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On the cover: Süleyman Demirel (left), President of Turkey, and Oğuz Alpözen (right) at the recent opening of the seventh-century Byzantine ship replica. Many years of research and hard work have led to an exhibit at the Bodrum Museum of Underwater Archaeology that will bring pleasure and knowledge to all who see it. Photo: Aybars Attila.

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The Institute of Nautical Archaeology is a non-profit scientific and educational organization, 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.

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Byzantine Ship Replica Exhibit Opens!

When Süleyman Demirel, President of Turkey, drove the last nail into the stern of a replica of the Yassıada Byzantine ship last summer, research begun almost four decades earlier by the founders of INA dramatically became available to the public.

It all began in 1958 when Bodrum sponge-diver Kemal Aras showed a pile of globular amphoras to American photo-journalist Peter Throckmorton (see *INA Newsletter* 17.2, 20-21), who described the discovery to George Bass in the winter of 1959. The amphoras were all that remained visible of a ship and its cargo that sank about 120 feet deep off Yassıada, or Flat Island, a two-hour sail up the coast from Bodrum.

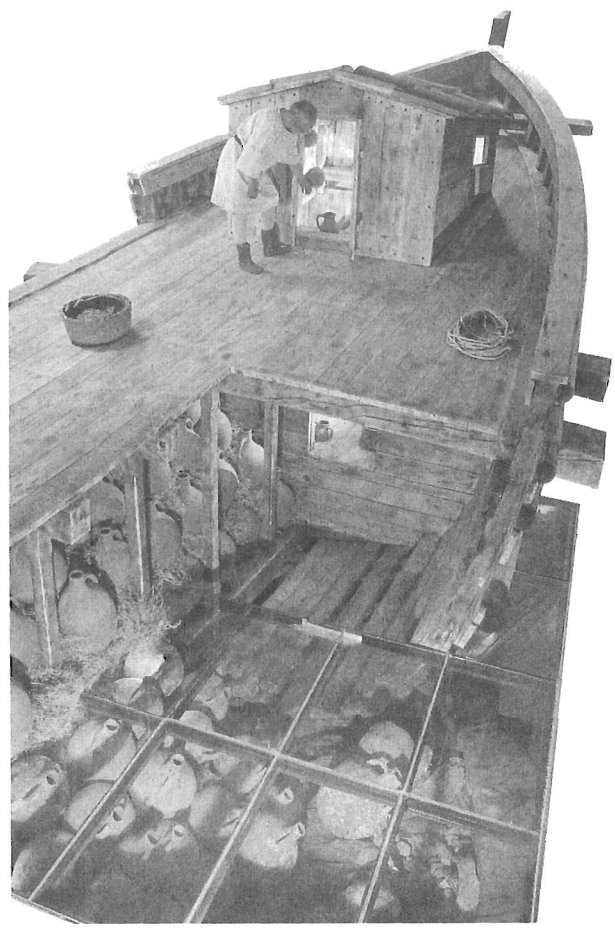
During the subsequent excavation of the wreck site, the second directed by Bass for the University Museum of the University of Pennsylvania, underwater archaeology came of age. The development of accurate mapping techniques, including the use of stereo photography, allowed Bass's fellow Penn graduate student Fred van Doorninck to be the first to reconstruct on paper an ancient ship's hull from fragmentary wood remains. Still another Penn student, Michael Katzev, worked with van Doorninck and Larry Joline to perfect methods of replicating disintegrated iron objects from their natural seabed molds (and it was there that Michael met his future wife, illustrator Susan Womer, with whom he would later excavate a classical Greek ship off Kyrenia, Cyprus). Claude Duthuit, now an INA Director, served as chief diver. Soon after the completion of the fieldwork, Dick Steffy tested and refined van Doorninck's results with a series of research models. A glance at the back cover of this *Quarterly* shows how close this dedicated "family" has remained for more than thirty-five years.

Another of the archaeology students who helped excavate the ship was Oğuz Alpözen (see *INA Newsletter* 17.2, 22-23). Since he became Director of the Bodrum Museum of Underwater Archaeology in 1978, Oğuz has dreamed of having as an exhibit a full-scale replica of the stern and galley of the ship, the part that would give visitors to the museum the best idea of shipboard life thirteen centuries ago—and the part of the ship that had been best preserved on the sea bed. He asked Fred Hocker, a former student of Dick Steffy, to make plans for a replica, and then Hocker turned the project over to one of his Texas A&M students, Taras Pevny, who describes in the following pages how he, with other students, and members of the Bodrum Museum staff, completed the task.

The team effort paid off beautifully. On only the second replicated ancient ship in the Mediterranean, the other being the *Kyrenia II*, Bodrum Museum visitors can now walk across the deck, look down through an opening in the galley's tile roof to see a mannequin of the ship's cook at work, and then have the experience of "walking on water" above the reconstructed pile of original amphoras covered by a thick glass floor—another of Oğuz's inspirations. Oğuz also arranged a display of original artifacts outside the replica.

"I was stunned by the ship's size," says Bass. "Those little scraps of wood we mapped so carefully between 1961 and 1964 seemed so puny on the sea bed."

We hope that many of you will be able to visit the Bodrum Museum and see the replica for yourselves.



The replica of the seventh-century Yassıada ship, showing the reconstructed pile of original amphoras under a glass floor.

Photo: Oğuz Hamza

Shipbuilding Traditions: Building the Yassıada Exhibit

By Taras Pevny

This fall the President of Turkey, Süleyman Demirel, and the Culture Minister, İstemihan Talay, opened a new exhibit in the Bodrum Museum of Underwater Archaeology (cover). The exhibit displays the artifacts from a seventh-century CE merchant shipwreck, and it also represents more than 35 years of nautical archaeology in Turkey. This exhibit is the result of a lifetime of work by members of the Bodrum Museum and the Institute of Nautical Archaeology and of their commitment to studying, preserving, and sharing with the public the maritime treasures found along the Turkish coast.

The task of recreating the Yassıada ship was given to some of the next generation of nautical archaeologists. This was a unique opportunity for us to become deeply immersed in the traditions of seafaring and shipbuilding. We were going to work on the coast along which ships have sailed for millennia and where wooden shipbuilding is still a respected and profitable profession. Bodrum Harbor is lined with a forest of masts. There are hundreds of wooden vessels, most of them built by local shipwrights. The walk around the harbor leads to the gates of the Castle of St. Peter (fig. 1), where visitors can see the work of several ancient shipwrights in the Bodrum Museum of Underwater Archaeology. We were expected to build an exhibit that would similarly bring to life the Yassıada ship. I think we have succeeded.

Yassıada, which translates as "Flat Island," is located at the end of the Bodrum peninsula. Extending out from this island is a submerged reef, a hidden danger to any ship that ventures too close. Georgios, a Byzantine ship captain, lost his ship thirteen hundred years ago when it tore its hull on these rocks and sank to the bottom thirty meters down. There it lay until the early 1960s, when a group of archaeologists under the direction of George Bass brought the remains back to the surface.

The ship appears to have been built to carry both passengers and cargo, and sank with a hold full of wine-filled amphoras. Over the years the hull slowly relinquished its strength and shape and was transformed into the remains of timbers flattened on the sea bottom beneath the spilled cargo. When the shipwreck was discovered, no one imagined that within these scanty remains lay the secrets of an ancient shipwright's craft.

The reconstruction of a ship from very fragmentary remains had never been attempted. A pile of drawings of the shipwreck site and timbers was given to one of the excavators, Frederick van Doorninck. He used this information to determine the original shapes and locations of the surviving timbers. Like solving a three-dimensional jigsaw puzzle, the remaining edges of the ship's timbers were once again fitted together. In this puzzle with a large percentage of its pieces missing, every clue was important. The angle at which the ancient shipwright drove a fastening, or the mark he made when aligning or fitting timbers, could not go unnoticed. To the surprise of many, a ship slowly appeared in Fred van Doorninck's drawings. Not only was the shape of the vessel revealed, but also the process by which the ancient shipwright created it. To bring this ship off the drawing board, Fred van Doorninck recruited the help of Dick Steffy, whose passion for years had been the study of wooden shipbuilding. From the preliminary reconstruction, ship construction drawings were developed, and testing and display models constructed (fig. 2). In 1982 the results of this work and studies

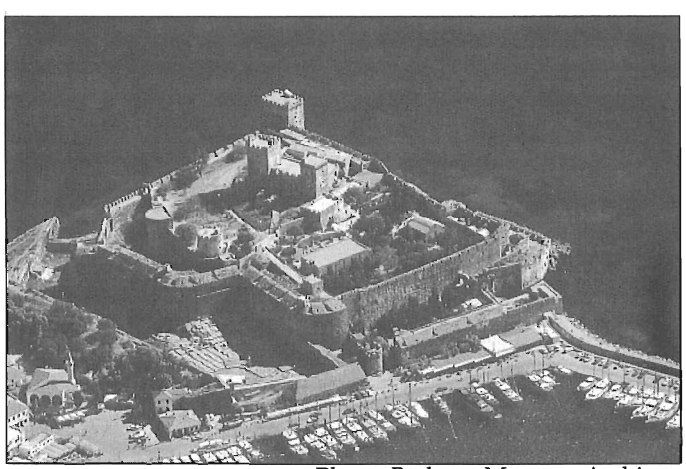


Photo: Bodrum Museum Archives

Fig. 1. *The Castle of St. Peter*

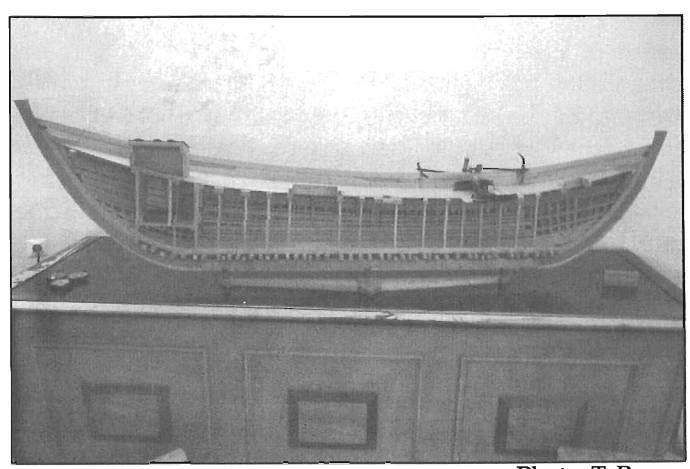


Photo: T. Pevny

Fig. 2. *Display model from the Bodrum Museum*

of the ship's cargo were published in 1982 as *Yassıada* I: *A Seventh-Century Byzantine Shipwreck*, the first volume in *The Nautical Archaeology Series* of the Texas A&M University Press.

The idea of making this pioneering effort in underwater archaeology into a featured exhibit was discussed for many years. The challenge was how to explain in an exhibit the historical richness of the shipwreck. To the uninitiated, the importance of the artifacts is not self-evident, for only archaeological research has transformed these items into treasure. Oğuz Alpözen, Director of the Bodrum Museum of Underwater Archaeology, wanted an exhibit that would literally bring the ship back to life. With the help of Fred Hocker, Sara W. and George O. Yamini Faculty Fellow at Texas A&M University, an exhibit design was developed which centered on a full-size replica of part of the ship (see *INA Quarterly* 21.4, 3–7). Such a display would give visitors an appreciation for the vessel's size and shape and for how the available space on it was used. When visitors walked through the front door, they would face the Yassıada ship appearing to float on the chapel floor.

Unfortunately, the available exhibit hall has a definite space limitation—although the height and the width are more than sufficient, the whole 20-meter length of the Yassıada vessel would not fit. However, one end of the vessel and part of the central cargo hold could be reconstructed. The vessel was double ended. At the ends, the planks of the ship came into long curving stem and stern posts. A study of the artifacts revealed that a galley, valuables, and most tools were located in the stern. A full-size replica of this part of the vessel would provide the perfect exhibit case in which to display these artifacts. Since visitors would be allowed to walk on and touch the replica, it was decided that only reproductions of the original artifacts would be displayed in this manner. Once visitors saw replicas in the reconstructed context, they could take a closer look at the originals in glass exhibit cases and read their accompanying descriptions (fig. 3). This modern interactive display would let the visitor enter a time capsule of seventh-century Byzantine seafaring. Support from the Turkish Ministry of Culture and the joint efforts of the Bodrum Museum of Underwater Archaeology and the Institute of Nautical Archaeology allowed this ambitious idea to be realized.

Photo: O. Hamza

Fig. 3. *Display cases at the Bodrum Museum.*

Work on the replica began not in Bodrum but at Texas A&M University. In the spring of 1994, I became familiar with the hull shape of the Yassıada ship, and developed the working drawings from which the replica would be built. It was important to ensure that when the modern graphic description of the hull, a lines drawing, was used to build the replica, it would give a shape close to that reconstructed from the remains (fig. 4).

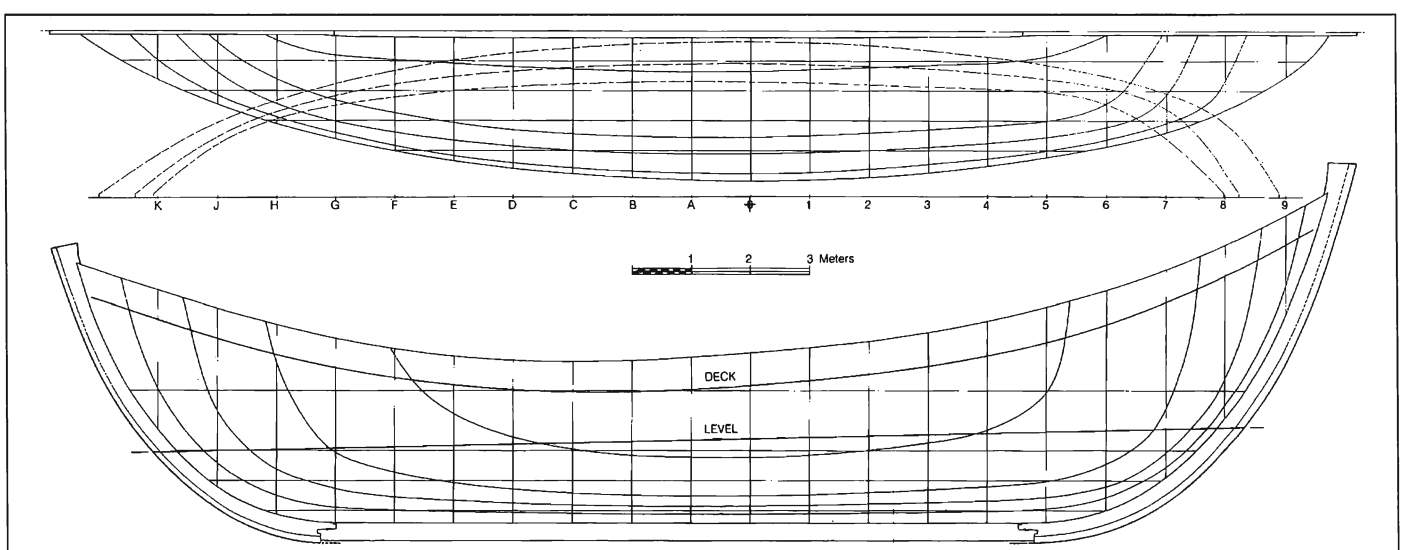


Fig. 4. Ship's lines as reconstructed by F. H. van Doorninck Jr.

The lines drawing method of describing a ship's shape on paper was not perfected until the eighteenth century. Sailing ship hulls generally have few—if any—corners, and their curves are rarely defined by formulas. A lines drawing of a ship can be visualized as three topographic maps of the same object viewed from the ends, bottom, and side. Each map or view is composed of fair (smooth) curves representing the shape of a slice through the ship. If the curves from these three views could be lifted and properly aligned in three-dimensional space, they would form a wire frame model of the hull. Using a lines drawing, a shipbuilder can construct the frames (ribs) of a ship and be confident that once they are faired (smoothed out) they can be covered with a skin of planks. The key to developing modern lines drawings lay in the realization that in the graphic description of a vessel the curves, although smooth, have no mathematical regularity. The points in each curve, however, cannot disturb the fairness of the corresponding points in a line or curve belonging to the other views. The skill in drawing ship lines is to know which points to adjust when there is a discrepancy, while still retaining the desired vessel shape characteristics.

The relatively long time it took to develop this method can only partly be attributed to learning time; need and motivation must also be considered. In Turkey we observed first hand that shipwrights, although knowledgeable in these modern methods, were nonetheless building without them. Mehmet Nalbantoğlu, who has built ships in Bodrum for more than thirty years, told us that although he employed a naval architect and built some ships from lines drawings, he still built most of his ships using an older method. He also pointed out that he charged more money for a ship built from a lines drawing, not because it was a better ship but because it took longer to build.

In Mehmet Nalbantoğlu's yard, as in the others in Bodrum, most ships are built by first making a few of the center frames from templates known as molds. A typical yard has molds for the midship sections of several traditional hull shapes, which over many generations have developed in that area. These frames are then raised on the keel. Next, the master shipwright uses long wood battens to define the shape of one side of the vessel between the center frames and the end posts. Once enough of the battens are up to define the shape, the rest of the frames are made to fit (fig. 5). By using this method, Mehmet Nalbantoğlu's yard builds ships that satisfy the needs of his customers, although he cannot build two of exactly the same shape if they are not built simultaneously. Most of the vessels being built in Bodrum are built by this method.

Mehmet Nalbantoğlu took a keen interest in our replica project. He helped us acquire good planking wood, and on several occasions the workers in his yard cut timbers for us. The day he first visited the project, a sense of history was almost palpable. We had the opportunity to tell a present-day builder of wooden ships about the methods of an ancient shipwright. For a moment, we became the apprentices of two master shipwrights.

Conceptually the construction of the seventh-century CE wreck found off Yassıada was shell-first. However, the builder of this Byzantine ship only used loose-fitting and widely-spaced mortise and tenon joints to assemble several layers (strakes/runs) of planks before installing pieces of the frames (floors and futtocks) to secure them in position. In essence the ship was built in spurts of shell-first construction. Only when building the upper parts of the sides of the ship did the builder insert the frames before the planking. In this part of the hull the curves of the sides are easier to predict and the builder did not need the shell to define the shape. From the archaeological remains it was determined that mortise-and-tenon joints were not used at this later stage of construction.

Since we had the primary goal of reconstructing the shape of this seventh-century ship and not its construction sequence, we decided to build the replica frame-first from the lines drawing. This allowed us to closely reproduce the shape determined from the shipwreck remains.

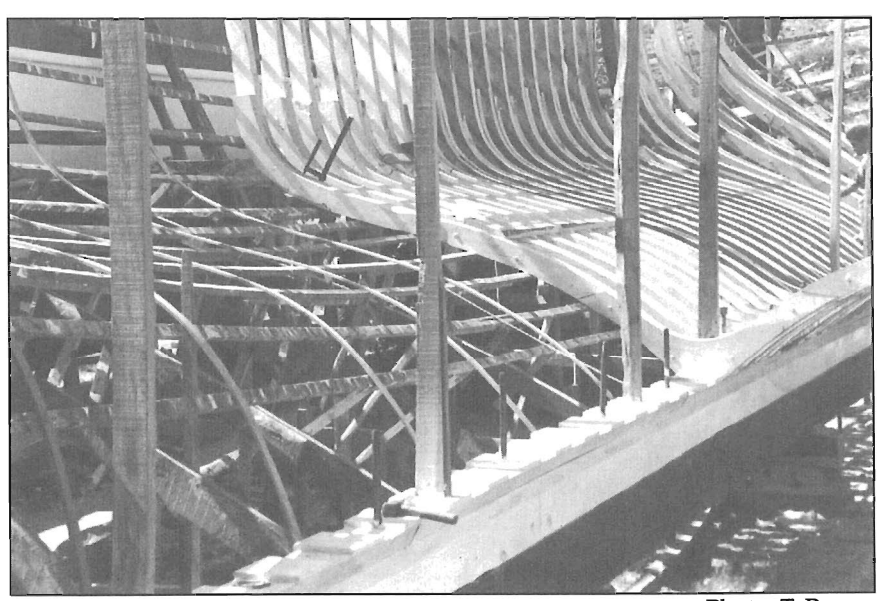


Photo: T. Pevny

Fig. 5. *The traditional method of building the hull along the Turkish Coast.*

By using the original timber dimensions and their general arrangement, if not the construction order, we were hoping to get some insight into the challenges of constructing this vessel's shape.

At the very beginning of the project we became intimately familiar with the wood that would be used for the replica. Our makeshift boatyard was not situated at sea level, but high up in the Bodrum castle. For three days we carried our initial shipments of timber up the castle's winding staircases. At the end, although we only had stacks of wood in front of us, we had our first feeling of accomplishment. Moving all this wood by hand foreshadowed the important role teamwork was to play in our project. The safe and efficient transporting, cutting, and positioning of large timbers rely heavily on teamwork as well as an understanding and appreciation of leverage.

Once the timber was stacked and ready, it was time to start building. By enlarging the curves of the lines drawing, we were able to get the shapes for the pieces that would make up the skeleton of the replica. Making the curves on the lines drawing requires flexible strips of wood or plastic (battens) held down by lead weights (ducks) as guides for the pencil. When building the vessel, one enlarges the tools, drawing the curves with long wooden battens held in place with nails. Some curves are concave, some convex, and sometimes both shapes occur in one timber. While some of these curves were easily distinguishable, some varied so little from each other that they were barely discernible; this is indicative of the flowing nature of the change in shape along the length of the ship's hull... flowing only if the frames are placed in the right place.

Unfortunately, trees do not grow in the exact shapes of ship curves. Shipbuilders attempt, as much as possible, to utilize the natural curves of trees in order to make strong timbers, with minimal wastage of wood (fig. 6). Nonetheless, a shipyard's off-cut (waste) piles are substantial in size. Proper selection and efficient utilization of timber are critical issues to understand when studying the history of wooden shipbuilding. The timber of old wooden ships inevitably contains fastening holes without any apparent purpose. A need frequently arises to nail on temporary braces, steps, etc. In addition to cutting and nailing, building a ship entails a lot of clamping, levering, wedging and prying. We soon had a special pile for any wedge-shaped off-cut.

After the components of each frame were joined, care was taken to raise, position and secure the frame in its right place. Diligence was important at this point because the skin of the boat had to be bent onto this framework. Thus, the frame structure not only had to have the right shape, but also the strength to withstand the substantial pressure of the planks being bent on. On the replica the components of each frame were temporarily linked to each other, but this was not the case in the original ship. Because the shell was built first, the original shipwright was able to fit and secure the frame pieces to the planking.

When it came time to raise the first timbers of the replica, we honored some longtime shipbuilding traditions. Throughout the many centuries of shipbuilding there has been a custom of putting a coin under the heel of the mast. This was a tradition around the ancient Mediterranean, as well as in Northern Europe, that eventually spread to the New World and lasted into modern times. Knowing we would never raise a mast on the replica, we imbedded a Turkish coin in the cement base to which the keel was secured. While we did not slaughter a lamb when raising the end post—still done in the shipyards of Bodrum—we did nail a glass eye pendant (the evil eye) to it in order to ward off evil spirits.

With the frame structure raised and braced, it was time to prepare for planking. In a process called fairing, long wooden battens are used to help guide the shipwright in cutting down any high points on the frame structure. Unlike the lines on the drawing, the actual frame timbers have a thickness. As a result, only the line drawn on one side of the timber fits the hull shape. To get the right curve on the other side of the timber, the face between the two has to be cut down (beveled) along the entire length of the timber. In areas of the most extreme curves on the Yassıada hull, the bevel angle of the frames is around 10 degrees outboard at the top of the timber and around 35 degrees inboard at the bottom. Depending on what kind of saw is used, at least some—if not most—of this excess wood can be cut off while the frame is being made. The remainder is most easily removed during the fairing process. The process can be visualized as completely removing the corners from the steps of a staircase until all that is left is a smooth

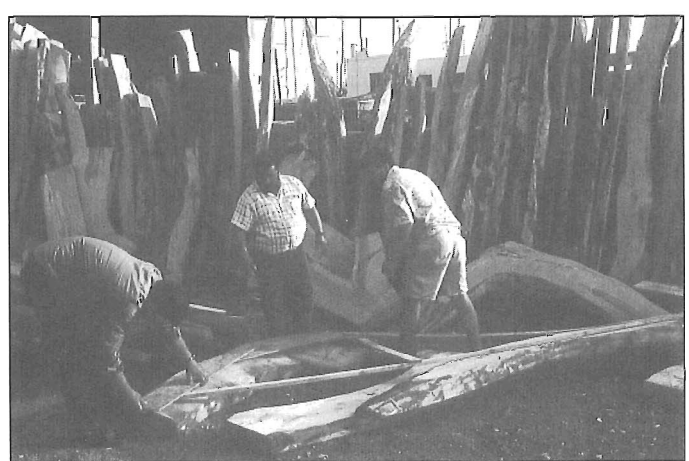


Photo: H. Özdaş

Fig. 6. Choosing timber in Mehmet Nalbantoğlu's yard.

Photo: T. Pevny

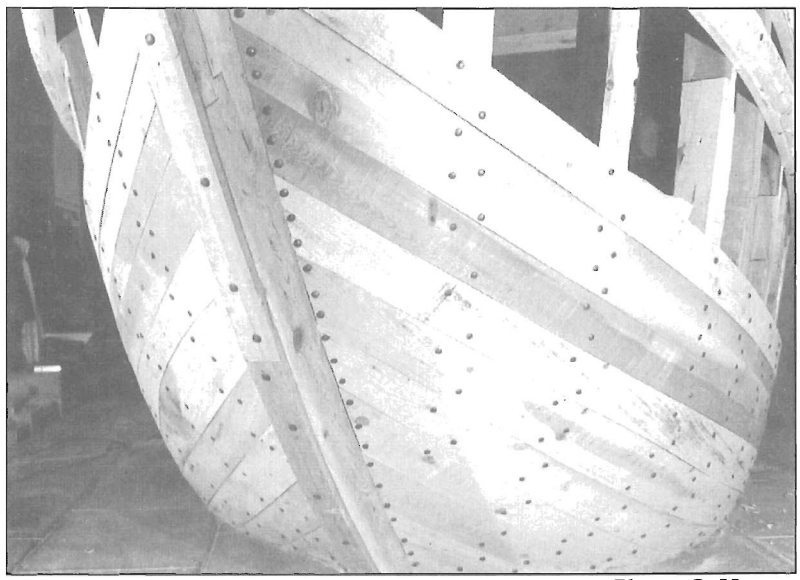


Photo: O. Hamza

Fig. 7 (left). Peter van Alfen fairing frames. The power planer saved a lot of time and energy.

Fig. 8 (above). The stern of the Yassıada replica.

slope. When the frames are fair, a batten, when bent on in any direction, should define a smooth curve with no undesired bumps or hollows (fig. 7).

At this point in the construction, the frame structure completely defined the shape of the Yassıada replica, and the lines drawing had essentially served its major purpose. At the point when the Byzantine shipwright had the shape defined, he had already had completed the framing as well as the planking of the ship. On our project, as in modern Bodrum shipyards, the completion of the framing only marked the beginning of the planking process. Even in ships where frames are the essential strength timbers, the planking helps bind the framework into an integral structure, and of course makes the vessel watertight.

When the remains of the Yassıada vessel were reconstructed, the stern of the vessel was determined to be extremely full (very round; fig. 8). The research and display models were successfully built with such a stern, but there was still a question of how easily this shape could be built with wood of the original dimensions (scantlings). While working with the lines drawing, I sometimes looked at the waterlines (horizontal sections through the ship) with trepidation. Some of these are almost semicircles. Luckily, the planks of the vessel do not follow the run of these waterlines, especially in the ends of the vessel. Instead, at the bow and stern they sweep up and essentially cut across these full lines, which accounts for the high ends of the vessel (fig. 8). Practically, this means that these individual planks do not need to be bent as much. Nonetheless, there was a point—when all the frames were raised, but were still unfaired—that the stern of the vessel literally looked like a bizarre staircase lying on its side. Although I was quite sure all the frames were cut and raised correctly, I must admit a moment of private panic. While alone, I took a small adze and anxiously faired part of the frames leading into the sternpost. When I was finally able to bend a small batten in this area, I started to breathe easier.

The next challenge was to bend four-centimeter thick pine planks around the faired frames. We learned that in the past the shipwrights in Bodrum soaked planks in order to bend them, and we decided to try this method first. We carried two planks down to the sea (fig. 9). After they had soaked about three hours, we carried them back up to the chapel, and were able to bend them into posi-

Photo: T. Pevny

Fig. 9. John De Lapa and Glen Grieco lowering planks into the sea.

tion. "Bending" entails much more than this short word may indicate; it is a process that one needs to experience. In short, it entails balancing the pressure from multiple clamps and wedges in order to bring the plank flush against all the frames without stressing any particular point more than necessary. Carefully choosing which piece of wood to cut a plank out of, and how to lay out the shape, can mean the difference between success and half a day's wasted work. The sound of a four-centimeter plank breaking under pressure is loud and intimidating. Once in position, the planks were fastened with long iron spikes. The wood of the frames held onto these spikes tenaciously; pulling out fastenings is another skill shipwrights acquire, but try not to cultivate. We used this same method of soaking in order to bend all the planks, and it was not long before we had a five-meter long soaking tank in front of the exhibit hall.

In addition to the regular planking, the Yassıada vessel had four large timbers (wales) that ran from stem to stern on each side of the vessel. Wales were a prominent structural feature of this vessel and characteristic of vessels in the Mediterranean for many centuries. The Yassıada wales were large half-logs of cypress at least 20 centimeters wide and 10 centimeters thick. Cypress grows tall and straight, and one of the characteristics of the reconstructed hull shape is that when such straight timbers are bent around the frames they rise up at the ends, giving the characteristic high bow and stern. Rather than soaking such large timbers we decided that it would be easiest to bend them green (freshly cut). Cypress was not available at the lumberyard, and so began our long search for appropriate trees. In this part of Turkey, cypress trees are most commonly found growing in rows around orchards, but special permission from the government is needed to cut them down. Eventually we received permission to fell five trees that were part of a large number surrounding a vast mandarin grove. Under the guidance of Ali Uçarer and with a lot of helping hands from the Bodrum Museum, we succeeded in cutting and lowering them into the two-meter-wide rows between the mandarin trees. The extra hands were needed to manhandle the cypress trees onto a truck for the trip to the sawmill. For the next two weeks the trees were kept from drying out as we bent and secured them onto the frames. We soon learned why the original shipwrights used cypress. In its green state, cypress bends beautifully and with little difficulty. Once it dries, it is hard to imagine how it was bent. We were quite worried about shrinking and cracking problems as these timbers dried. The space between the wales was not planked until they had dried in place for about a month and a half, and after that time shrinkage was minimal and unproblematic.

The wales were not the biggest timbers on the Yassıada vessel. It would have been steered from the side with quarter rudders (steering oars); these were secured to two large through beams that pierced the sides of the hull between two lower wales. Five meters long, 20 centimeters thick, and 30 centimeters wide, these arched and beveled beams had to be shaped with hand tools. This gave us a better appreciation for the amount of manual labor that it took to build the original ship without the aid of bandsaws, circular saws, electric drills, and planes. Lifting and positioning these timbers into place was a group effort (fig. 10). These through beams, together with smaller

Photo: J. Pannell

Fig. 10. Carrying a through beam up the castle stairs.

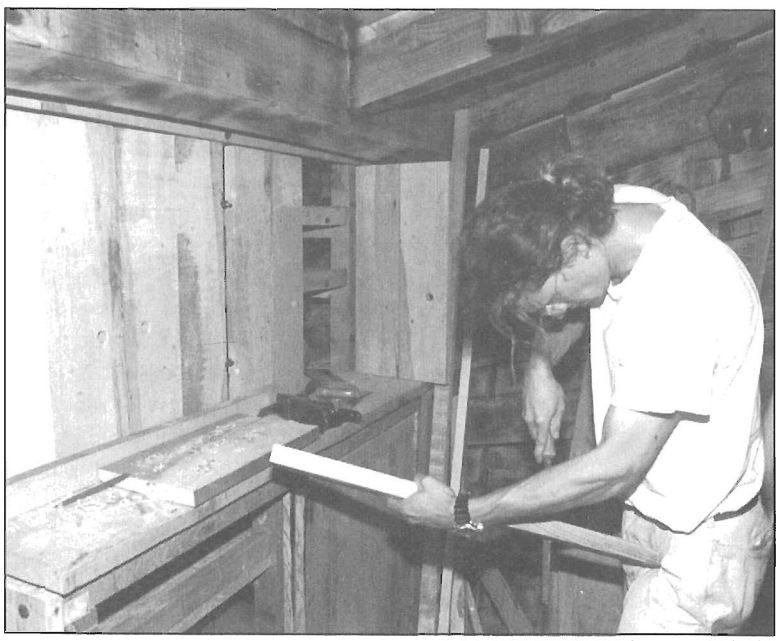


Photo: B. Lledó

Fig. 11 (above). The author building the galley cabinets.

Fig. 12 (right). Galley shelves with pottery.

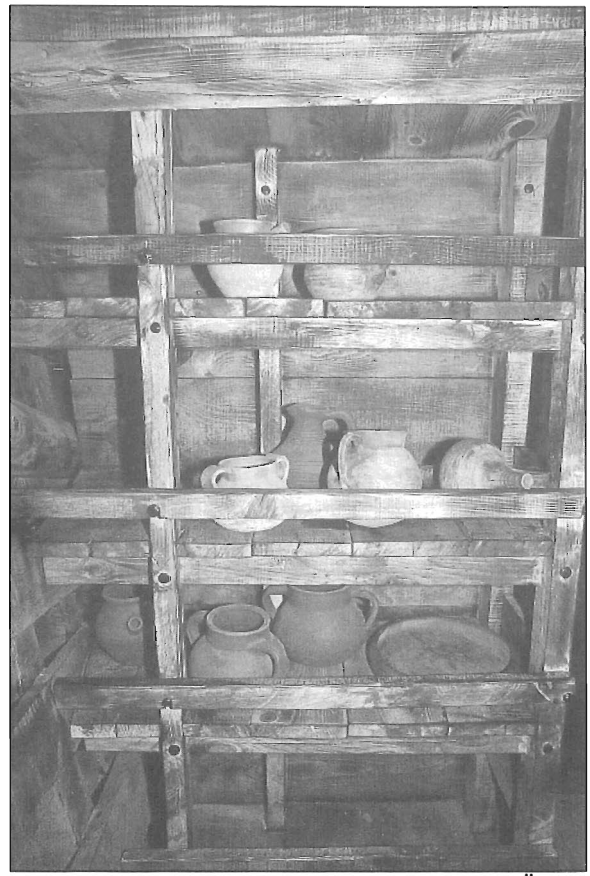


Photo: H. Özdaş

beams, carlings, and ledges, made up the skeleton of the vessel's steeply sloping deck and framed the openings in it for hatches and galley house.

One of the pleasures of our work in the Museum was the opportunity to answer the questions of visitors. Although the work area was closed, no signs or practical barriers could keep away the curious: one family visited us three or four times in an afternoon just to see us bending on a single plank. Such visits provided us with the opportunity to share some boat-building secrets and a good reason to take an occasional break. One of the major strengths of the completed exhibit is that it excites and satisfies the visitor's curiosity; in that sense, the exhibit was open long before it was completed.

There is a definite pattern to the disintegration of a sunken ship. A careful study of the distribution and stratigraphic location of the objects as well as the remains of the hull allowed Fred van Doorninck to reconstruct the size and location of bulkheads (walls in the ship), the galley house, the galley floor (the sole), hearth, storage lockers and even shelving. He had the opportunity to confirm the practicality of his conclusions on the replica. It was a special moment for us when Professor van Doorninck helped us measure out the locations of the galley lockers, something he had done on paper many years earlier. On a few occasions our discussions about the layout became quite lively and contentious. Professor van Doorninck and the archaeological evidence always prevailed.

In essence, by the end of the project we were doing the work of house carpenters and cabinetmakers (fig. 11). The results of this work allowed us to display replicas of the shipwreck artifacts in a very realistic setting (fig. 12). Museum director Alpözen arranged with the castle potter, Bora, to make replicas of the cargo amphoras, and the pottery that was found in the galley, as well as the galley roof and hearth tiles. In addition, a local blacksmith made copies of the tools. We had a close relationship with the blacksmith because he made the more than 1500 large iron spikes with which the replica timbers were fastened together. These artifact replicas gave us a greater appreciation for the quality of craftsmanship exhibited in many of the objects found on the wreck. Many of these are very expensive and difficult to replicate with the skills available in the modern world.

The amphora display serves to make the transition between the replica and the rest of the exhibit (figure, page 3). Upon descending from the deck of the ship the visitor is able to look into the cargo hold with its neatly stacked cargo of replicated amphoras. The floor in this section of the exhibit hall is made of glass, and under the feet of the

visitors the neatly stacked cargo melts away into a scatter of original amphoras arranged to closely resemble part of the shipwreck site. Oğuz Alpözen was able to realize his vision of having both the ship and shipwreck in one exhibit.

After 18 months of building, we arranged the replicated tools and pottery in the finished ship. When everything was in place, it felt as if one were actually inside the dimly lit and smoky galley of a Byzantine trading ship (fig. 13). The exhibit brings the ship with its artifacts to life, and as a result we can now share the excitement of, and information gained from, archaeological work with the public.

Acknowledgments. When studying the timbers from a shipwreck, one of the thrills is to identify the distinctive tool marks of an individual shipwright even though you will almost never know his or her name. I take this opportunity to list the names of people that in some way or another left their marks on this project: George Bass, Frederick van Doorninck, Richard Steffy, and the rest of the excavators and investigators of the shipwreck and its artifacts; Oğuz Alpözen, the Director of the Bodrum Museum, whose vision inspired the exhibit and who also dived on the excavation as a young undergraduate; Ali Uçarer, of the Bodrum Museum staff, whose enthusiasm and organizational skills moved both materials and people; Harun Özdaş and Mehmet Özgenç, archaeologists with the Bodrum Museum, who were part of the core group of people who built the replica (fig. 14); the rest of the Bodrum museum staff, who helped with building the exhibit and made us all feel part of a big family; Fred Hocker, who helped design the exhibit and was our mentor shipwright; John De Lapa, a project sponsor and boatbuilder from Michigan; Texas A&M University graduate students Stefan Hans Claesson, Greg Gidden, Glen Grieco, Tommi Makela, and Peter van Alfen; Turkish students Ozlem Buyuran and Cagdas Oralkan; and various craftsmen, general laborers and friends whose skills and help cannot go unmentioned.

Suggested Reading

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Steffy, J.R.
1993 *Wooden Ship Building and the Interpretation of Shipwrecks.* College Station: Texas A&M University Press.

van Alfen, P.G.
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Fig. 13 (below). Replica of the Byzantine ship's galley.

Fig. 14 (right). Four of the many members of the replica building team, from left to right, Taras Pevny, Harun Özdaş, Greg Gidden and Mehmet Özgenç.

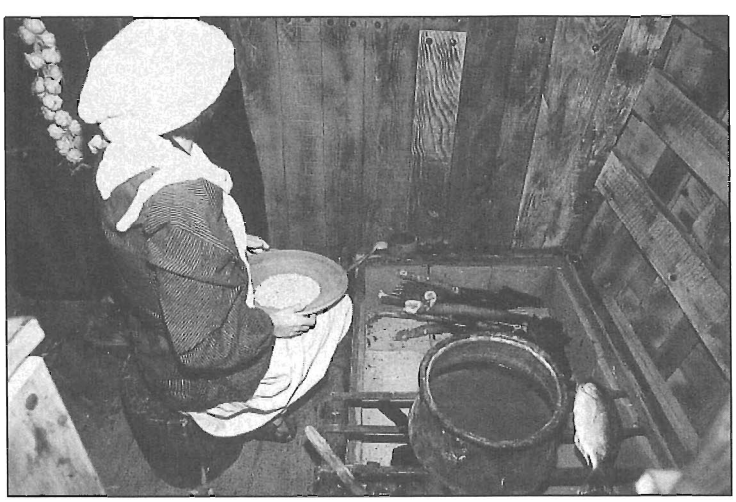


Photo: O. Hamza

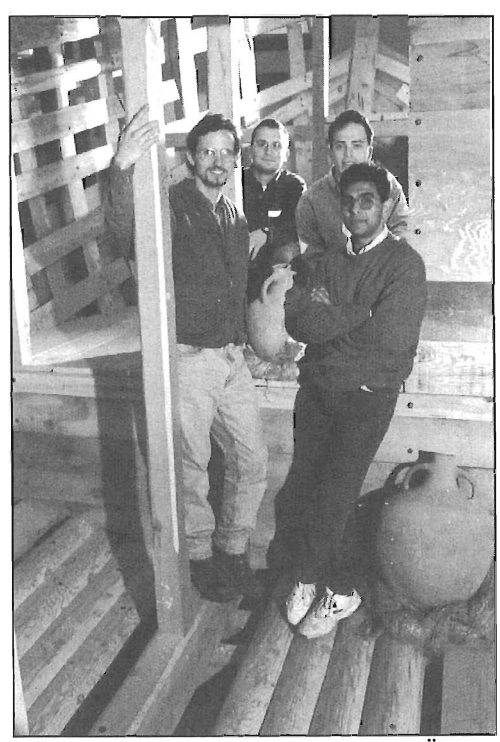


Photo: H. Özdaş

Uluburun Shipwreck Project: Conservation and Research 1996-1997

by Claire Peachey

As preparation of the new Uluburun Shipwreck exhibition hall at the Bodrum Museum of Underwater Archaeology, Turkey, nears completion, conservation and study of the finds that will be displayed inside continue apace. At times the task seems overwhelming, but the shelves and tanks of untreated artifacts are steadily getting outnumbered by the shelves of artifacts ready for display and study. Work in 1996 and through summer, 1997, continued as discussed in the 1995 report published in the *INA Quarterly* (23.1, 4-11). Some highlights of our recent work are described below.

The Uluburun exhibition hall

The new exhibition building just completed by the Turkish Ministry of Culture is impressive, with three display rooms, large storage facilities and an outdoor garden area. The interior presentation is to be created jointly by INA and Bodrum Museum director Mr. Oğuz Alpözen. The first room will contain introductory explanations, possibly including videos of underwater excavation activities, along with artifacts from the Cape Gelidonya shipwreck (c. 1200 B.C.), nearly contemporary with the Uluburun shipwreck (c. 1305 B.C.) and the first that Dr. George Bass ever excavated. In the main central room, visitors will stand in an elevated gallery area and look across to see a huge cross-section of the fully laden Uluburun ship depicted on the opposite wall, with replica objects positioned in the hull as the originals may have been. This will be based on the painting published in the December, 1987, *National Geographic* magazine, which featured the Uluburun excavation as its cover story. Looking down, the visitors will feel that they are looking over the shipwreck site as it lay on the seabed, with stacks of copper and tin ingots and stone anchors, and rows of ceramic pithoi and amphoras (storage and transport vessels) and other artifacts. The third room, to be called the Treasure Room, will display some of the finer and more precious objects from the wreck, such as the wooden "book" or diptych, gold and silver jewelry, ivory objects, the bronze and gold female statuette, seals, beads, and other finds. It is planned that the exhibition hall will open to the public in 1999, with what will surely be a grand ceremony.

Ivory, bone, shell, and tortoise carapace

Conservation treatment of almost all the ivories and other organic material of faunal origin, such as marine shell, ostrich eggshell, bone, and tortoise carapace, has now been completed. These objects all underwent a similar type of treatment, either consolidation in water-based Acrysol™ WS-24 acrylic colloidal dispersion, or dewatering in a series of alcohol and acetone baths followed by consolidation with Paraloid™ B72 acrylic copolymer in acetone and/or toluene. If the object was robust, as most of the shells were, only slow air-drying directly from water was necessary.

Several ivory objects are now completely treated, including pomegranate-shaped finials (KW4806, KW5156), papyrus-shaped finials (KW4854, KW5521), an exquisitely carved acrobat (KW5754, see *INA Quarterly* 21.4 , 13), a peg (L10892) belonging to one of the two ivory duck-shaped containers, a hinge (KW4013) possibly belonging to the larger of the two wooden diptychs found on the wreck, an unusual prism-shaped object (KW5541), and several pieces that appear to be scraps or blanks awaiting final carving and finishing (KW4261, KW4446, KW4587, KW5602, KW5730, L11331). Only a handful of small ivory objects awaits final treatment, including a partially worked plaque embedded in thick marine concretion (KW4767; fig. 1) and a cylindrical rod of uncertain function (KW4751+KW5169). Reconstruction of the small elephant tusk (KW3843) is nearly complete and the last of the thirteen hippopotamus teeth (KW5187) is undergoing final desalination. Restoration of the two duck-shaped containers (KW2818, KW2534) has just begun and promises to be an enjoyable job.

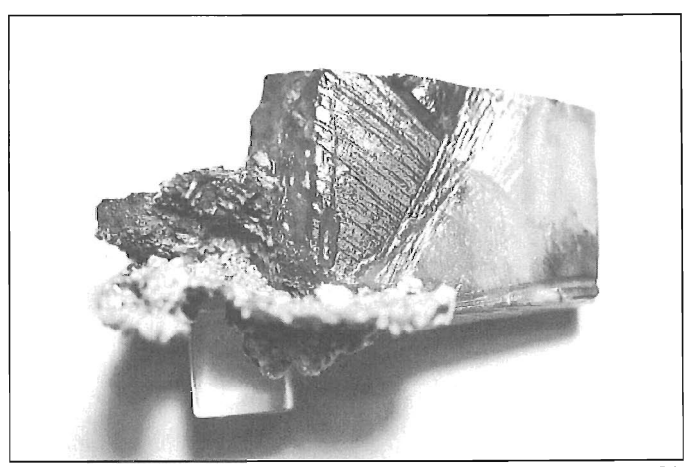


Photo: INA

Fig. 1. *Partially worked ivory plaque KW4767, showing two directions of saw marks and a "spur" remaining on the sawed surface. The plaque (4.5 cm long) is still covered in concretion and has green, orange and brown metal and organic stains.*

Bone objects treated include tiny flat pieces that may be inlays (KW5406 and various lot numbers), two of the fourteen astragals found on the shipwreck (KW3748, KW5001), and three inlay strips (KW5575) decorated with incised circles and, in one case, with an attachment peg preserved.

Partial reconstruction of some fifty-five ostrich eggshell fragments shows that in addition to the one fully intact eggshell (KW1391, see *INA Newsletter* 15.1, 3), two others, now incomplete, were being carried on board the ship. No signs of decoration are seen on the shells. Two additional eggshell fragments are encased together with ceramic sherds in a thick concretion; once these are freed, the two incomplete eggshells will be restored.

All tortoise carapace pieces were treated, including forty-eight pieces that constitute one nearly complete carapace (KW4250), found in one spot on the shipwreck. The carapace is the bony material lying beneath the outer shell of the tortoise, made up of forty-nine plates joined together along the suture lines. A search through crates of bone objects from early excavation seasons turned up several previously unidentified carapace pieces, bringing the total to eighty-two dissociated pieces in addition to the forty-eight mentioned above. Based on diagnostic characteristics, these 130 pieces represent at least five different carapaces.

Balance pans and balance-pan weights

Dr. Michael Fitzgerald completed cataloging and weighing the 149 geometric and zoomorphic balance-pan weights from the Uluburun shipwreck, along with the sixty-five geometric weights from the nearly contemporary Cape Gelidonya shipwreck, as described in the report for 1995. As part of this study, the material of each of the weights was tentatively identified by its appearance and streak color (where applicable), most being hematite or related iron minerals, magnetite, diorite(?), serpentine, limestone, or bronze. The weight catalog, along with a detailed analysis of the weight systems by Dr. Cemal Pulak, are now nearly ready for publication.

Two fragmentary, heavily concreted, and misshapen sets of bronze balance pans (KW4519, KW4811) were partially treated in order to determine if they were originally part of the same set. It appears from their overall shapes and from the location of suspension holes that they are indeed of the same set, although no points of contact can be found for a clear join. Some of the thousands of fragments of bronze sheeting found on the shipwreck were inspected in order to determine if any of these might also be parts of balance pans. To date, it appears that the ship carried two complete pairs of pans (KW4519+KW4811, KW4167), and at least one other pan, as indicated by a small edge fragment with a suspension hole (L10976).

Glass

Several whole and fragmentary discoid glass ingots ranging in condition from excellent to extremely poor underwent conservation treatment. Well-preserved ingots require little treatment beyond desalination and slow air-drying. However, most of the glass remaining to be treated is fragmentary and in a state that does not resemble glass at all. The chemical makeup of this highly deteriorated glass has not yet been determined by instrumental analysis, but is likely to consist of a hydrated silica network that has lost most of the original metal ions (for example, calcium, sodium, copper, manganese). The glass as preserved is usually a yellow-brown-green color, broken down into amorphous lumps, dissected by a network of cracks and fissures, with a surface of cloisonné-like cells. It varies in consistency from gel-like to brittle and is light in weight. Occasionally some chunks of undeteriorated glass are preserved within this network to indicate the original color. Some ingots remain intact but have a thick surface layer of opaque, white, sometimes iridescent deteriorated glass. In general, the Uluburun ingots do not exhibit the kind of deterioration often seen in vessel glass, which usually develops thin, parallel, delaminating surface layers.

A variety of treatments was experimented with in order to find the one most suitable for the crumbling and fragile glass: slow air-drying (resulting in disintegration), dewatering in alcohol and air-drying, dewatering in acetone followed by consolidation with Paraloid B72 in acetone and/or toluene, or consolidation in water-based Acrysol WS-24. The glass in the worst condition does not respond well to any of these treatments, but the treatment with Acrysol is the most successful and requires the artifacts to undergo the least handling. However, the glass always requires further consolidation with Paraloid B72/acetone once it has dried. Treatment of the Uluburun glass will not be continued until a silicone impregnation technique being developed by Dr. Wayne Smith at Texas A&M University is fully tested; if this treatment is suitable for the glass material, it may be preferable. A treatment involving impregnation of shipwreck glass with calcium acetate, experimented with in Australia, perhaps can also be tried on the Uluburun glass in the future.

Diane Fullick, a third-year student in the Art Conservation Program at the University of Delaware, continued her work testing the consolidant Aquazol™ on the glass beads from the shipwreck. Despite the good results achieved elsewhere with this consolidant on other types of glass objects, it was found not to be ideal for the highly degraded, waterlogged Uluburun beads. It imparted little strength to the beads and left them with an opaque, hazy surface. It was found that Acrysol WS-24 produced more satisfactory results, but as with the ingot glass, treatment of the remaining beads will be suspended until other treatments can be tested.

Canaanite amphoras

The Uluburun ship carried an estimated 150 Canaanite amphoras, approximately ninety of which were intact or nearly intact (fig. 2). This is the largest extant set of such amphoras from the Late Bronze Age Mediterranean region. Dr. Michael Fitzgerald has been studying and cataloging these vessels in detail, with a view to correlating differences in manufacturing details, size, capacity, and contents. Capacity measurements of the intact amphoras continue as described in the 1995 report. Wet amphoras are measured with water, as previously described, and dry ones with 2.1mm-3.5mm diameter polystyrene spheres. Repeatability equal to that achieved with water, ±0.06%, is obtained in the dry measurements. Comparison of wet and dry measurements shows that volumes measured with dry beads are consistently a maximum of 1.5% higher than those measured with water, and usually less than 1% higher. Since most of the amphoras are already desalinated and dried and therefore will not be rewetted for the more accurate wet measurements, a correction factor can now be applied with confidence to the dry measurements of these amphoras.

A condition survey of the intact amphoras was also begun as part of this project. Concretion removal, consolidation, and attachment of fragments are carried out as necessary to allow study and drawing. When all sherds from the shipwreck are finally treated and dried, probably by the end of this year, restoration of the fragmentary amphoras will begin.

Selma Oğuz continues to make full-scale drawings of the intact amphoras for publication. Her drawings are aiding in the study of vessel shapes and construction details, particularly by illustrating the consistent occurrence of many features.

Michael Sugerman, a doctoral student in the Anthropology Department at Harvard University, visited the lab for two weeks in the summer of 1996 to investigate the amphoras and select samples for his examination of the production and distribution patterns of Canaanite amphoras in the Late Bronze Age east Mediterranean. His project is based on petrographic analysis of jars from the Levant, Cyprus, the Aegean, Greece and the Uluburun shipwreck.

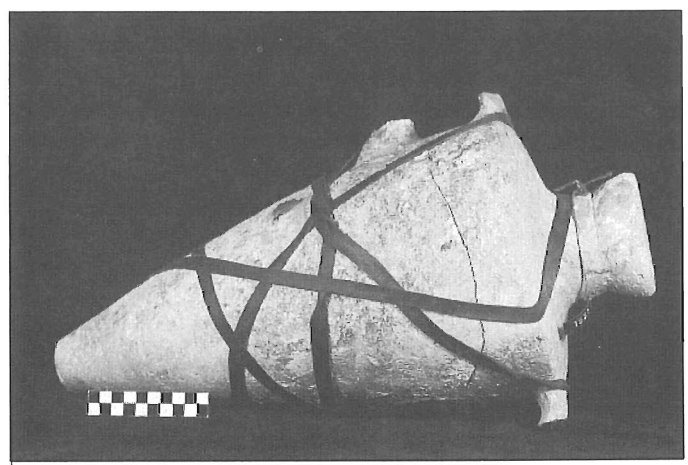


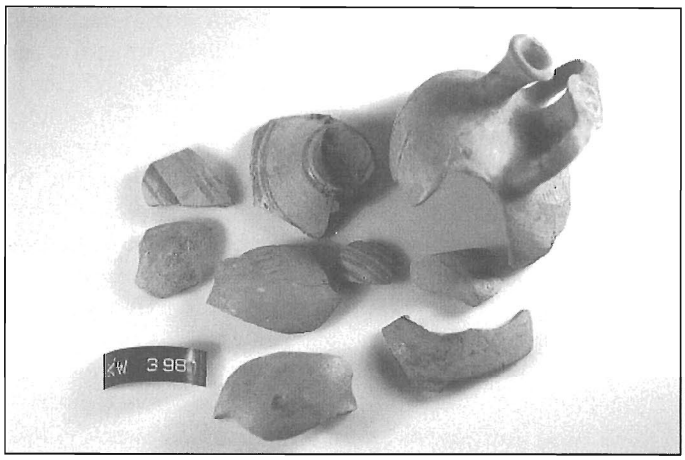
Photo: INA

Fig. 2. *Canaanite amphora tightly wrapped in strips of rubber to prevent further cracking during drying.*

Other ceramics and faience

Sherds and intact vessels of Cypriot, Canaanite and Mycenaean fabrics continued to be cleaned of concretion, dried, and consolidated as necessary. Reconstruction of ceramics on a large scale will not begin until all sherds from the shipwreck are dry and available for sorting, but in order to begin restoration of some of the more distinctive vessels, all fineware fabrics were separated out for priority treatment. Lorna Barnes from the Sherman Fairchild Center for Objects Conservation at the Metropolitan Museum of Art, New York, came to the lab for six weeks to work on treatment and restoration of the fineware Mycenaean stirrup jars. It seems that at least nine fineware stirrup jars were on board the Uluburun ship, as represented by seven nearly whole vessels (KW88, KW137, KW171, KW308, KW905, KW2405, KW3981) and an additional two spouts (L10745).

All treated coarseware sherds continued to be sorted into more specific fabric categories and sometimes into specific, unique vessels with distinctive fabrics. Among the latter are a black-grey stirrup jar (KW1977), a handmade, flat-bottomed, closed vessel with orange fabric and traces of wide horizontal and vertical bands of red pigment (KW2558), and one or more stirrup jars with coarse, angular temper in the fabric. The other coarse fabrics separated



Figs. 3 & 4. *Small, fineware Mycenaean stirrup jar KW3981, before and after restoration. Vessel is 7.5 cm tall. Photos: L. Barnes.*

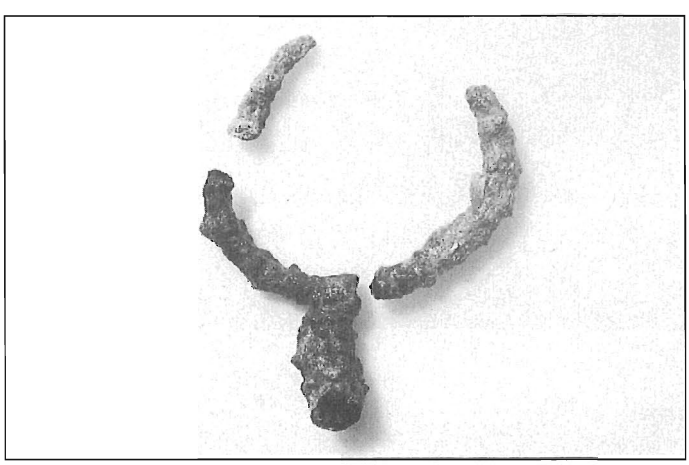
include carinated bowl, plain bowl, stirrup jar, "platter", pilgrim flask, trefoil mouth pitcher, Syrian lamp, krater, and various unidentified but distinctive fabrics.

In sorting the dry ceramic sherds from early excavation seasons, several previously unidentified sherds of faience vessels were found (fig. 5). In previous years, partial restoration of faience sherds revealed at least five fragmentary vessels, four in the shape of a ram's head and one of a woman's head (KW42, KW565, KW707, and various lot numbers). Now that all faience sherds from the wreck have been conserved, additional joins to the fragmentary vessels are being found. Most of the faience is in worn, fragile condition, having turned powdery and granular after centuries in the sea, and has a yellow-beige color that may not be original, with no traces of glaze.

Fig. 5. *Fragments of two faience vessels.* Photo: INA

Copper ingots, lead, tin, and bronze

Several of the unusual lead and tin-alloy objects found on the Uluburun shipwreck have now been treated. Crescent pendants(?) KW4827 and KW4755 appear to have the same shape but exhibit completely different corrosion



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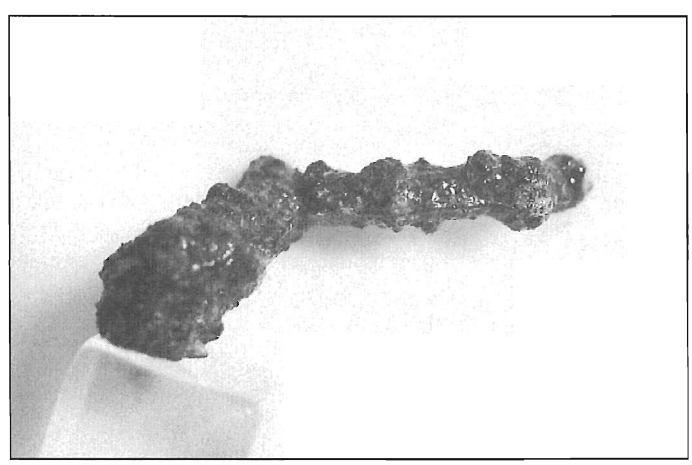


Photo: INA

Fig. 6 & 7. *Left, tin(-alloy?) crescent pendant KW4755, partially cleaned of concretion. Pendant is 3.5 cm wide. Right, detail showing mold flash, after conservation treatment.*

features. KW4827 shows slight expansion, fissuring, and development of a thin, grey-white corrosion layer typical of lead. KW4755, on the other hand, exhibits disfiguring warty corrosion with yellow and blue flecks in it, similar to the corrosion seen on tin objects on the shipwreck. This appears to be a tin-rich metal, perhaps a tin-lead alloy. Despite the disfiguring nature of the corrosion, the flash along the edges of the object is clearly visible after conservation treatment, indicating the crescent was made in a two-part mold. Other objects crafted of this metal and found on the wreck include a group of small Bes figures (KW4439). It is hoped that future analysis may identify the metal of these objects and provide information about corrosion of tin underwater.

Other lead objects treated or partially treated include more possible jewelry fragments (KW4812), a possible lead "staple" of the type used to repair a ceramic vessel (KW5341), an unidentified object which may be mold waste (KW5245), a large trolling weight shaped like a papyrus boat (KW3987), and fish-net weights.

Several small bronze artifacts, many of uncertain function, were treated: a pyramidal cone (KW5217), a cylinder (KW4465), zoomorphic weights (a wolf or dog head KW4943, a bull KW2736, and a cow KW5841), several cauldron handle and strap fragments, two daggers (KW3451, KW4217), an adze (KW4399), a harpoon (KW4254), netting needles (KW3339, KW4920), and a fragmentary vessel rim. Molly MacNamara, a third-year conservation student at Queen's University, Canada, is performing analyses to identify some of the corrosion products on the Uluburun bronzes.

Dozens of the 354 copper oxhide-shaped ingots continue to be treated, several revealing undeciphered symbols chiseled into their surfaces (see *INA Quarterly* 23.1, 9-11). This summer, 1997, Mark Smith, a graduate of the TAMU Nautical Archaeology Program and now a doctoral student in Anthropology at New York University, has been taking samples of all the copper ingots of all shapes so that Drs. Noel Gale and Sophie Stos-Gale of Oxford University can continue their program of lead isotope analysis, started in 1995. Dr. Cemal Pulak has also been taking samples of all the tin ingots for a similar study by Drs. Gale and Stos-Gale. Dr. Patricia Sibella continues to draw the conserved ingots and compile a catalogue of the chiseled symbols.

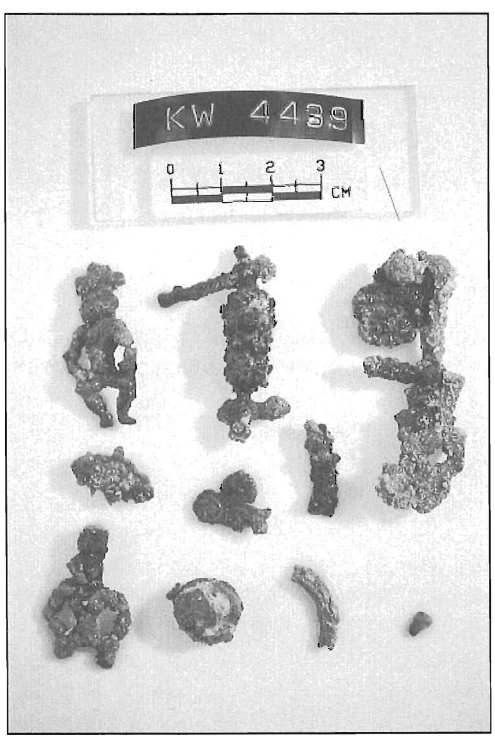


Photo: INA

Fig. 8 (left). *Tin(-alloy?) bes figures and associated pieces, KW4439, before conservation treatment.*

Fig. 9 (below). *Lead object KW5245 (6.1 cm long), possibly mold waste, in its storage box lined with inert polyethylene foam. Suggestions from readers as to the function of this object are welcome!*

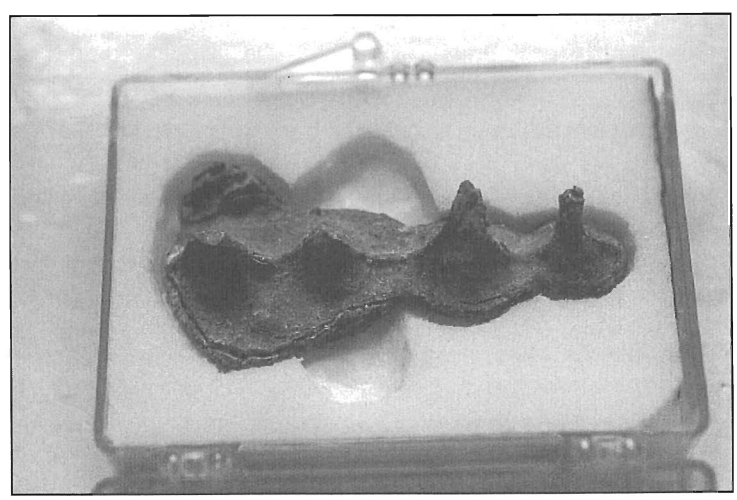


Photo: INA

Database

A database for the Uluburun artifacts was created on Microsoft Works™ software and information is regularly being entered. This now allows tracking of the treatment and location of objects and creation of status reports for each artifact category. Data for approximately one-third of the artifacts have been entered to date.

Storage

Work continues in the French Tower storage area to improve storage of treated artifacts. Most metals have been put into closed, clear plastic boxes with inert polyethylene foam supports and acid-free tissue, with like artifacts grouped together. Plastic sheeting is now draped over stacks of ingots and other large artifacts to protect them from the ubiquitous dust. Repackaging of vulnerable objects continues.

Conferences

In June, 1996 and again in 1997, two symposia for archaeological conservators working in Turkey were held at the site of Kaman-Kalehöyük, near Ankara, sponsored by the Middle Eastern Culture Center in Japan (MECCJ) and organized by conservator Glenn Wharton. Claire Peachey attended both summers, and Asaf Oron, Assistant Conservator on INA's Bozburun Shipwreck Excavation, attended in 1996. These were most useful gatherings in which participants held discussions about their sites, conservation problems encountered there, analyses and research projects being carried out, and specialized conservation and restoration techniques. Ways of working together to pool research results and useful information, such as chemical suppliers in Turkey, were also discussed, and future gatherings, publications, and educational courses were planned. Walking through MECCJ's formal Japanese garden on the Anatolian plateau was a highlight of the symposia.

In August, 1996, INA conservators Claire Peachey and Jane Pannell both attended the International Institute for Conservation conference, "Archaeological Conservation and Its Consequences," held in Copenhagen, Denmark. This meeting addressed practical, theoretical and ethical topics particular to archaeological conservation, and was a pleasant and useful forum for the exchange of ideas and for meeting new colleagues in this specialized field.

Staff, Interns

Full-time and part-time staff of the Uluburun Shipwreck project are Dr. Cemal Pulak, Director; Dr. Michael Fitzgerald, Archaeologist; Selma Oğuz, Illustrator; Claire Peachey, Head Conservator; Sema Pulak, Illustrator; Dr. Patricia Sibella, Archaeologist; Mark Smith, Archaeologist; and laboratory assistants Güneş Özbay, Birgül Akbülüt and Sevil Gökmen-Kaftanoğlu. Laboratory assistants Gülser Sınacı, Esra Altınanıt and Sebla Yiğit also contributed to the project. The help of many conservation students, professionals and volunteers who worked in the Bodrum laboratory between January, 1996, and August, 1997, is gratefully acknowledged: Talat Altier, Paula Artal-Isbrand, Çağlar Ata, Rose Barbosa, Lorna Barnes, Daan Blits, Devrim Cebe, Ron Chomicz, Jenn Danko, Shirley Ellis, Nil Emre, Debbie Forkes, Diane Fullick, Emre Gülcan, Molly McNamara, Lori McCoy, Lisya Melaard-Biçaçi, Şükran Şenyüz, and Büke Tüfekçioğlu. We were pleased to receive many visitors, friends both old and new, in the laboratory during this period.

Arabia Felix et Maritima: The Trade and Maritime Legacy of Yemen

by Roxani Margariti and Peter van Alfen

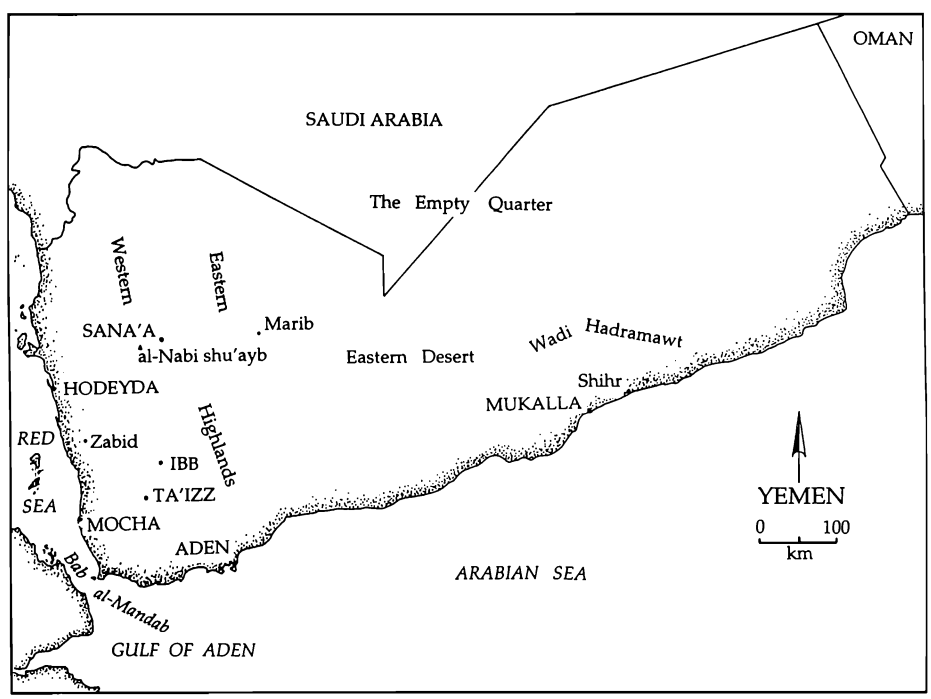
"I then traveled to the city of Aden, the port of the land of Yemen on the coast of the great Ocean... it is the harbor of the people of India. Great ships arrive there from Cambay, Tanna, Coulam, Calicut, Fandarayna, Shaliyat, Mangalore, Fakanwar, Onor, Sandapur, and other places. Merchants from India live there as well as merchants from Egypt." This account of a visit to Aden in the early fourteenth century CE by the famous Moroccan traveler Ibn Battuta attests to the incessant flow of trade and ships between India, East Africa, and the Red Sea. Through the ages the main players changed, but Yemen's strategic location between East and West remained central to this maritime network.

Stretching over 1500 kilometers, the Yemeni coastline comprises the southern part of the Tihama coastal plain on the Red Sea, then turns the peninsular corner at Bab-al-Mandeb, the Red Sea's southern "door," and extends eastwards along the Indian Ocean up to Dhofar, the frankincense country that nowadays belongs to the Sultanate of Oman (fig. 1). Situated in such locations, Yemeni ports made natural entrepots for Easterners and Westerners, pilgrims and traders, coasters and ocean-plying seafarers alike. The coastal region shaped the life of the native people, many of whom became traders, navigators, and fishermen, and exchanged material goods, customs, practices, and ideas with the foreigners they encountered.

Our two-month stay in Yemen during the past summer was primarily for language study in Sana'a, the country's capital and a UNESCO World Heritage City. From our highland base, however, we also sought to explore the potential for nautical archaeology and other research related to Yemen's rich maritime heritage. Of the many foreign archaeological missions that have worked in Yemen almost none, with the current exception of a Russian team working at Bir Ali (ancient Qana), have focused on the coast. The intense heat of the summer—we were repeatedly, if unsuccessfully, warned not to visit the coast because "the heat there is unbearable"—and the general inaccessibility of large parts of the country due to political turmoil in the past may partly explain this lack of interest in maritime research.

Arab-speakers call this country *al-yaman*. The best-known and most persistent etymology derives the name from the term *al-yumn*, Arabic for blessing with good luck, fortune, or prosperity. In similar fashion, Greek and Roman geographers called what is now Yemen *Eudaimon Arabia* and *Arabia Felix* respectively, that is "Fortunate Arabia" as opposed to the less felicitous areas of the Peninsula, *Arabia Petraea* (Rocky Arabia) and *Arabia Deserta* (Desolate Arabia). "Fortunate" indeed for its high mountains, high annual rain-fall, and fertile soil, Yemen also earned the additional nicknames "roof-top" and "bread-basket of Arabia."

From atop al-Nabi Shuayb, the highest mountain in Arabia (at 3660m) which we climbed one mercifully cloudy day last July, we saw lush cultivated terraces extending in every direction and small clusters of tall tower-houses, homes of the farmers who tend those terraces, perched in the most inaccessible places (fig. 2). Less than 200 kilometers due east of the mountain lies the infamous "Empty Quarter" and Eastern Arabian Desert; beyond this inhospitable wasteland and stretching over most of the eastern



Map: P. van Alfen and T. Pevny

Fig.1. *Yemen, indicating places mentioned in the text.*

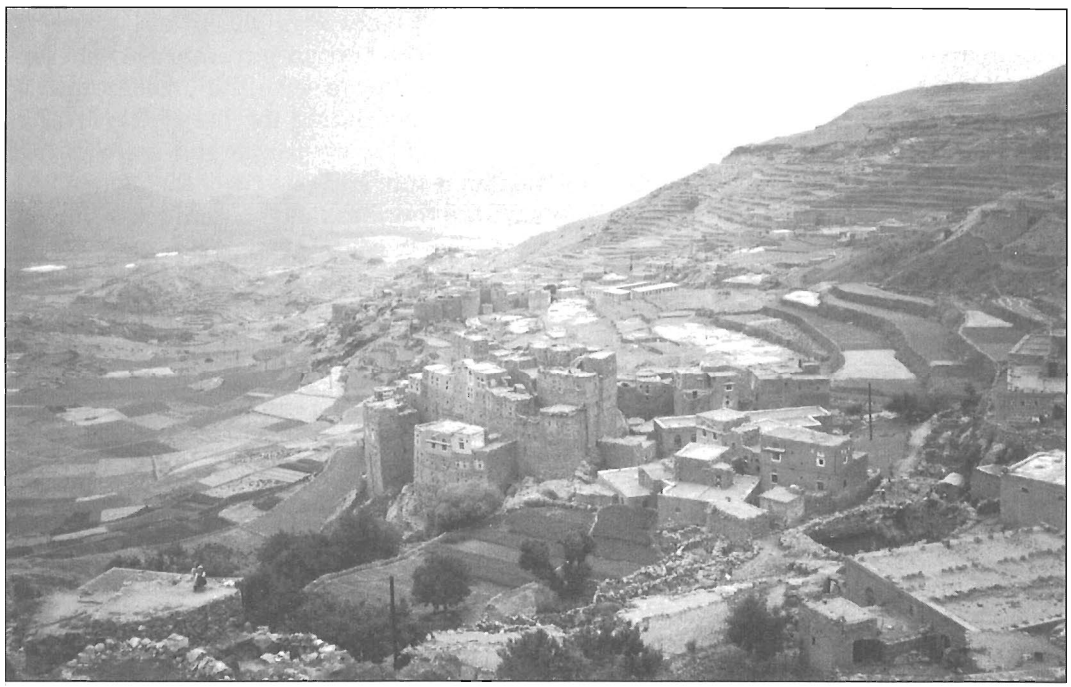


Photo: P. van Alfen

Fig. 2. *Mountain village and terraces on the slopes of al-nabi Shu'ayb.*

reaches of the country lies the Hadramawt Plateau dissected by the deep valley of Wadi Hadramawt. To the west the mountains drop abruptly at about 65 km from the seashore to form the coastal plain of the Tihama, while the Indian Ocean coast in the south features a much narrower coastal plain. This geographical fragmentation corresponds to, and is partly responsible for, significant regional differences in traditions, architecture, and even dialects. Furthermore, Yemen's long history is characterized by political fragmentation; the times when most of this territory has been united under a single powerful state are relatively few. Regardless of who held power, however, trade, both overland and maritime, has always featured prominently in the region's economy, and has linked its different parts.

Pre-Islamic Trade

Sometime shortly before the seventh century BCE, the Mediterranean world became aware of the fragrant gums and resins harvested from the frankincense and myrrh trees of southern Arabia. The reputation and wealth of the Arabian traders, the Sabeans, who brought the incense to the Mediterranean quickly grew proverbial. Controlling the overland incense and spice trade, the Sabeans built wealthy cities with large columned temples and imposing structures, such as the ancient dam at Marib, throughout their extensive kingdom in central Arabia. The Queen of Sheba (her name appears as Bilquis in the Quran) is said to have visited Solomon in Jerusalem sometime in the seventh century trailing a large retinue of camels laden with spices, gold and precious stones (1 Kings 10.1 ff.); Ezekiel's dirge over the Phoenician city of Tyre (27.22) also mentions Sabean traders in this famed port. Increasing contact between the Greek lands and the eastern Mediterranean led to the Greek adoption of some eastern Mediterranean practices, including the use of incense in religious rituals. The ancient Greek word for incense, *libanos*, derived from the Semitic *lbn*, appears for the first time in Greek literature in works of the poetess Sappho (44.30) around the middle of the seventh century. For centuries the Sabeans maintained their virtual monopoly of the incense trade; almost 700 years after Sappho, the Roman poet Vergil still refers to contemporary rich Sabeans and their famed incense (*Georg*. I.57, II.116).

Such wealth and control of valuable commodities did of course attract the jealous attention of Greece and Rome's great leaders. Alexander the Great, cut short by his early death in Babylon, intended to subdue the Sabeans; Augustus sent Aelius Gallus with a legion on an ill-fated mission to southern Arabia in 25 BCE. Rather than conquer the Sabeans, the Greek Ptolomies of Egypt, in the years between Alexander and Augustus (third to first centuries BCE), chose to compete with them by opening the Red Sea to Greek trading vessels by means of a canal between the Nile and the Red Sea, thereby allowing vessels to sail directly from the Mediterranean into Arabian waters. Pushing farther afield, the Greek explorer Eudoxus of Cyzicus, around 116 BCE, discovered for the Hellenistic world the secret of the monsoons, the annual east-west trade winds of the Indian Ocean, and so opened direct trade with India. Before Eudoxus, Greek seamen were obliged to stop

at a port named Eudaimon Arabia (probably Aden) to exchange goods with the Arabian or Indian seafarers who knew and protected the secret of the monsoons.

But Greeks were not the only traders bringing Arabian and Indian goods to the Mediterranean: inscriptions from the Greek island of Delos, the great trading entrepot in the middle of the Aegean, dating to the second or first centuries BCE, roughly contemporaneous with Eudoxus, attest to the presence of South Arabian merchants on the island. Two of the bilingual inscriptions, in Greek and South Arabian script, note the dedication of a separate altar and statue to individual Arabian gods. One inscription mentions the names of the traders: Hane and Zaidil.

By the first century CE, the seaborne trade between the Mediterranean and the Red Sea/Indian Ocean was so well established that poets and other writers of the period frequently spoke of imported eastern luxuries, often with disdain. A sailing handbook of this period, the *Periplus Maris Erythreae*, gives sailing directions, lists Red Sea and Indian Ocean harbors, and tells traders what commodities to expect in the various harbors. Cargoes of incense, spices and even pearls from the Persian Gulf awaited these ships in the Yemeni harbors of Bir Ali, Aden, and Ocelis, all on the Indian Ocean coast.

In the National Museum in Sana'a, impressive evidence of this long-lasting and extensive contact between the Greco-Roman world and ancient Yemen is displayed. Most stunning are two larger-than-life bronze statues of a father and son, rulers of the united Sabean-Himyarite state, executed in a late Roman, Severan style. The knee of one of the statues bears the inscription, in Greek, *Phokas epoiei*, "Phokas made this." Also displayed are smaller imported bronze statues and ceramic vessels and a series of Sabean and Himyarite coins minted in Marib and elsewhere that imitate, very accurately, the famed Athenian tetradrachma of the fourth century BCE.

Ports and Seafarers of Islamic Times

In the sixth century CE, as the Sabaean-Himyarite state was breathing its last, Yemen became the arena of power struggles between the Abyssinians of East Africa and the Sassanians of Persia. Under the pretext of protecting local Christian communities from persecution, the former crossed the Red Sea and occupied the country under the leadership of Abraha, builder of a magnificent church in Sana'a and known from the Quran for his attempted attack on Mecca. It was then the Persians' turn to intervene; in 575 Chorsoes sent troops by sea. The Persian force succeeded in ousting the Abyssinians and established a Persian governor in the area. But the Sassanian Empire was soon to be eclipsed by the Muslim Arabs, who came to dominate most of the Middle East and North Africa within fifty years of their initial venture out of the caravan trade center of Mecca in Western Arabia. Yemen came into the realm of Islam very early on: in the second quarter of the seventh century, the Persian governor Badhan embraced Islam and, according to some, the Great Mosque of Sana'a was built already during the life of the Prophet Muhammad. The mobility of people and merchandise within the Muslim realm, and especially the demand for eastern products in its northern and western parts, the continued mercantile contact with the Byzantine Empire and Europe, and the demands of the locally-based semi-independent (and at times entirely independent) dynasties ruling Yemen, ensured prosperity and flourishing business in the Yemeni ports.

It seems that the most important harbors of the area throughout the Middle Ages were Aden, Shihr, and Dhufar on the Indian Ocean coast. Though not on the coast, the town of Zabid served as the main entrepot for local and imported goods in the Tihama, and was linked to two harbor towns in its vicinity, al-Buqah and Fazah. Archaeology remains silent as regards these entrepots, but a vivid picture of their physical characteristics, daily life, and trade emerges from works Arab geographers and historians, as well as travel accounts by both Arabs and Europeans. In addition to those sources, medieval almanacs, some dating as far back as the Rassulid period (1235-1454), detail the regular pattern (in terms of timing, origin, and destinations) of ships coming in and out of the harbor during the year.

Most notable of the travel literature as an invaluable source for the social and economic history of Yemen is Ibn al-Mujawir's remarkable text *Tarikh al-Mustabsir*. Ibn al-Mujawir, an early thirteenth century traveler from Khurasan who visited Yemen towards the end of Ayyubid rule (1173-1228), shows a particular interest in maritime trade and vividly describes its every detail in Ayyubid Aden. He offers a clear picture of the course of events upon the arrival of traders at port: inspection of merchandise and body searches of crew and passengers by customs officials, dissemination of news to the families of those on board, disembarkation of passengers, unloading of merchandise, imposition and payment of taxes. Taxes included a customs tax, a "galley tax" (for the maintenance of an Ayyubid patrol fleet which protected merchantmen against pirates), the *zakah* (charity tax mandatory in Islamic law), and a brokerage fee. Lists of taxable and non-taxable imports reveal the fascinating array of commodities traded in Aden. Pepper, cardamom, camphor and other spices and aromatics, cloths and fabrics of various kinds, bamboo sugar, iron, sheep, horses, and slaves constitute some of the taxable goods. Wheat, flour, rice, soap, olive and flax oil, nuts, honey, all from Egypt, cushions, prayer mats, sesame, and aromatic woods from India, as well as dates and salted headless fish feature, among other items, as non-taxable commodities. Ibn al-Mujawir's curiosity, keen observation, and meticulous documentation also produced

detailed records of the workings of Aden's slave-girl market, as well as the currency types, values, and exchange rates in Yemeni ports at that time.

Division into ethnic, as well as professional, quarters was characteristic of Medieval entrepot towns, and names reflecting such divisions sometimes survive to the present day. In reference to Medieval Aden, the sources speak of the Indian and Jewish quarters; it is very likely that these correspond to communities or enclaves of foreign merchants who staffed local branches of international businesses. In the case of the Jewish community, a series of private letters and other documents in the *geniza*, or document repository, of the Cairo Synagogue sheds light on the nature and operation of such businesses. Indeed this source testifies to the existence of a Jewish trading network in the Indian Ocean, a network with Cairo, Aden, and the west coast of India as its focal points. In several of the Cairo Geniza letters, the Jewish merchants of Aden are reporting to their Cairo associates or vice versa; references to wrecks are not rare, and losses, as well as salvage attempts, are described in detail.

What types of vessels carried the Indian Ocean trade in Medieval times? Starting with the *Periplus*, textual as well as iconographic evidence testifies to distinct structural details found in the prevalent indigenous boatbuilding tradition (double-ended, open hulls, partial decks fore and aft, and stern rudders) and suggests that at least since the first century CE the tradition featured "laced" or "sewn" construction, a method in which ropes or cords constitute the primary means of fastening the planks of the vessel's shell to one another and to the frames. The advent of European shipping in the Indian Ocean in the 16th century seems to have precipitated the adoption of nailed construction across the region, yet some boatbuilders continued to produce entirely or partially "laced" vessel types. Ethnoarchaeological research testifies to the persistence of the "laced" boatbuilding tradition in the region. The "Traditional Boats of Oman" project led by Tom Vosmer, of the Western Australian Maritime Museum, yielded ample evidence of laced construction hold-overs in the contemporary wooden boatbuilding of Oman, and similar data has come to light in Yemen and the Eastern African coast. Tom Vosmer also directed the building of Tim Severin's *Sohar*, a reconstruction of a Medieval Omani merchantman of laced construction, which then successfully completed an experimental voyage between Oman and China.

Post-Medieval and Modern Times

For most of their history, the ports of Yemen were primarily entrepots for the exchange and shipment of goods from elsewhere; with the exception of frankincense, the export of indigenous products played, for the most part, a secondary role. In the 16th century, however, a new local product of Yemen stimulated the growth of a significant export trade. Just as frankincense had been the most widely desirable indigenous commodity throughout antiquity and early Islamic times, coffee was Yemen's contribution to global merchandise after the 16th century when the Ottomans discovered it and introduced it to Europe. Yemen's fertile highlands were ideal for coffee cultivation, and although the details of the plant's introduction into the country (probably from Ethiopia) are shrouded in myth, commercial production of the crop is linked with the first period of Ottoman rule over Yemen (1517-1636) and the development of Mocha, a hitherto insignificant Red Sea fishing port and the place whence "mocha coffee" derives its name, into the most active trading center in the country.

From the 17th century onwards, trading houses of the Dutch, English, and French competed for privileges and influence in Mocha. The presence of coffee on the 18th-century Sadana Island shipwreck currently under excavation by INA-Egypt off Egypt's Red Sea coast, makes Mocha a likely port of call on the ill-fated ship's last voyage (see *INA Quarterly* 22.3 and 23.3). Eventually the Americans also became involved and by the early 1800s were the main exporters of Yemeni coffee, having gained special concessions from Mocha's ruler, who sought the cheap American cotton piecegoods that Europeans could not provide.

The expansionist policy of the British and Ottoman Empires had a lasting effect on the region's politics. In 1848 the Red Sea coast came once again under Ottoman jurisdiction while in 1839 the British, concerned with maintaining control over the sea route to British India, seized Aden and established a Protectorate on the southern Yemeni coast. These occupations resulted in the division of Yemen and the establishment of a loose boundary line between the north and the south that, despite the eventual departure of the foreigners, remained in place until Yemen's unification in 1990.

The decline of Mocha and the declaration of Aden's "free port" status in 1850 led to an increased flow of maritime traffic through Aden. Later, the opening of the Suez Canal in 1869 and the increasing use of steamships further enhanced the port's fortunes, and exports of gums, resins, skins, and coffee rapidly increased. Ideally located for the refueling of ships on their way to and from India, Aden boasted impressive bunkering facilities, first for coal, and later, when maritime propulsion technology changed, for fuel oil. The *Port of Aden Annual* issues between 1949 and 1967 describe massive modern tankers and liners sharing the port with hundreds of "dhows" (the European generic term for Arab wooden vessels) which plied the monsoon trade route between India and Africa. Berthing maps from the *Annuals* show that one of the small islands within the harbor was reserved for "dhow" building and repairs.

In the sixties, however, Aden's flourishing trade came to a halt. In 1967, the closure of the Suez Canal, coin-

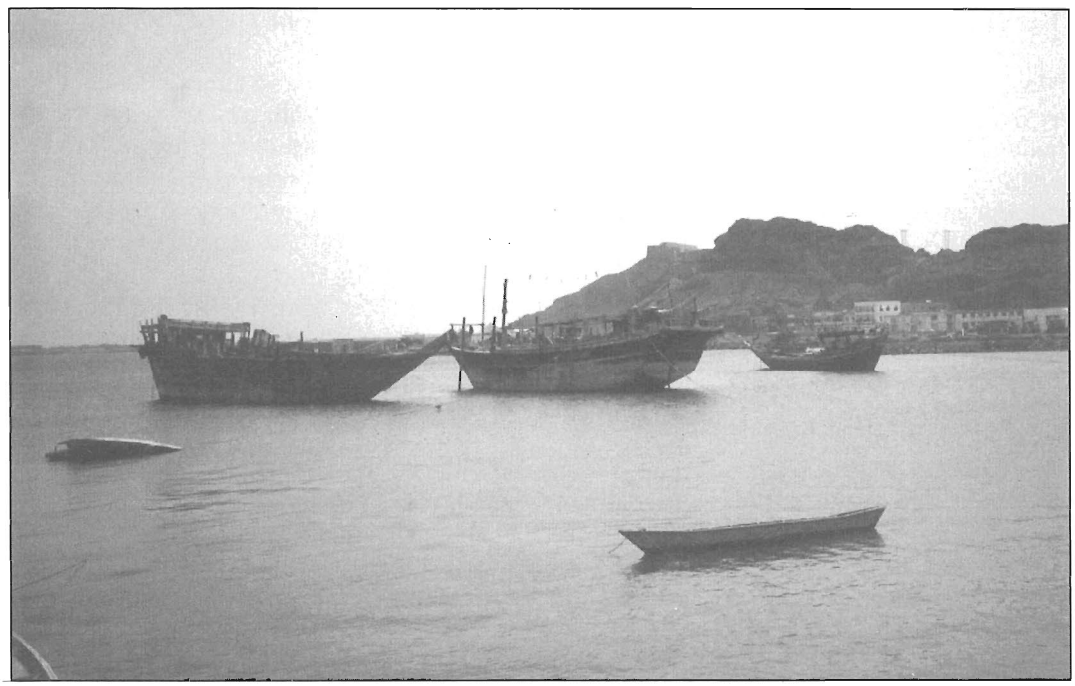


Fig. 3. *"Dhows" at Ma'alla in Aden.*

Photo: P. van Alfen

ciding with the British withdrawal from the area and the establishment of a communist government, severed shipping routes and curbed the maritime traffic passing through Aden. When the canal reopened nearly a decade later, trade patterns had changed forever and Aden's port had fallen into deep decline. Shortly before Yemen's unification in 1990, millions of dollars were spent in a refurbishment project that would enable Aden to handle RO/RO (roll on/roll off cargo ships and tankers. This investment has yet to see any return.

In a new book on Yemen, Tim Macintosh-Smith describes Aden as a "feast of faded magnificence." Indeed, the place may seem depressing to the nostalgic. Rows of British-built apartment buildings are crumbling and stately colonial hotels are mere ghosts of their former selves. The civil war of 1994 has taken a visibly heavy toll on the defeated south, as bullet-ridden walls, bombed-out structures, and the occasional rusting hulk of a half-sunk navy ship testify. Of the once booming "dhow" trade, only a few motorized wooden vessels were to be seen in the harbor at the time of our visit, while stevedores were sleeping under rows of battered 40-year-old Bedford trucks parked along the waterfront (fig. 3). In a musty Aden bookstore, hand-colored postcards from the 1950s show the city as a

Fig. 4. *The port of Mukalla from* Port of Aden Annual *1961-62, p. 44.*

clean, orderly, and lively place; the comparison with today's Aden certainly invites reflection on the ever-changing fate of port cities.

Despite plans to reinstate Aden's "free port" status, and the Yemeni government's commitment to turn Aden into the nation's economic capital, it is difficult to predict the port's future. Other harbors have now taken precedence as Yemen's maritime centers, while a score of smaller ports along the Yemeni coast forge a living from the bountiful fisheries of the Red Sea and the Indian Ocean. The numbers of ships calling at Hodeyda on the Red Sea are so great that, according to some reports, waiting periods to on- or off-load can extend up to six months. On the Indian Ocean, the spectacular port city of Mukalla boasts recently refurbished harbor facilities, as well as a canning factory and cold storage units for the local fishing cooperatives (fig. 4). While trade has become largely containerized and relies on enormous steel hulls, fishermen all along the coasts of Arabia primarily employ wooden Arab-built vessels, motorized and equipped for deep-sea voyages and long-term cold storage. For Yemen's maritime communities, the sea is not only a link with their past, but it also continues to play a paramount role in the shaping of their present and future (fig. 5).

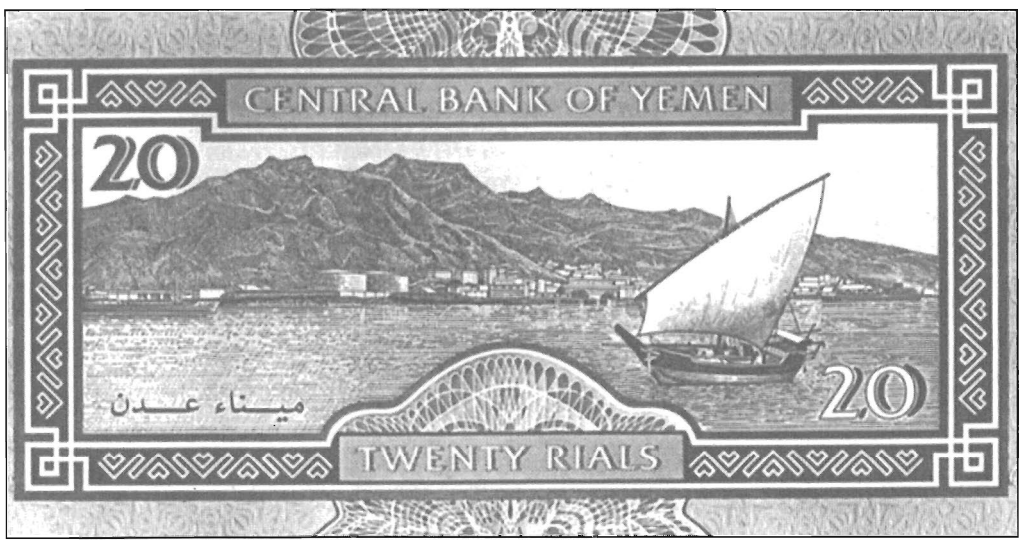


Fig. 5. *Current Twenty-Rial banknote from Yemen, showing the modern port facilities at Aden and a "dhow" under sail, an image of Yemen's maritime past.*

SUGGESTED READING

Casson, Lionel
1989 *The Periplus Maris Erythreae*. Princeton: Princeton University Press.

Goitein, S.D.
1973 *Letters of Medieval Jewish Merchants*. Princeton: Princeton University Press.

Makintosh-Smith, Tim
1997 *Yemen: Travels in a Dictionary Land*. London.

Prados, Edward
1996 "Huris, Sanbuqs, and the Boatbuilders of Yemen." *Wooden Boat* 131 (August): 50-56.

The Camel's Nose is in the Tent. Can the Whole Camel Make it in?

By Mary Rosenberg

How the Northwest Friends of INA was organized to spread INA's story and become a model for other groups to provide financial support to a growing institution.

Dick and Mary Rosenberg and David Perlman of Portland, Oregon, have formed a unique financial support group, the Northwest Friends of INA, which in turn allows its members to learn about archaeological projects on a firsthand basis. We asked Mary to tell how it all came about.

The idea of a group to tell the story of INA and raise funds for the Institute began over dinner in Portland and continued in the courtyard of the Bodrum Museum of Underwater Archaeology, where we sat one afternoon with George Bass. The need we saw was large, but if one group could be formed successfully, others could surely follow in different parts of the country.

As originally conceived, our group would aim to have one hundred members, each member contributing $100, thus raising $10,000 annually. No one thought of a single purpose for the money at this point. First it seemed important to establish local interest. Thus, in 1991, Don Frey spoke to an invited group in the Portland Art Museum Auditorium about underwater surveys along the Turkish coast.

Shortly afterward, we arranged for Dr. George Bass, INA's founder and president, to visit Portland under the auspices of an established lecture series. On a cold, icy night he drew well over two thousand people to the public auditorium to hear him talk about INA's discovery and excavation of he Bronze Age shipwreck at Uluburun. After the lecture, invited acquaintances met at the home of David Perlman's mother. Then and there, the Northwest Friends of INA was officially born. There was no election of officers, but clearly those who were interested could identify themselves. We set out to develop a large mailing list of interested people and to present one public lecture each fall to raise an annual $10,000. Membership would range from Friend, at $100–$499, to Benefactor, at $500–$999, to Patron, at $1,000 and above.

During the next five years, several changes evolved, most important of which was the tangible commitment to raise $50,000 to bring a 4,000-volume library of classical archaeology to INA's Bodrum headquarters. We agreed to pay INA $10,000 each year for five years. Another lecture was added each spring, with INA providing speakers form varied areas of its activities.

The story of INA came alive with each speaker describing his or her participation and function. Following Dr. Bass came Dr. Faith Hentschel, to discuss the Medieval "Glass Wreck" at Serçe Limanı. Then there was Dr. Claire Dean to talk about teaching conservation at the Bodrum Museum. Dr. Frederick Hocker lectured on the reconstruction of a medieval boat. William Charlton talked about unique challenges of diving at great depths for archaeology. Dr. Shelley Wachsmann presented a lecture on the recovery of the Sea of Galilee boat in Israel, and Dr. Cheryl Haldane discussed the significance of finding Chinese porcelain on a wreck in the Red Sea. Rezart Spahia, visiting scholar from Albania, also described his hope of establishing a branch of INA on the Albanian coast.

An important component for adding potential audience and promotional impetus was shared sponsorship with related organizations. Natural links were with the Middle East Studies Center at Portland State University, the Portland Art Museum, and (with Dr. Cheryl Haldane Ward talking about "Transporting an Egyptian Obelisk Down the Nile") the Ancient Egypt Studies Association.

In Los Angeles, where Dr. Haldane Ward spoke in spring of 1997 under the aegis of INA-Egypt, additional sponsorships once more came into play. Effectively coordinated by Ellie Stern of the Los Angeles area, Dr. Haldane Ward appeared at the Los Angeles County Museum of Art, the UCLA Center for Near Eastern Studies, and the Pacific Asia Museum.

Each speaker, as professional scientist or student, gave an individual story. Each brought an illustrated talk about a different site of archaeological importance in the expansion of knowledge of past civilizations. We visualize thirty or forty cities, each with an organization contributing $15,000 to $100,000 per year, helping INA expand a network of organizations, scholars, specialists, and popular audiences. With these ever widening circles of appreciation and deeper understanding of archeology, INA will open its tent beyond future imagination.

Profile

John De Lapa

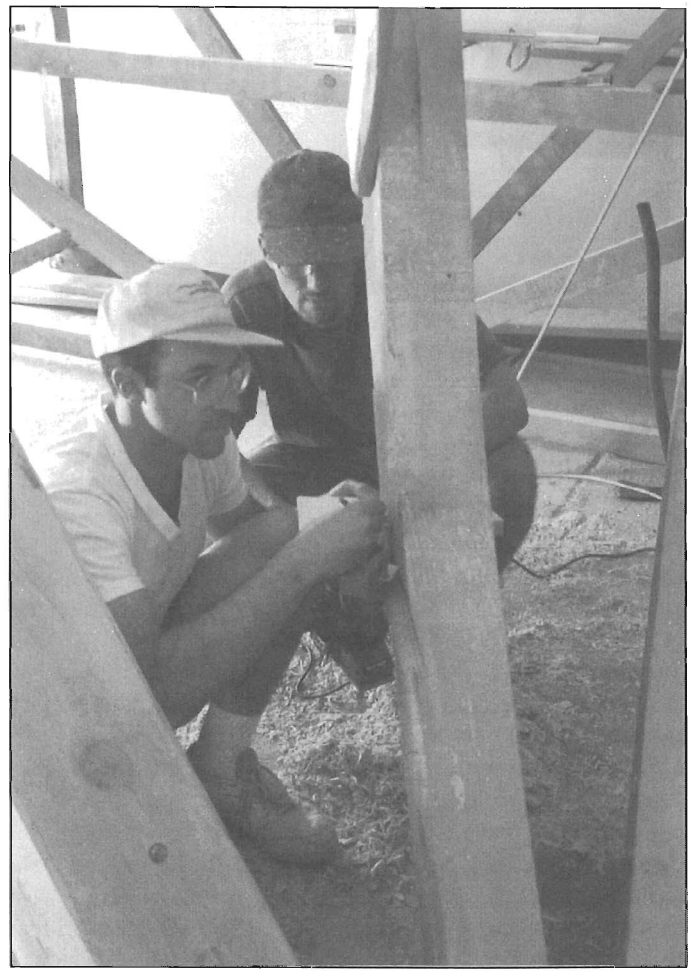


Photo: T. Pevny

John De Lapa (left) and Peter van Alfen fairing the hull of the Yassıada replica.

This past summer, John De Lapa traveled to Athens, Greece, for the wedding of two graduates of the Nautical Archaeology Program at Texas A&M University, Peter Van Alfen and Roxanni Margariti. It was not surprising to see him there, for although John started his association with INA as one of the sponsors of the Yassıada exhibit, he has since become a close friend to many of us. It was surprising to see John in a suit.

John's outfit of preference is a white tee shirt, shorts (a pocketknife included), and sneakers—a baseball cap being an optional accessory, depending on the weather. John somehow makes this outfit look proper, if not conservative, in most settings. John showed up dressed like this for his first day of work on the Yassıada exhibit. He also brought with him a suitcase full of tools. As I recall he had a handsaw, circular saw, plane, and a drawknife. This was not the individual I pictured when I was told that the sponsor of the project's travel expenses was coming to work with us.

On the morning walk to work at the Bodrum castle, John would usually buy a *Wall Street Journal* in order to check on the status of his investments. A caricature of John would not be complete without a newspaper tucked in his back pocket. A complete portrait of John is far more complex. When he put down his newspaper we soon learned that John was a great carpenter. His previous boat building experienced proved a valuable asset for the project. John and I spent many hours discussing, often arguing, about various techniques of ship construction. This became a great basis for our friendship. As I have learned over the last couple of years, boat building is just one of John's interests and talents. We hear many clichés about work ethic, self-reliance, family, and community values; it is not an exaggeration to say that many of these are embodied in John.

For people familiar with Turkey, many of these social values seem quite tangible in everyday Turkish life. This spirit is captured in John's photographs. Every year John rents a car and travels around Turkey and photographs traditional crafts that are practiced there today, for example: wooden boat building, bread making, glass bead making, basket weaving, charcoal making, and olive oil pressing. His photographs do not simply show the technical side of a craft but are portraits of working people. As for the technical aspects, John usually studies the traditional techniques and tries to replicate them himself. He doesn't just try it once but usually tries to develop some level of proficiency. As a result, he is also a good teacher.

For example, last winter John visited us in College Station. He arrived in the morning and by that evening I had my first lesson in casting lead. We cast four lead drafting weights that I have since found very useful. We melted the lead over a campfire at night, and so I didn't notice a small carving on the mold. I would always remember that John made the molds, because the weights have the Turkish moon and star cast into their sides. I distinctly remember his amused smile when I first noticed this detail.

Most people who know John become familiar with the merits of catalpa wood. These he knows well, and as a result has invested in a large catalpa farm in the back of his house in Michigan. It is a farm he personally planted and maintains. He will be lucky if the trees are ready to harvest when he is an old man, yet this in no way dampens his interest or enthusiasm. It is a worthwhile long-term project. John once told me that he supports projects that are backed by determination and hard work, that have a worthy goal and not only an assured successful outcome. He has been a good friend to INA, another long-term project of great merit.

Taras Pevny

News & Notes

Visiting Scholars

The Nautical Archaeology Program at Texas A&M University is fortunate in the Fall semester of 1997 to be both the recipient and the donor of visiting scholars. The Institute and University in College Station has welcomed Dr. John M. McManamon, Professor in the Department of History at Loyola University of Chicago. Dr. McManamon, a member of the Society of Jesus, has a long-standing interest in nautical archaeology. He has served as the Project Historian of the Committee for Underwater Archaeology of the Chicago Maritime Society since 1987. His major academic focus has been on the Italian Humanists of the fifteenth-century Renaissance, and his "dream excavation" is one of the many Venetian trading vessels of that era. Dr. McManamon has been attending several of the core courses in the Program to familiarize himself with some of the technical issues involved in the study of the history of seafaring.

Christopher Cook, a third-year Nautical Archaeology student left at the beginning of October 1997 for a two month academic visit as a Jordan Scholar to Roskilde, Denmark. He will be studying the development of ancient boat burial traditions in Scandinavia. Mr. Cook continues the fruitful exchange of scholars that has been established between the Nautical Archaeology Program and Danish institutions such as the universities and the Danish National Maritime Museum in Roskilde.

Joint Memberships Available

The National Maritime Historical Society invites members of the Institute of Nautical Archaeology to join their organization for $25 annually, $10 off the regular rate of $35. The Society's address is PO Box 68, Peekskill, New York 10566. INA members need only identify themselves to qualify for the reduced rate.

Film Available

The Ancient Mariners, produced in 1980, tells the story of how INA was then tracing the history of ship design from ancient through Byzantine times, using as examples the classical Greek ship excavated off and restored at Kyrenia, Cyprus; the seventh-century CE Byzantine ship at Yassıada, Turkey; and the eleventh-century medieval ship at Serçe Limanı, Turkey. Animation vividly makes clear the evolution from shell-first to frame-first hull construction. The program, often using archival footage from the 1960s, moves between Greece, Turkey, and the United States as INA's Michael Katzev, J. Richard Steffy, and George Bass describe and discuss different aspects of their work, sometimes illustrated by artifacts or replicas. Scholars Lionel Casson and Barbara Kreutz lend their expertise in interviews. The Film, initially telecast on PBS-TV, was the first produced by Sam Low, who had dived at Yassıada while still an undergraduate, but who left the field of archaeology for a successful career in film production.

INA members can order *The Ancient Mariners*, identifying that is part of the *Odyssey* Series, by calling Stella at PBS Video, 1–800–328–7271, for $29.95 each plus $6.00 shipping and handling.

Students receive 1997–98 Honors

The following students in the Nautical Archaeology Program at Texas A&M University have received non-teaching graduate assistantships in the Program: Deborah Carlson, Timothy Collins, Doreen Danis, Janalyn Gober, Kristin Romey, Christopher Sabick, and Erika Washburn. Christine Powell has received an assistantship through the Institute of Nautical Archaeology. An INA scholarship was awarded to Eric Emery. Erich Heinhold will hold the Marion Cook Graduate Fellowship, while Sam Mark will hold the Ray Sigfried Graduate Fellowship. In addition, the following individuals have received LaSalle Assistantships: Jason Barrett, Amy Borgens, Jonathan Faucher, Peter Fix, Ben Liu, and James Mason.

Cheryl Haldane Ward Receives Mellon Foreign Area Fellowship

The United States Library of Congress Office of Scholarly Programs has announced that INA Adjunct Professor Cheryl Haldane Ward has received one of their first five Mellon Foreign Area Fellowship awards. These fellowships are intended to support post-doctoral research by less-established American scholars as they embark on a second major research topic following their dissertations. Dr. Haldane Ward received her master's and doctoral degrees through the Nautical Archaeology Program at Texas A&M University, with a research focus on ancient Egyptian watercraft. She has more recently been the archaeological director for INA–Egypt and the director of the Sadana Island Shipwreck excavation (see *INA Quarterly* 23.3, 3–8). She will use the fellowship to research "Red Sea and Western Indian Ocean Trade in the Seventeenth and Eighteenth Centuries." Dr. Haldane Ward will use consular reports, travel accounts, maps, and contemporary documents to provide a broad context for the detailed archaeological record provided by the mid-eighteenth-century Sadana Island ship, its crew, and its cargo.

Shelley Wachsmann Honored

Dr. Shelley Wachsmann has been selected by the Biblical Archaeology Society—publishers of *Biblical Archaeology Review* and *Bible Review*—to receive a BAS Publication Award. The prize names Dr. Wachsmann's book *The Sea of Galilee Boat: An Extraordinary 2000 Year Old Discovery* as Best Popular Book on Archaeology published in 1995–96.

Photo: C. A. Powell

Left: *Kendra Quinn, Bob Warkentin, and William Charlton (left to right) carry out routine maintenance on their underwater camera equipment at the one-day seminar arranged by Dr. Shelley Wachsmann.*

Below: *Helen Dewolf arranges items in the showcase for the exhibit at the Bush Presidential Library.*

Photography Seminar Held

Underwater photography expert Bob Warkentin of the Southern Nikonos Service Center, Houston, donated his time and expertise to a group of interested A&M students and faculty on 4 October 1997. The seminar, arranged by Dr. Shelley Wachsmann, provided excellent advice and practical help in the operation and maintenance of underwater cameras. The first workshop was attended by Dr. Wachsmann, Deborah Carlson, William Charlton Jr., Doreen Danis, Dan Davis, Christine Powell, Kendra Quinn, and Erika Washburn. It is hoped that similar seminars can be arranged on a regular annual basis.

Nautical Exhibit at Bush Library

The Nautical Archaeology Program at Texas A&M University was invited to provide an exhibit of its work for the opening of the George Bush Presidential Library in College Station. This included displays of both INA projects and other nautical archaeology projects with which the Program has been involved.

INA receives valued gifts

INA would like to thank the Shell Company ofTurkey Ltd., for its generous donations to the annual survey in Turkey and the Mobil Foundation, Inc., Egypt for their donations towards the Conservation Laboratory in Alexandria, Egypt. Their valued support has greatly contributed to the efforts of the Institute.

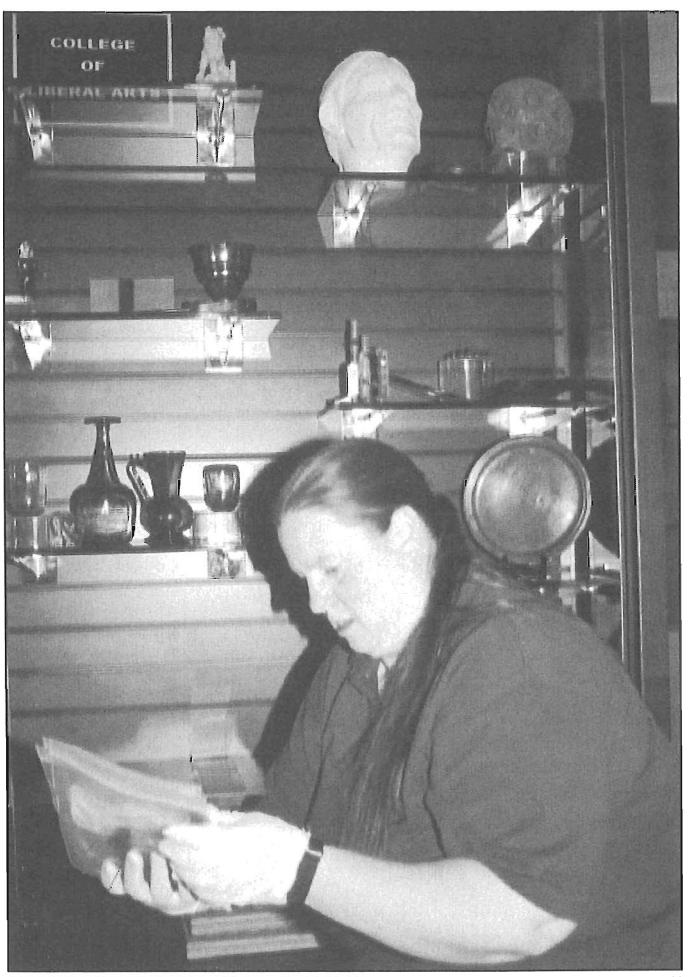


Photo: C. A. Powell

INSTITUTE OF NAUTICAL ARCHAEOLOGY