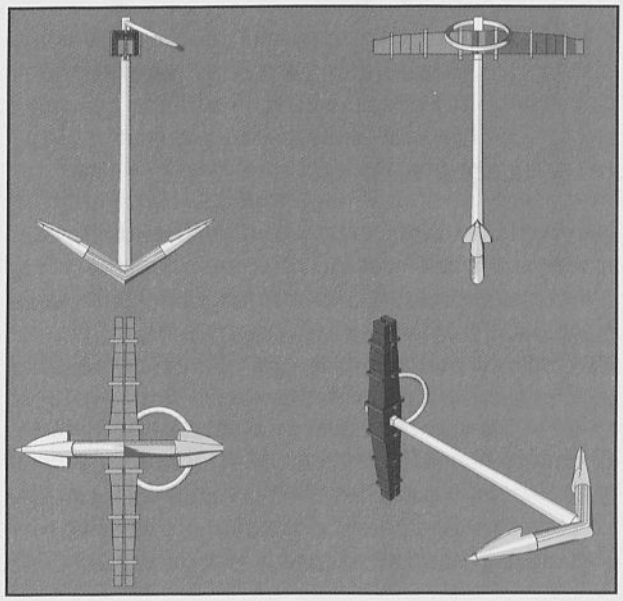

Fig. 3. *Architectural renderings of the main views. Image: Samuel Koepnick*

In this era of life-like computer simulations and the expectations for instantaneous dissemination of data, models like the one created for this project are no longer an option. There has been a great deal of use lately of laser scanning and

photometric techniques to form models. Ultimately it is up to the investigator which method to use. Laser scanning and photometric reconstruction can take large amounts of time but will also yield models with higher than millimetric accuracy. The hardware and software requirements for these techniques are correspondingly high in cost as well. For these methods half of the work is done in the field with as many scans or high-resolution photographs as possible. The other half is done in a lab combining the scans or images. The digital reconstruction was accurate enough to superimpose on to the orignal photograph of the anchor (Fig. 4).

Fig. 4. *A rendering of the anchor superimposed over an actual photograph of the original. Photo: Filipe Castro, Digital Image: Samuel Koepnick*

Recent tests in a controlled environment resulted in a complete scan of a geometrically regular object approximately 2 meters by 1.5 meters by 1 meter in a little over an hour. The time figure, but should be viewed very conservatively as conditions in the lab; controlled lighting, a constant power supply, ready access to computers, are seldom available in the field. The processing of the scans is an ongoing project that has proved to be very time consuming. The fact that the object is geometrically regular makes both phases of the process easier, however many archaeological remains do not have the fortune of being regular. While the anchor modeled can be diagnostic, its overall gross features are more important than nuances that would have been revealed if the model had been created at a millimetric level. In this case, from a cost-benefit standpoint, it was more efficient to model this artifact based on data rather than obtain the data from a scan. In cases involving intricately decorated objects, or one-of-a-kind artifacts a more accurate technique would have to be employed.

While this sort of modeling can be a great deal of fun, there does have to be an ultimate end. The next step for this project will be to create a bump map of the surface of the object. With a bump map the illusion of intricate surface textures is possible while maintaining a small file size and a reasonable load on the computer. Finally the volumetrics of the object will be reconstructed; its weight and water displacement will be calculated and measured against what is already known about the period the anchor operated in.

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The Lagos Project Acknowledgements

The Nautical Archaeology Program and INA team would like to thank the Municipality of Lagos , namely Mr. Júlio Barroso, the city's Mayor, as well as Dr. Rui Loureiro , director of the city's Projecto Municipal Ciência e Descobrimentos, for their invitation and generous support of this summer school. We would like to extend our appreciation to Mrs. Elena Morán, the city's archaeologist, for her invaluable help.

Dr. Peter Amaral, Texas A&M University alumnus and a long time friend of the Institute of Nautical Archaeology, and the Nautical Archaeology Program, whose generous contribution made it possible for the students to travel to Portugal. RPM Nautical Foundation, for its grant which allowed for the study of important collection of stone anchors from Ponta da Piedade and other underwater sites.

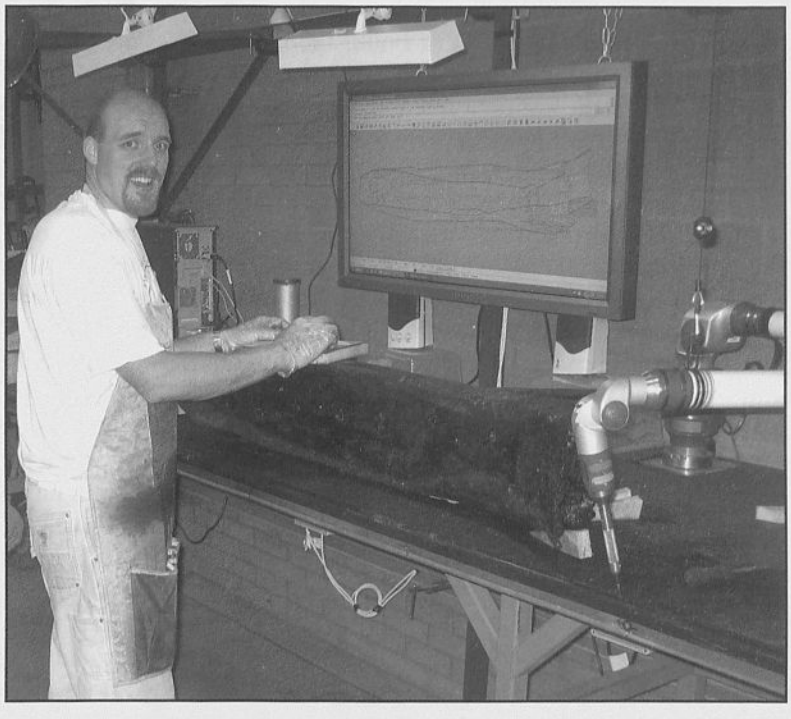
The Center for Martime Archaeology and Conservation at Texas A&M University for its substantial financial support. The logistics of this project were patiently and professionally handled by Brett Ringsel and the Osmosis Dive Center. The boats and storage areas were generously loaned to us by the great Clube de Vela de Lagos .

Where are they now?

Toby Jones

My name is Toby Jones and I am the senior project officer for the Newport Medieval Ship Project. I was recruited as part of a team tasked with cleaning and recording the recently discovered mid-15th century clinker-built merchant ship abandoned before 1469 along the River Usk in Newport, Wales, United Kingdom. I started working on the project soon after graduating from the Texas A&M University Nautical Archaeology Program in 2004.

The initial phase of the project involved turning the cavernous warehouse that stored the ship into a suitable ship timber cleaning and recording laboratory. The ship had been disassembled into several thousand component timbers during the excavation in 2002 and was stored in tanks spread around the warehouse. With the help of the project team, I set about designing work tables, installing plumbing, ordering tools and supplies, and laying the practical groundwork for what would rapidly evolve into a major nautical archaeological project employing around a dozen people, including archaeologists, conservators, administrators and various specialist consultants.



Toby Jones recording ship timbers with a FaroArm three dimensional digitizer at the Newport Medieval Ship Project lab. Photo courtesy of Newport Medieval Ship Project

Early on, the project leaders compared several types of recording techniques, including traditional tracings and laser scanning. The choice was made to utilize three-dimensional (3D) digital recording technology (specifically a FaroArm three dimensional digitzer). It was decided that additional training in this relatively new type of documentation would be desirable. A week after arriving in the UK, a colleague and I flew over to the Viking Ship Museum in Roskilde, Denmark, to take part in an intensive course in three-dimensional digital documentation. After returning to the UK, we began recording hull planks and frames and tailored the recording process to fit each type of ship timber. I created a documentation manual for the other staff to follow. With financial support from the Heritage Lottery Fund, we purchased three more FaroArms, and expanded the team size accordingly. My typical day-to-day work of recording ship timbers was altered so I could train the incoming archaeologists how and what to record with the digitizers.

The direction of the Newport Ship project has been greatly influenced by an independent expert panel, a group of esteemed nautical archaeologists from around Europe who meet annually to review progress and chart a course for the future. They bring ideas and experiences to the table, and provide a wealth of information regarding contemporary medieval ship construction. Members of the recording team also have the opportunity to travel and participate in other nautical archaeology projects, bringing fresh perspectives and enthusiasm to the project. I have used some of my time to assist another TAMU NAP alumnus, Justin Leidwanger, with marine surveys in the Republic of Cyprus.

During my time in Wales, I have presented papers about aspects of the Newport Ship at conferences around Europe and America. The recent discovery and significance of the find make it appealing to a variety of audiences. The fact that I am heavily involved in developing the 3D recording procedures has made this a focus of many of my papers. I believe that the use of digital recording will come to dominate large-scale archaeological timber recording projects in the near future.

Finally, I invite anyone in the area to drop by and see this amazing ship find first hand. Just contact me at tobynjones@yahoo.com or 0044 1633 215707.

For background on the Newport Medieval Ship project see: *INA Quarterly* Fall 2005 Jones

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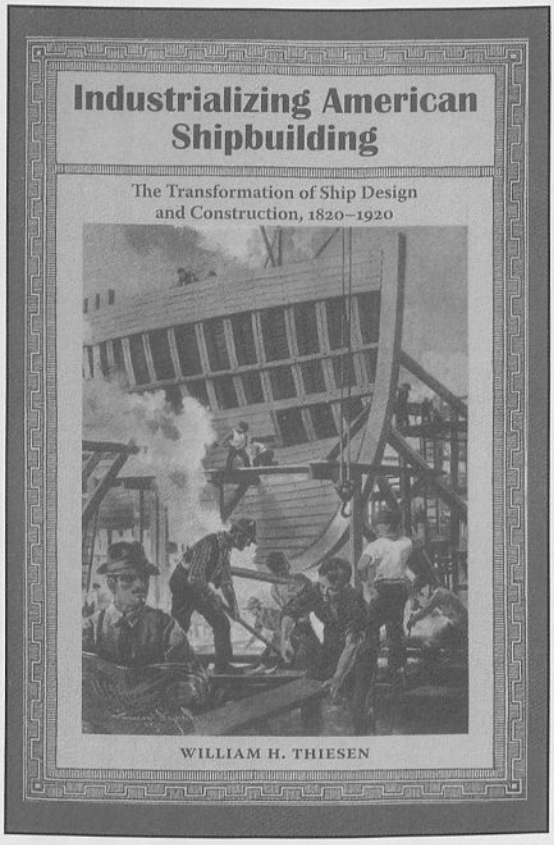
Just Released

Industrializing American Shipbuilding
The Transformation of Ship Design and Construction, 1820–1920
William H. Thiesen



Gainesville: University Press of Florida, 2006
ISBN: 0-813-2940-6, 302 + xi pp, 25 black and white illustrations, notes, bibliography, index. Cloth. Price: $59.95

William H. Thiesen recent book, *Industrializing American Shipbuilding*, is an engaging social and technological history of shipbuilding that spans the century from 1820 to the second decade of the 20th century. This book forms a necessary bridge between two well-known periods in nautical history, the early-19th century Golden Age of wooden ship construction and the fully industrialized shipbuilding that fluoresced during World War I. Despite its technical focus, the text is accessible to all readers because Thiesen clearly explains the often arcane nautical terminology that is necessary to describe ship construction. He also makes good use of quotes to enliven the text and his depth of scholarship is clearly evident in the extensive and insightful notes that draw heavily on primary sources.

Industrializing American Shipbuilding is strongest where it describes the shipbuilding process and addresses the socio-cultural and technological drivers for change in American shipbuilding. Thiesen posits that American and British shipbuilding diverged from a common Anglo-American tradition during the early years of the 19th century. The differences developed from both social (the dominance of British shipbuilding by educated, elite designers as compared to the American tradition of apprenticed, practical mechanics) and associated differences in design (British reliance on drafted lines as opposed to half-hull models in America). American ship construction prospered through technological innovation and an emphasis on practical training but eventually stagnated following the Civil War due to social and political forces. At that time, a new class of educated, affluent naval designers began to draw on British ship design and techniques in order to reinvigorate American ship construction, ushering in a period of American shipping dominance. Thiesen's use of Great Britain as a foil for American ship construction and his discussion of the exchange of ideas and technology between the two countries broadens the applicability of this book and allows for a much richer understanding of the period.

Thiesen extends Muckelroy's much quoted description of ships as the "largest and most complex machine produced" through the 19th century by demonstrating the role of ship construction in American industrialization. His description of the tasks involved in assembling a late-19th century iron vessel allows the reader to appreciate the complexity of these vessels and how the industry changed during the preceding century. While the workers remain largely faceless, the text focusing on capitalists and engineers, this is by no means a purely technical history. For instance, Thiesen explores not only the technical challenges of introducing pneumatic tools, but also the associated effects on the workforce. Additionally, his descriptions of the men who pushed ship construction into the industrial age are evidence of the power of individuals to drive industry. It is also interesting to note that many of the naval architects, merchant vessel designers, and men responsible for yacht designs were intimately associated. Many of these men were trained in the same institutions and remained in contact, allowing American shipbuilding to progress as a unit rather than as distinct subfields.

Industrialized shipbuilding is also firmly placed in the larger context of American industrialization and Thiesen draws on broad scholarship to demonstrate the relationships between ship construction and other industries. For example, he effectively argues that the construction techniques and modular design principles of bridge construction directly influenced late-19th century shipbuilding. By the advent of World War I, ship construction, which had long been a bastion of craft production, was fully integrated into the philosophy and technology of industrial construction. Thiesen quotes an early-20th century observer of Hog Island, then one of the newest industrialized naval yards in the nation: the island was the "assembling floor of a colossal ship factory, whose machinery was made up of all the interrelated wheels of American industry, whose employees were a large part of the entire body of American labor, and

whose conveyor belts were the American railway."

Industrializing American Shipbuilding is not without some minor shortcomings, including the repetition of particular facts and nearly identical phrasing, the occasional use of period sources for statements of fact rather than as evidence for the contemporary state of knowledge, and a few minor errors such as crediting Henry Eckford, rather than Noah Brown, with constructing the War of 1812 Lake Erie fleet. The period photographs are useful and well-placed to illustrate the text, but they nearly all depict Great Lakes shipyards while the text is almost exclusively concerned with coastal shipbuilding. This tendency is understandable given Thiesen's involvement with the Wisconsin Maritime Museum but it detracts from the book. These criticisms, however, are minor and do not detract from the overall strength of the book. This work is highly recommended to anyone interested in ship construction and design, regardless of period.

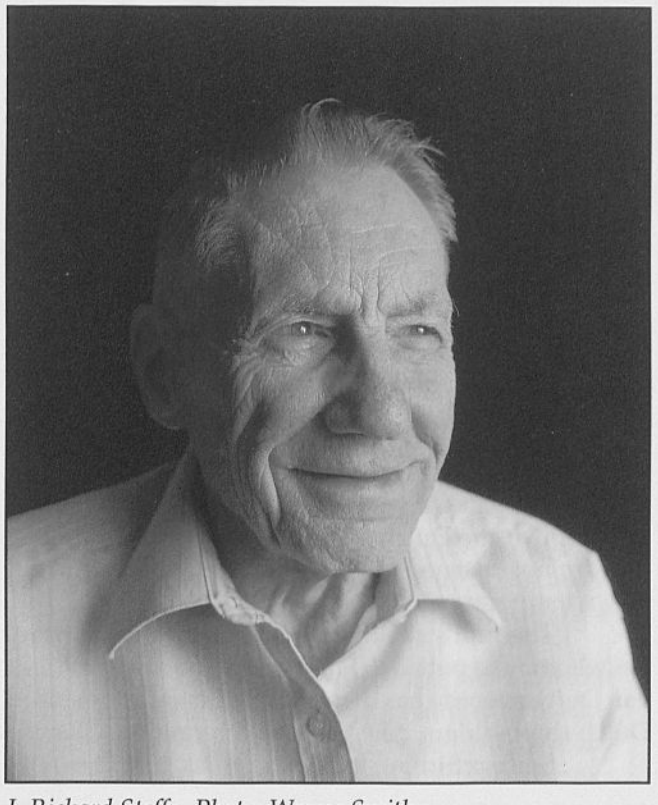
-Ben Ford

News and Notes

J. Richard Steffy Scholarship

Announcing the establishment of the J. Richard Steffy Scholarship for graduate students enrolled in the Nautical Archaeology Program at Texas A&M University.

J. Richard Steffy, known by most just as "Dick" was one of the first two archaeologists to start the Nautical Archaeology Program in 1976 at Texas A&M University, the same year that George Bass affiliated the Institute of Nautical Archaeology with TAMU. Dick retired in 1990 but has stayed active in ship research as an emeritus professor. He is recognized for establishing the Ship Reconstruction Laboratory, which is named in his honor, and creating the history of shipbuilding classes which are the basis of the present day shipbuilding courses in the Nautical Archaeology Program. While a professor at TAMU, no faculty member earned the respect of the students to the degree as did Dick; thus the best way we can honor him now is to establish an INA student scholarship in his name. The first scholarship will be given for the Fall Semester 2007 and qualifies the recipient to pay in-state tuition at Texas A&M University.



J. Richard Steffy Photo: Wayne Smith

Former students and friends of Dick are encouraged to contributed to an endowment fund that is being established to fund the scholarship. All contributions received from non-INA Directors will be matched dollar for dollar by INA allowing the contributions to be doubled. Checks indicating its purpose can be made payable to the INA and can be sent to:

Institute of Nautical Archaeology
P.O. Drawer HG
College Station, TX 77841-5137

For additional information contact Donny L Hamilton at *dlhamilton@tamu.edu.*

Yukon River Survey - 2007

The new Canadian INA project will begin field work in July 2007 when Dr. Wayne Smith, Dr. Robyn Woodward, Sam Koepnik and John Pollack will be joined by Doug Davidge of Whitehorse, and Doug Devine of Pacific Survey Supplies, Oregon. The first stage of the work will involve mapping the 130-foot 1908 wooden-hulled sternwheeler *Evelyn*, which lies at Shipyard Island, 60 miles from the road. The team will pilot the use of Leica and Minolta 3D scanners in a remote setting, to document a large vessel in five days. Two river boats will be used to cross Lake Laberge and descend the swift Thirty Mile section of the Yukon River to reach the site.

The team will also examine the wreck of the 210' sternwheeler, *Klondike*, which lies with its decks awash approximately 9 miles farther downstream. This latter vessel was located in July 2005 during a preliminary survey (see *INA Quarterly* 33.2) and is slated for detailed mapping in 2008.

The second stage of the season involves the documentation of several intact rudder-and-tiller systems at the Dawson City Shipyard, where a fleet of seven large sternwheelers lie abandoned in two rows on the western side of the Yukon River.

-john-pollack@shaw.ca

Center for Maritme Archaeology and Conservation Lecture Series

WA Museum Maritime Archaeologist Wendy van Duivenvoorde with the remains of Batavia*'s hull in the Shipwreck Galleries. Courtesy the Western Australian Museum, photo: Norman Bailey.*

After a resoundingly successful inaugural year, the Center for Maritime Archaeology and Conservation (CMAC) Lecture Series got off to an early start in 2007 with a special presentation given by Ms. Wendy van Duivenvoorde, Assistant Curator of the Western Australia Maritime Museum (WAMM) in Fremantle and doctoral candidate in the Nautical Archaeology Program (NAP). Ms. van Duivenvoorde is a veteran of several INA projects and is studying the hull remains from the Dutch East India Company (VOC) ship *Batavia* for her Ph.D. dissertation on late 16th and early 17th century Dutch shipbuilding practices. The *Batavia* was blown off course on her maiden voyage to Indonesia in 1629 and wrecked on the Houtman Abrolhos Reef off Australia's western coast. WAMM Archaeologists discovered the shipwreck in 1963 and raised the remains several years later. After a lengthy conservation process, a substantial part of the aft-most side of the hull was reconstructed and displayed along with other shipboard artifacts in the WAMM's Shipwreck Galleries. According to Ms. van Duivenvoorde, the *Batavia* timbers are the only surviving example of an early 17th-century Dutch East Indiaman to be raised and conserved, and thus represent a unique opportunity to investigate the building techniques and design concepts that made the Dutch the foremost shipbuilders in northern Europe of that period. In her lecture, "From *Batavia* Onwards: New Light on Dutch Shipbuilding Practices," Ms. van Duivenvoorde highlighted her ongoing research of *Batavia*'s hull and some of the significant discoveries it has revealed.

Ms. van Duivenvoorde has been able to show that *Batavia*'s hull was built using a bottom-based construction method that the Dutch had employed since the Medieval period. The evidence for this includes futtocks and floors that are not fastened to each other, and rows of plugged holes (spike plugs) in the planking strakes that indicate the use of temporary cleats.

The hull's shell consists of two layers of oak planking and a third, sacrificial layer of thinner pine planking nailed onto the outside. Through careful study of this construction, along with relevant Dutch archival materials, Ms. van Duivenvoorde has demonstrated that the practice of "double-planking" large, ocean-going ships was standard for Dutch shipbuilders. She has also determined when in the construction process the second oak layer was applied.

Since returning to Australia, Ms. van Duivenvoorde has received the results of dendrochronology or tree ring dating of *Batavia*'s timbers, which revealed surprisingly that the ship was built from 200-year-old oaks harvested from forests in Poland. Intriguingly, the forests were the same ones from which renowned Flemish artists such as Rembrandt and Rubens sourced wood for panels on which they painted their 17th-century masterpieces. According to Ms. van Duivenvoorde, this is the first example of wood from this region being used in shipbuilding.

In concluding her talk, Ms. van Duivenvoorde announced that she will be leading a research project this summer at the WAMM to record the conserved *Vergulde Draeck* (1656) hull timbers for study and publication, and extended an invitation to NAP students to participate in the effort. The hull remains of this Dutch East Indiaman that, like *Batavia*, ran aground off the coast of Western Australia, could provide important information about the transition from bottom-based to frame-based construction in Dutch shipyards and, together with *Batavia*'s remains, reveal much more about this exciting period in Dutch naval history.

-Mark Polzer

In Memoriam

Lillian Ray Martin

1961-2006
Nautical Archeologist, Wife, Mother, Friend

In 1987 I arrived at Uluburun, a remote promontory off the southwestern corner of Turkey, where INA was beginning its third season excavating the world's oldest shipwreck. I was a (terrified) camp doctor and Lillian Ray, a 25 year old TAMU nautical archeology graduate student, was one of the first friends I made. Her sense of humor was infectious and her energy was boundless. As if the days were not tiring enough, she would begin them at dawn with a quarter mile swim against the current to "the point." While everyone else rested and warmed between frigid, deep dives, Lil uncomplainingly blistered in the sun using makeshift equipment to create quality photographs of the Bronze Age artifacts. When long days of excavation began to fray nerves, Lil remained resolutely cheerful with her characteristic, ready smile.

After finishing her MA at TAMU, she transitioned gracefully into motherhood. My obstetrician husband delivered both of her children and although Lil and I had our sons within a few months of each other, I was still struggling to get out of bed while Lil, a baby strapped to her back, seemed ready to scale Mt. Everest. She finished her book, The Art and Archaeology of Venetian Ships and Boats, with two toddlers in the house, a feat only a parent could appreciate. In the book, Lil integrated manuscript illuminations, graffiti, mosaics and all manner of pictorial representations to create a conceptual image of Venetian ships. She was all about integrating disparate parts into a whole. Lil made it look easy. She and her husband Paul Martin, an engineer, were always on the move, commuting between their home in Austin and Lil's family farmhouse in Maine, with frequent side trips around the world, always with the children. They relocated a 19th-century barn piece by piece to their property in Maine. Of course it evolved into a farming museum, and then a beloved annual "Heritage Day" celebration which involved the entire Searsmont, Maine, community. For Lil, archeology was not just a career; it was about the love of history and of artisanship. An award-winning 3rd grade science project to recreate ancient dyes? Whether it was with a multimedia elementary school presentation on Pompeii or a Boy Scout merit badge project to recreate the pottery of the lost Minoan civilization, Lil taught her children to appreciate the past and have fun in the present.

This past summer, Shawn (11) and Kitana (10) accompanied Lil to Crete where she worked with Elpida Hadjidaki. Shawn and Kitana had become scuba certified and another generation of nautical archeologists was in the making. Paul and Lil, Shawn, and Kitana did everything together as a family, so perhaps it is a mercy that they were not separated in death when their private plane crashed en route to Maine on December 17th.

A few months earlier, the Martins were returning from Europe during the "liquid bomb" scare in London. They were advised by British Air not to get on their scheduled flight. Lil later told me they decided to come home anyway because, "Our lives are always in God's hands." How does one measure success? In ingots of copper and monuments of stone as did the ancients, or in publications, position, and tenure as we do? Lil transmitted her love of archeology to her friends and her children, she was devoted to her family, she was a creative and loving mother, she was a faithful wife, and she was a steadfast friend. Lillian Ray Martin was a success in **life**. Güle Güle, "Go with a smile," Lil.

-Caroline Fife

INSTITUTE OF NAUTICAL ARCHAEOLOGY