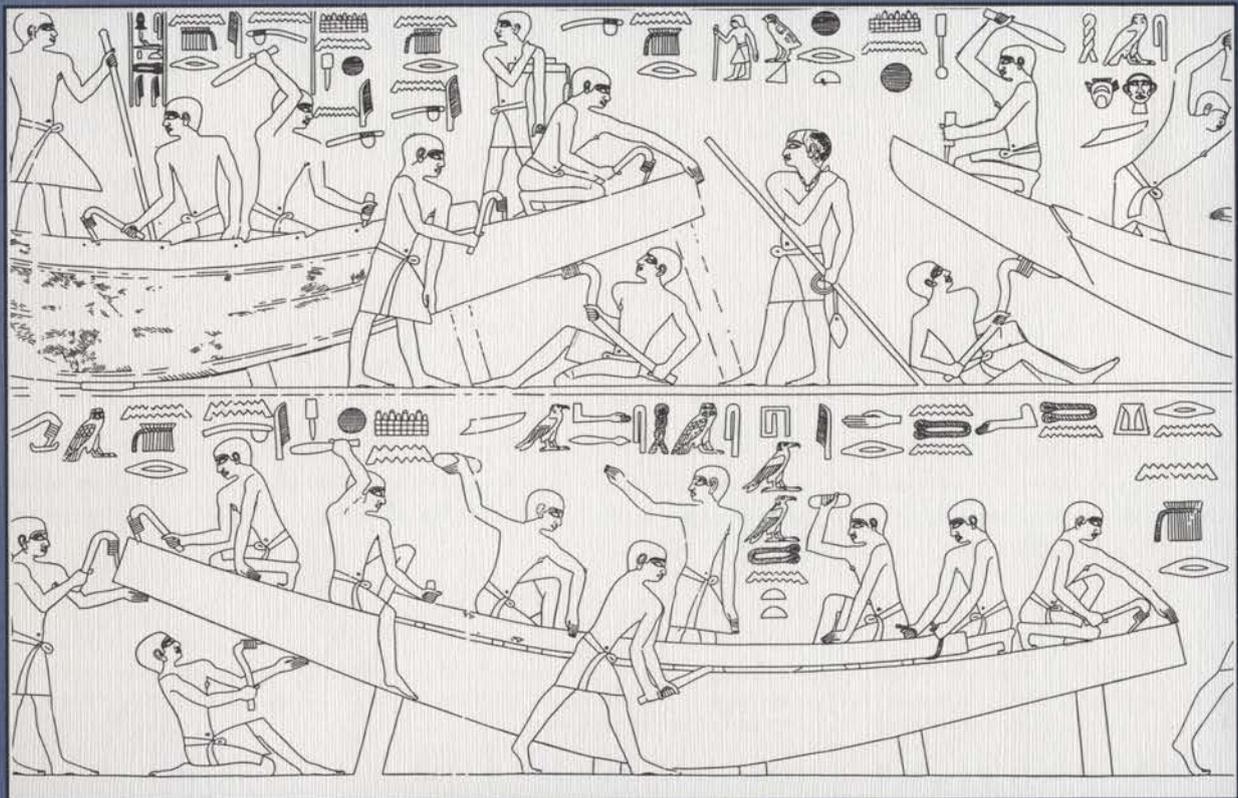


# THE INA QUARTERLY



Fall 1992

Volume 19, No. 3



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*On the cover: A relief from the tomb of Ti, a Fifth Dynasty court official, delineates the process of shipbuilding in ancient Egypt. Such reliefs provide nautical archaeologists with information about vessel construction from an era that has left few physical remains of ships and boats. (From Le Tombeau de Ti, Fascile II, plate 129.) Reprinted courtesy of l'Institut Français d'Archéologie Orientale (IFAO), Cairo.*

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Editor: Margaret Lynch

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## *Building a Model of the Kinneret Boat*

by William H. Charlton, Jr.

When Shelley Wachsmann arrived at Texas A&M University in the fall of 1990 to join the Nautical Archaeology Program faculty as the Meadows Visiting Assistant Professor of Biblical Archaeology, he brought with him the idea of having a scale model of the Kinneret Boat to display alongside the remains of the 2000-year-old hull. In 1986 Dr. Wachsmann (then underwater inspector for the Israel Antiquities Authority) had directed the excavation of the nearly 9-meter-long boat from the shores of the Sea of Galilee (*Yam Kinneret* in Hebrew). After excavation, the boat was moved to the Yigal Allon Museum at nearby Kibbutz Ginosar where the long process of conservation in polyethylene glycol (PEG) continues, possibly into 1996.

This fantastic discovery, the only ancient boat ever excavated from the Sea of Galilee, attracts great interest by native Israelis and visiting tourists alike, but there is little to see of its ancient timbers while they are immersed in dark brown PEG. Thus, Dr. Wachsmann proposed a model that would show museum visitors what the ancient boat would have looked like as it sailed the Kinneret some 2000 years ago.

When Dr. Wachsmann and I met, we found that we

shared similar interests and experiences, and he soon asked me to build the model of the Kinneret boat for him. Now, I had not done any modeling in wood since making model airplanes out of balsa wood nearly forty years ago (and I almost cut a finger off doing that), and this certainly looked like a long, detailed, and much more difficult project; however, the experience I would gain in the techniques of the ancient boatwright far outweighed any apprehensions I might have had. The job was given to me as a half-time graduate assistantship late in the fall of 1990. Funding for the project, to include my assistantship and all materials for the model, was provided by the Meadows Visiting Professor of Biblical Archaeology Endowment.

In mid-January 1991, as the new semester began, I spent a few weeks in detailed study of the original set of preliminary lines drawings made by Professor J. Richard Steffy, along with the field sketches, some photomosaics of the boat, and the final excavation report. Then I made a new set of drawings specifically for the model.

The model was to be in 1:10 scale, each piece being shaped and sized as close to the original as the scale would allow, and its design was to be based on Professor Steffy's



Photo: R. Pedersen

*Left: Bill Charlton compares the shape of a strake to its original counterpart on the field sketch plan.*

*Below: Parts of the Kinneret Boat that did not survive were derived from other sources. The model's stem post, shown with a railcap, was based on a boat mosaic dating from the same period as the excavated hull.*

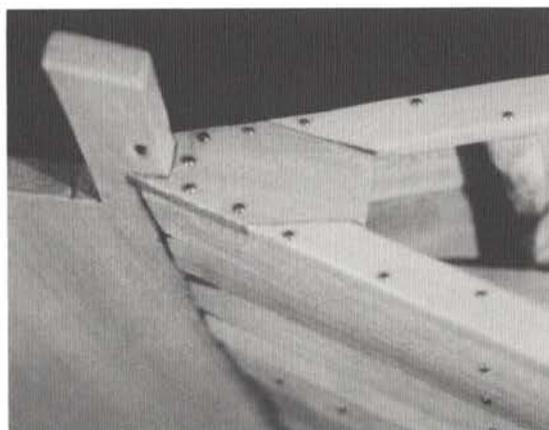


Photo: R. Pedersen

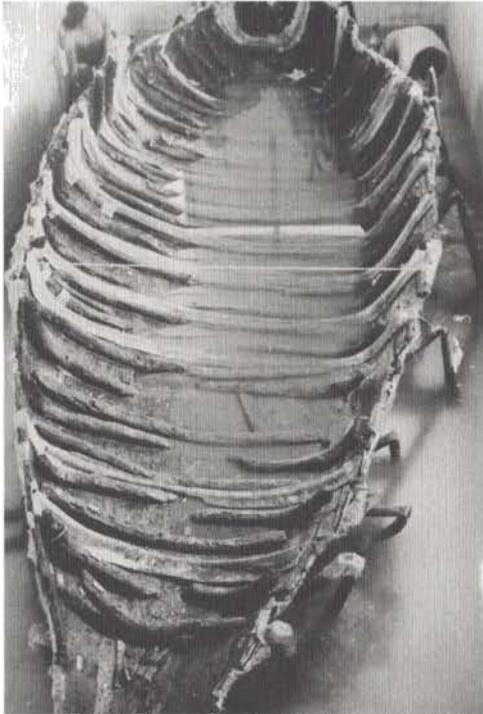


Photo: D. Syon, courtesy Israel Antiquities Authority (IAA)



Photo: R. Pedersen

suggested lines. His hull lines were based on measurements of the original boat remains, while a high incurving stern post and cutwater prow were based on a mosaic depicting a boat, and dating to the same period as our site, found at the nearby town of Migdal. The stem and stern posts had been removed from the original boat. (See the fall 1991 *INA Newsletter* for a field sketch of the hull and Professor Steffy's lines drawings.)

My next consideration was the type of wood to use. Always a concern in wooden modeling is the "scale effect." Wide-grained woods appear to be out of scale and detract from the appearance of the model, so a close-grained wood would be required. Further, since the climatic conditions under which the model would be displayed in the museum were uncertain, a dimensionally stable wood, one that would not shrink or swell to any great degree with changes in relative humidity, would be required. Fred Hocker, successor to Professor Steffy as head of the Ship Reconstruction Laboratory at Texas A&M, suggested European pear wood (*Pyrus communis*), a species that fit both requirements exceptionally well.

Finding pear wood proved a little more difficult than buying pine shelving boards at the local hardware store. After a few days of researching hardwood suppliers and many phone calls, I found a source. Jim Heussinger of

Berea Hardwoods in Berea, Ohio, was enthused with the project; he would ship our pear wood immediately.

Before I could start cutting wood for the model I had to decide how I was going to join the planks to one another. The original boat's planks were joined edge-to-edge with mortise-and-tenon joints, but this method would be difficult at 1:10 scale using 3.5mm-thick (about 1/8 inch) planks. If the project had been a research model rather than one for display it would have been necessary to cut mortise-and-tenon joints; instead, I would be gluing the planks' edges together. But how could I hold them in place while the glue dried? I knew that woodworkers used three-way edge clamps, but none were available in the small size I would need, so I designed an appropriately sized clamp, and Dr. Hocker and I milled fourteen of them out of aluminum stock, using materials and machinery generously donated by Vilas Motor Works, a local machine shop.

It was now time to start cutting wood. I began with the stem and stern posts, rough-cutting them on the band saw and then planing them to the correct thickness. Next came the two pieces that made up the keel. All of these were fairly easy to shape, and I thought I was moving along well. But when I began trying to join the two keel pieces and the stern post with their hook scarfs (copied from the original hull remains), I discovered how easy it was to

*Far left: In 1986, the Kinneret Boat was placed in a conservation tank immediately after excavation, where it will remain for the next few years.*

*Left: Following the ancient method in shipbuilding, the model's frames are placed inside the shell of the vessel already built of edge-joined planks. The model's planks were glued together edge-to-edge since the traditional mortise-and-tenon joinery would have been difficult at 1:10 scale.*

*Right and below: A hemostat was used to hold each iron nail as it was gently tapped into place. Iron nails on the original hull were well preserved, displaying rounded heads--faithfully reproduced on the model with miniature railroad tie spikes (see below). Two scarfs are just visible (to the left) in the photo below, along with the nails, rail cap, and a thole pin for one of the two oars copied from the Migdal boat mosaic.*

break the notched ends. The scarfs on the original boat would have been fairly sturdy, but at 1:10 scale were quite fragile. I ended up recutting the stern once and the forward keel twice because of broken scarfs. After quite a bit of shaping and trimming, the posts were attached and the keel was laid.

For the planking I rough-cut a stack of 20mm-wide (25/32 in) strips to 5 or 6mm (12/64 to 15/64 in) thickness, and then planed them down to 4mm (5/32 in) thickness, which would allow for scraping and smoothing the exterior of the hull while still maintaining a plank thickness of 3 to 3.5mm, or one-tenth of the original planks. Individual planks were then cut from the prepared stock. Planking widths throughout the model averaged 12mm (about 1/2 in).

My first attempts at planking were, of course, the garboards, the planks adjoining each side of the keel. I had to learn to bend the pieces to their required shapes. I began by wetting each plank and then curved each over a heating iron. This method sufficed for the garboards, which only required a slight bend, but would soon prove altogether unsatisfactory, especially for the more radical bends required to fit planks into the stern. But I would have to wait until the fall to learn this; it was time to depart for my second season on the Bronze Age Shipwreck excavation at Ulu Burun, Turkey.

After the summer in Turkey, work began in earnest on the model, and I quickly learned how frustrating it is to have a strake almost bent to shape only to have it snap in my hands. The bends required to fit the planking into the stern post are radical, and nearly a dozen pieces broke be-



Photo: R. Pedersen

fore the problem was solved. It will be interesting to learn how the Kinneret Boat's shipwright shaped his stern planking, a lesson that will have to wait until the ancient boat emerges from conservation.

The trick I learned for shaping the planks, and the method I would use for the remainder of the planking on the model, was to cut each piece roughly to shape and then soak it in water for at least twenty-four hours. I would then gently *massage* in the required curves and bends, clamp the

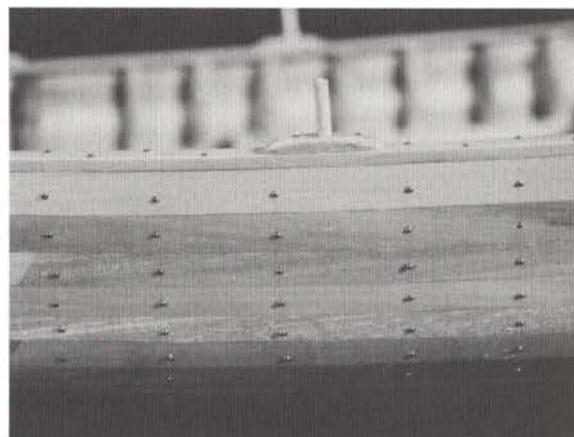


Photo: R. Pedersen

pieces into place on the model, and allow it to dry overnight and take the desired shape. It was then relatively easy to trim each plank to its final shape and glue it in place.

Once I got past the turn of the bilge, shaping and installing the planks proceeded much faster, and I was able to begin work on the framing. Each frame member was hand-carved in the general shape of the original and installed as the originals were--fastened to the inside of the planking by nails driven from the outside of the hull.

While the remains of the boat consisted only of the keel, exterior hull planking, and internal frame members, certain bits of evidence from the excavated remains indicated particular features of the original boat. Four nail holes in the top of the keel, just forward of midships, indicated the presence of a mast step, thus indicating that the boat had possessed a mast and sail. In consideration of the single square rig depicted on the contemporaneous Migdal mosaic, and since there is no evidence for a lateen rig as early as the turn of the millennium, I designed a square rig for the model. The sail was woven out of linen by Kay McWilliams, a local weaver, and the rope was hand-laid from fibers of the Torrey yucca (*Yucca torreyi*) by Pat Turner, a secretary at INA. The Migdal mosaic also shows two oars and a quarter rudder on each side of the boat; examples of these were included on the model.

The curious placement of certain frame members in the boat's bow and stern, noticed by Professor Steffy during excavation, indicated to him the presence of decks in both areas. Since we have no evidence of how the decks would have been constructed in this type of boat, I designed them as simple flat-board structures, each occupying approximately one-quarter of the length of the hull.

Now a few words about the finished model. We refer to it as "the Kinneret Boat model," but technically this is a misnomer. Because some parts of the original boat did not survive, and because only the most preliminary research was possible before the hull went into conservation, our knowledge of the hull was so incomplete that in order to present a finished model I had to go to other sources for ideas. The model should more correctly be referred to as a generic turn-of-the-millennium Sea of Galilee fishing boat, that likely would also have been used for all manner of other tasks, including ferrying people and cargo.

The project required eighteen months of work, and I thank Shelley Wachsmann for allowing me to take it on. My thanks also to Professor Steffy for the model's basic design and for a number of meaningful suggestions at crucial times; to Fred Hocker for being a sounding board for all my ideas, both good and bad, and for telling me the difference between the two; and to Claire Peachey for getting me started (she built a research model of the Kinneret Boat shortly after its excavation that pointed out some of the problems in the preliminary lines). Ultimately, though, I learned that just sitting back and staring at the model, sometimes for long periods of time, would tell me how to

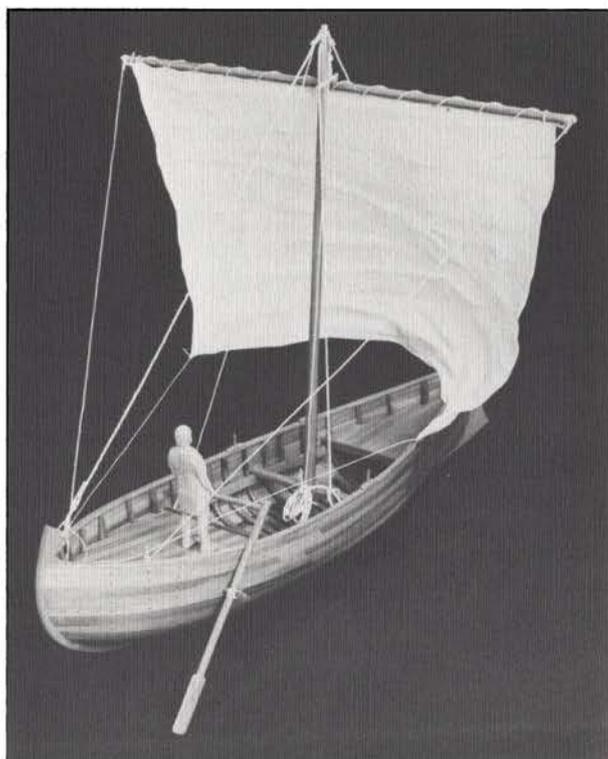


Photo: J. Lyle, courtesy Texas A&M University

*The completed model is furnished with a square sail and rigging. The Kinneret Boat's remains did not provide evidence for such detail; other sources, such as the Migdal mosaic (at far right), were used to suggest what the boat may have looked like when it was in use.*

shape the next plank or what my next move was to be.

The model will be delivered to Israel and displayed alongside the original hull in the Yigal Allon Museum at Kibbutz Ginosar in November of 1992.

#### Suggested Reading

Wachsmann, Shelley

1988 The Galilee Boat--2,000-Year-Old Hull Recovered Intact. *Biblical Archaeology Review* 14.5:18-33.

## Natural Fiber Rope-Making

by Patricia Turner

The techniques used on the Kinneret Boat model's ropes have been employed since ancient times in Egypt and continue to be used to the present day in many Third World countries. Basically, fibers are anchored at one end and then twisted together from the other end, either by hand or with a simple machine that uses a crank to twist attached strands.

Fibers for rope-making can be gathered from a variety of sources, including vines, tall grasses, fibrous roots, inner bark of trees, and fibrous leaves. A good rope-making material must possess four qualities: reasonably long fibers, strength, pliability, and holding, or "bite," which allows the fibers to grip one another.

The material I used for the model's rope was Torrey yucca (*Yucca torreyi*) from the *Liliaceae*, a family of plants indigenous to the southwestern United States and Mexico. Though yucca probably would not have been available to them, rope-makers in the Kinneret would also have chosen an indigenous plant, perhaps a reed or grass.

Following the traditional method, I split the 2.5 to 3 foot yucca leaves twice and scraped off a waxy cuticle and outer layer with a knife to expose the fibers. Next, as the leaf dried, I loosened the remaining pulp from the fibers by rubbing them between my hands and by gently hammering them. Then I patiently separated out single fibers and cleaned each with my fingernails.

*continued on page 15*

## A Sail for the Kinneret Boat Model

The 1:10 scale of the Kinneret Boat model demanded that its sail be woven from a very fine thread. We used half a pound of linen, ordered from Frederick J. Fawcett, Inc., of Petaluma, California (originally a company that supplied fine threads to makers of ships built in bottles). Linen was chosen over cotton as a sail material because linen probably was in use in the Mediterranean world at the turn of the millennium when the Kinneret Boat was built. Cotton was not introduced to Egypt as a fiber crop until much later, and most likely it was not produced in the area surrounding the Sea of Galilee before it came to Egypt. On the other hand, linen fabric has been found wrapping Egyptian mummies, which date to several centuries before and after the turn of the millennium, so we know it was being used in cloth production at the time when the Kinneret Boat sailed.

Linen fiber is produced from the flax plant (*Linum usitatissimum*), specifically from the structures that carry water in the stems. Therefore, it is very strong when wet, and even when dry it is stronger than cotton. It has long been used for sails because of its strength under damp conditions. It is also more resistant to sunlight than cotton, and while it is subject to mildew damage, it is resistant to insects.

The primary stems of the flax plant produce very long fibers that can be spun when wet into a very fine, strong thread, referred to as "line" linen. The line linen we used for the model's sail was as fine as baby's hair. It was spun very tightly to give it extra strength--but which caused it to twist back on itself or on any other threads in the vicinity when not under tension. The sail was woven in three sections, each 10 inches wide, then seamed with the same thread used in the cloth to create the appearance of an ancient rectangular sail. Each section consisted of 630 threads, each 3 yards long.

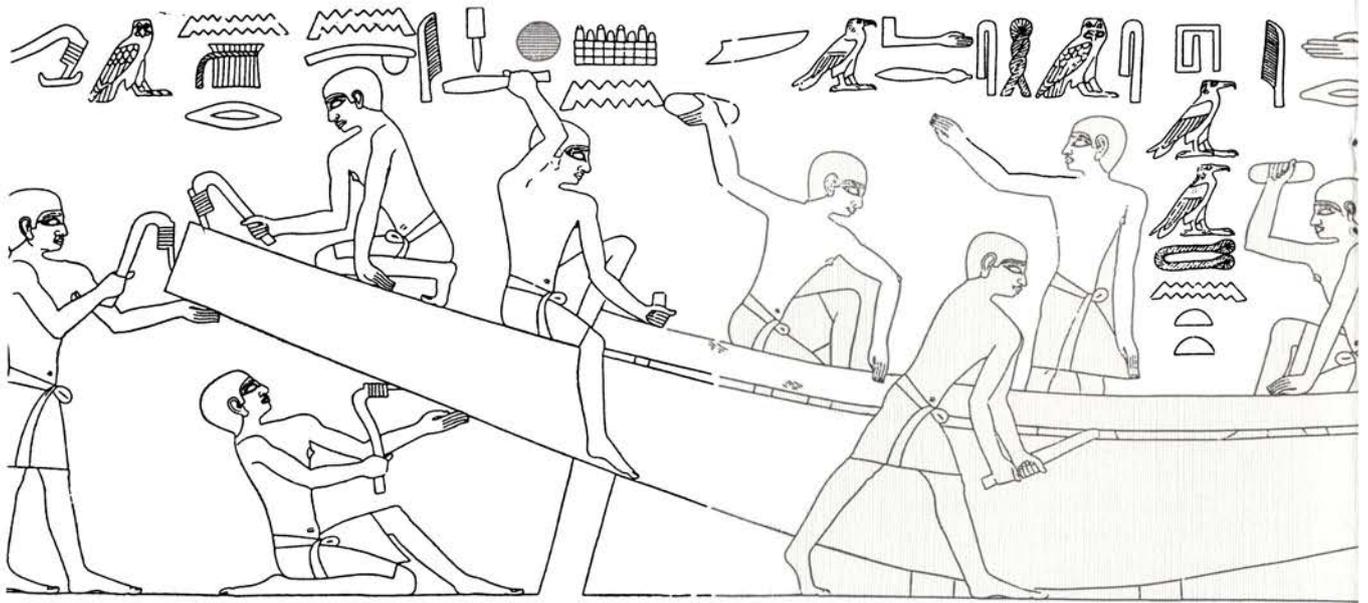
Dressing the loom, which with less easily tangled thread would have required about two hours, took fourteen hours. Each of 630 strands had to be threaded through slots in the reed (which keeps the threads separated in the loom); then each had to be inserted into individual heddles, which help form the weaving pattern. A plain weave was chosen for the sail. Finally the weaving could be started, taking only two hours to complete. To help prevent breakage, the warp was sprayed with a fine water mist during the weaving process.

Before a woven product can be considered cloth, it must be "finished." For linen, finishing consists of washing in very hot water and strong detergent. The damp fabric is then "beetled," which means that the cloth is pounded with a wooden mallet to flatten the fibers and help even out the weaving. Sails dating to the period of the Kinneret Boat were also probably "sized," or coated with boiled flax seed, to create a less porous cloth.

--Kay McWilliams

Photo: courtesy IAA





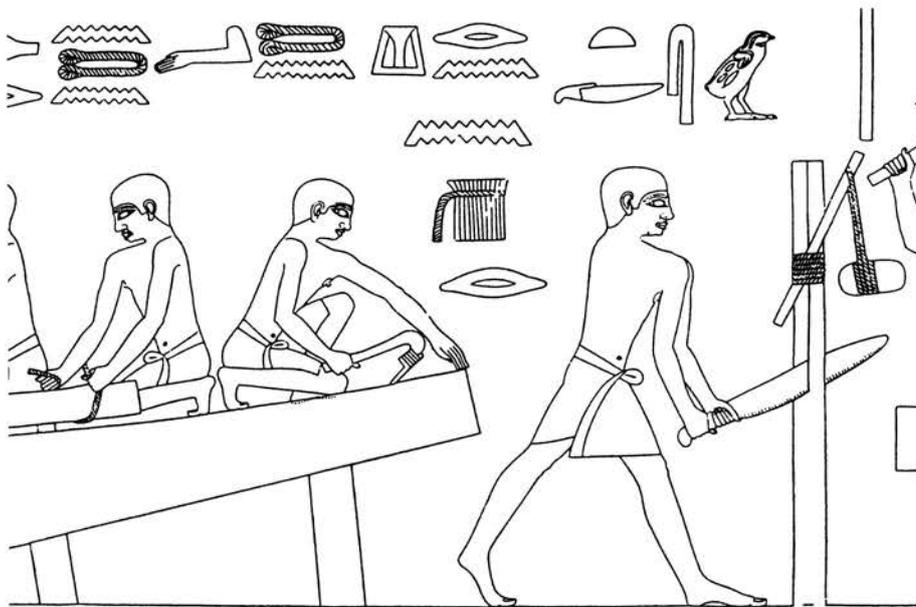
## *Boat Reliefs in the Tomb of Ti and Mastaba of Mereruka*

Ships and boats from the Bronze Age Mediterranean are represented by only a handful of known shipwrecks and boat burials. Fortunately for nautical archaeologists some of the great Bronze Age civilizations made written and pictographic records of their maritime cultures. The ancient Egyptians in particular left detailed information about their vessels in the form of papyrus documents, boat models, and tomb reliefs. These valuable sources of information can be used to complement what we know about Bronze Age vessel construction. It should be noted, however, that tomb reliefs were made by artisans, not shipwrights. Although detailed, they are not blueprints to Egyptian boatbuilding.

More than fifteen examples of reliefs with boat construction scenes survive from Dynastic Period Egyptian tombs. The most detailed of these reliefs is from the tomb of a Fifth Dynasty court official named Ti at Saqqara. Ti served under three different pharaohs *circa* 2500 BC. The relief is but a small part of his tomb, a portrayal of only one of the daily activities on his estate. Such day to day events were recorded in the hope that they would magically reoccur in Ti's afterlife. The relief consists of three registers and portrays the construction of five boat hulls, and it includes accurate depictions of Egyptian tools, tool usage, and wooden boats.

I originally studied the relief for a paper in J. Richard Steffy's History of Shipbuilding Technology class at Texas A&M University. The exceptional diversity of information present in the relief provided an excellent opportunity to study the methodology and technology of ancient Egyptian boat construction. During the past ten years, there has been a vast increase in knowledge about ancient shipbuilding in the Mediterranean. I wanted to apply this information to my analysis and to clear up some misconceptions about what was being portrayed. I also hoped to relate the relief to what we know about the evolution of wooden ship construction in the ancient Mediterranean.

The Ti relief depicts the greatest diversity of tools associated with Egyptian vessel construction. Adzes, axes, chisels, mallets, pounders, staves, and a plumb bob are represented. Variations in tool types which are not seen in many other boat construction reliefs are also portrayed. Perhaps the most important contribution of this relief is its depiction of the methods in which these common tools were used in boat construction. Adzes appear more frequently than any other tool and this high percentage reflects their importance in shaping and finishing crudely sawn boards into planks. The adzes are shown in a variety of sizes and are attached to two different types of handles. The size of



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*Reliefs from the tomb of Ti (circa 2500 BC) include a portrayal of the shipbuilding process. Such murals were carved in bas-relief in limestone and then painted, leaving highly detailed accounts of everyday activities in ancient Egypt. Here, workers use mortise-and-tenon joinery to attach two planks, while other workers use adzes to shape planks. (From Le Tombeau de Ti, Fascile II, plate 129.)*

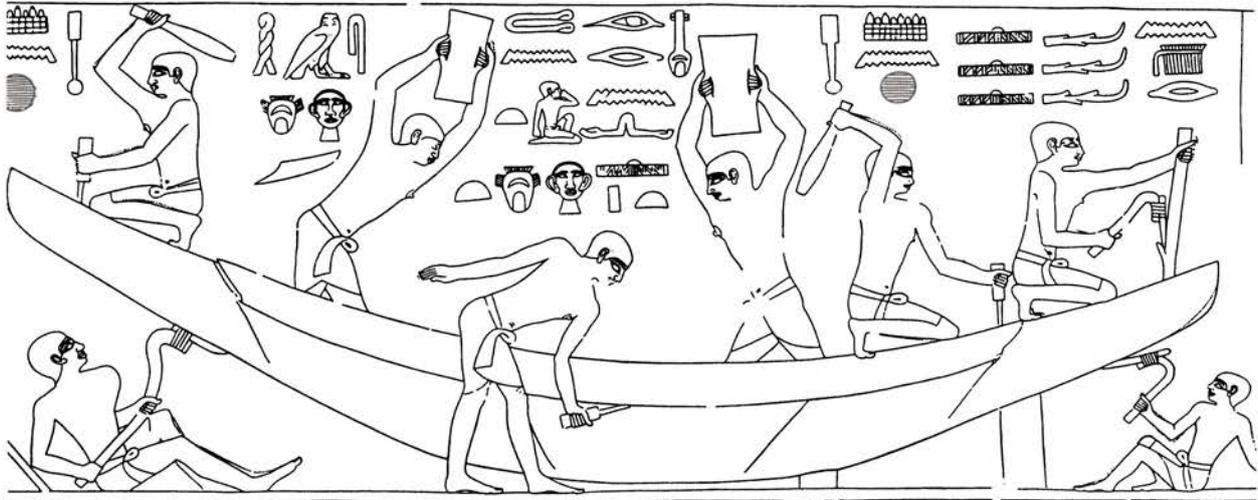
by Edward M. Rogers

the blade and the type of handle to which each is hafted seem to indicate where on the boat the adze will be used. (See drawing above, and cover.)

One of the most informative areas of the relief portrays mortise-and-tenon joinery in a highly detailed and accurate rendition of the attachment and seating of a plank using this ancient technique. Mortise-and-tenon construction was the predominant method used for joining hull planks in the eastern Mediterranean from the Early Bronze Age well into the medieval period. In this particular construction process, mortises, or slots, are cut into the edges of planks. Tenons, rectangular "tongues" of hardwood, are inserted into the mortises of one plank and matching mortises are cut into the edge of the next plank, which is then lowered over the top of the tenons. It is very likely that this method of construction originated in Egypt. Since all known examples of Egyptian vessels use mortise-and-tenon joints, the part of the relief portraying the process is vital to our understanding of Egyptian boatbuilding techniques.

The procedure as depicted is labor-intensive and requires teams of men working in unison while using five different types of tools. The initial attachment of a strake to another already joined to the hull involves four workers who are supervised by an overseer (see drawing above). Close

examination of the area between the two strakes being joined reveals three vertical pieces which are tenons (not to be confused with the lines representing the workers' legs). One of the workers holds a stick in between the center of the strakes while another grasps the end of the upper plank with a piece of rope. This technique helped to keep the seams of the strakes parallel, allowing the upper plank to seat evenly over the tenons without binding in the mortises. The fit was very precise and permitted no error in the join. Two other workers strike the plank with stone hammers to force it down over the tenons. In a continuation of the procedure (see next page) the plank is set into its final position. Two of the workers use large hourglass-shaped pounders of wood to achieve the final placement. The size of the mallets and the workers' extended height indicates they are using great exertion in their work. The worker at the center of the hull bends down to check the remaining amount of space between the planks. He uses the narrow blade of a chisel to maintain an even setting of the planks in the remaining space. This depiction of the attachment of the strake tells us that the fit of the mortise-and-tenon joints was very tight and that the hull was rigid and strong: the integrity of these hulls depended in large part on the strength of their mortise-and-tenon joints as no metal



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fasteners, and probably no frames, were added.

The relief contains a considerable amount of information and raises far more questions than I am able to answer at present, but one detail of the relief is especially intriguing. A shipwright (right) holds a plumb bob, line, and staff in his hand. While the fact that he holds them together in one hand suggests that they would be used together, the exact function of the tools in this scene is not known. The plumb bob in ancient Egypt is usually only associated with terrestrial architecture. It has been suggested by scholars of ancient shipbuilding that the plumb bob may have been used with the staff to ensure that the shape of the hull was fair and even. I wondered whether its inclusion in the relief represented some form of construction methodology. Did the Egyptians use a type of measurement in building their vessels? There is evidence of this from the mortise-and-tenon joints of the Dashur Boats (*circa* 1850 BC), where it is believed that the hulls' Egyptian builders used

*An Egyptian shipwright (below), standing between the hulls of two boats under construction, holds a plumb bob, line, and staff. The appearance of these tools in the tomb of Ti relief suggests that the ancient Egyptians used some form of control in hull construction. (From Le Tombeau de Ti, Fascicle II, plate 129.)*



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cubits (a standard unit of measure in ancient Egypt), palms (a royal standard unit based on hand width), and digits (based on finger width).

A visit to Egypt in the fall of 1991 led to more information on this question of construction methodology. I traveled to Egypt to use the excellent reference collections at the American University, American Research Center, and the Oriental Institute and to see the tomb of Ti. It was thrilling to view the relief in the context of the entire tomb complex rather than isolated in books or photographs. The relief had faded in places but I observed several details that I had not noticed from studying photographs and drawings.

I was also interested in examining all other Old Kingdom tomb reliefs depicting boat construction. Two days at the American Research Center were spent researching the other reliefs in the Saqqara/Memphis area. I was familiar with all of them except one from the mastaba of Mereruka, which dates to *circa* 2400 BC and which

*In the tomb of Ti relief (left), two workers raise pounders high above their heads in the process of seating a plank. Another worker stands at the center of the hull and ensures an even setting of the plank. (From Le Tombeau de Ti, Fascile II, plate 129.)*

*A relief from the mastaba of Mereruka (below) shows Egyptians using a plumb bob in ship construction. Two workers stretch a line across the hull on the right half of the relief, while a third (the fifth man from the right) drops a plumb bob to the hull. (Facsimile painting from The Mastaba of Mereruka, Part II, Chamber A13, North Wall, Scene 2)*



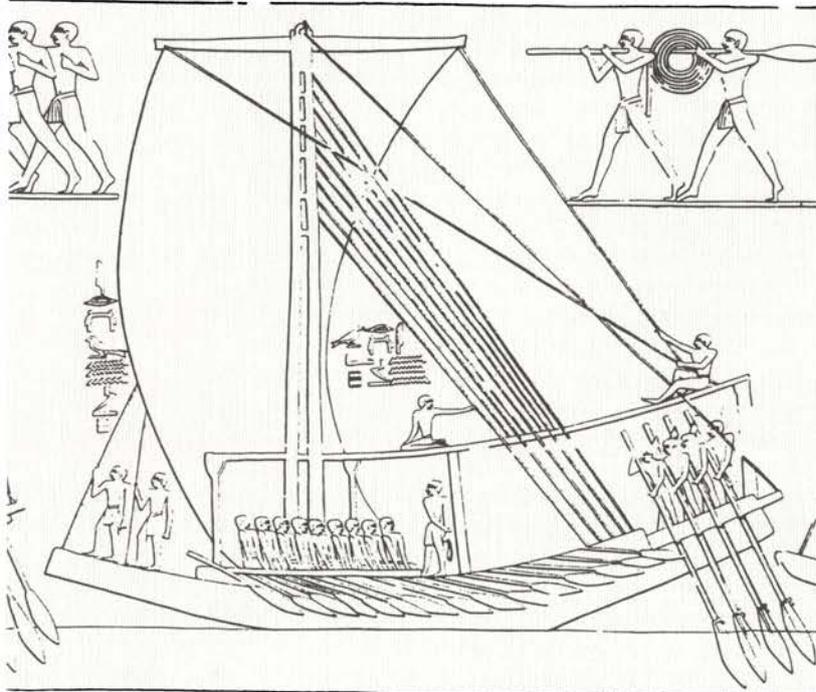
Reprinted courtesy of the Oriental Institute of the University of Chicago

happens to be located just one thousand yards from the tomb of Ti.

The relief (shown above) turned out to be much smaller and simpler than the Ti relief, but it contained some equally important information in a rendition of the construction of two boats. The right half shows two workers stretching a line between the ends of the boat while a third worker holds a plumb bob perpendicular to the line. A fourth worker appears to be marking a place where the plumb bob touches the hull. It was a very exciting moment of discovery for me as I knew that this was the only known example besides the Ti relief of a plumb bob being used in vessel construction. Here was further evidence that the Egyptians used some form of control during the construction of their boats. Classical Greek shipwrights may have used simple mathematical relationships to determine the size and proportions of their vessels, and I wondered if the older Egyptian reliefs were displaying a similar use of some kind of mathematical or geometrical principle. Perhaps a study of Egyptian architecture will provide some insight.

For the time being the Mereruka relief poses far more questions than it answers. I believe it is the only known depiction from antiquity of a boat under construction  
*continued on page 13*

*Ships in full sail appear in a relief of the tomb of Ti. The court official would have used these ships to travel to different parts of his estate and to visit sites of religious importance. The scale of the vessel depicted in the process of construction, in relation to the size of human figures, is greatly distorted. The boat is actually as large as the one below. (Le Tombeau de Ti, Fascile I.)*



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## REVIEW

by Fred Hocker

*Archaeology Underwater: The NAS Guide to Principles and Practice.*  
Martin Dean, Ben Ferrari, Ian Oxley, Mark Redknap, and Kit Watson (eds.)  
Nautical Archaeology Society and Archetype Publications, London, 1992.  
ISBN 1-873132-25-5, 335 pages, 152 figures, soft cover.

How do we define this peculiar sub-discipline of archaeology that takes up so much of our time and effort? Some call it nautical archaeology, the archaeology of ships and cargoes. Others call it maritime archaeology, the study of human use of the sea. These are both definitions based on an area of study, just as physical anthropology or historical archaeology define areas of interest. In the early days of nautical/marine/maritime archaeology, it was more often called underwater archaeology, and considerable attention was paid to the techniques of diving and excavation, sometimes at the expense of research and conservation. As nautical archaeology has moved into the academic mainstream, the underwater world increasingly has become just another place to excavate. Unfortunately, that world is hostile and presents peculiar difficulties to the archaeologist if he or she wants to do work of acceptably high quality. Not the least of these is staying alive. The technological support required for an underwater project can be daunting, if not prohibitive.

The first books addressing the technical problems of working under water were written in the 1960s, when the discipline was still young and largely experimental. As new techniques have been developed, they are often described in journals dealing with ocean technology and surveying, or in the *International Journal of Nautical Archaeology and Underwater Exploration (IJNA)*, but only recently have comprehensive manuals or textbooks been attempted. Jeremy Green's *Maritime Archaeology: A Technical Handbook* appeared in 1990, and now the Nautical Archaeology Society, a U.K.-based group similar to INA, has produced *Archaeology Underwater: The NAS Guide to Principles and Practice*. A number of respected British professional archaeologists have collaborated to publish a single volume that attempts to address virtually every aspect of underwater archaeology, from basic archaeological theory to the technical specifications for induction dredges. The book is aimed at the amateurs and diving volunteers who have been indispensable to underwater pro-

jects in the U.K., but it contains much of value to international professionals as well.

The authors of the *NAS Guide* have chosen a comprehensive rather than a technical approach, and a large part of the book is devoted to a sometimes condescending explanation of the goals and principles of archaeology in general. The NAS not only encourages surveys to locate and document sites, but definitely discourages excavation except where the site is threatened with imminent destruction. The reasoning is that because archaeology is destructive, and because future archaeologists will have more advanced (and perhaps less destructive) techniques, it is better to preserve a site than excavate it. To a certain degree, the NAS position on excavation and survey reflects the realities of archaeology in the U.K., where funding is scarce and most projects are undertaken as rescue efforts a short step ahead of bulldozers and dredgers, but I believe the preservationist argument has been taken too far. At

*"A number of respected British professional archaeologists have collaborated to publish a single volume that attempts to address virtually every aspect of underwater archaeology . . ."*

what point may we decide that our techniques are sufficiently advanced to permit excavation? Followed to its logically absurd conclusion, this line of reasoning suggests that we should abandon all scientific research, because later scientists will have better techniques and will be able to do a better job. Endangered sites should be given priority where resources are limited, but to discourage research archaeology (as the authors call excavation of unthreatened sites) is to discourage the quest for knowledge. We do not excavate merely to preserve the past, but to understand it,

and research archaeology, because it allows us to choose the site and to excavate and study it without the pressure of imminent destruction, offers the best avenue to that end. Similarly, the NAS insistence on partial excavation of shipwrecks (so that future archaeologists can re-investigate) dooms us to, at best, partial understanding of the site. I do not believe that a shipwreck can be sampled the way a large land site can; only complete excavation of a shipwreck offers the opportunity to draw informed and valid conclusions about such things as the ship's origins, route, and owners. Archaeology does indeed destroy historic resources, but that is the responsibility we bear as scholars. As long as we understand the consequences of our actions and take all possible steps to see that no scrap of information goes unrecorded, the knowledge gained is worth the damage done.

The more technical sections of the book are by and large excellent. Every aspect of an underwater project, from choosing staff to organizing records, to drawing, to photography, to research and publication, is covered in sufficient detail for the amateur or student to understand not only the practical aspects of a project, but the underlying reasons for why things are done the way they are. The sections on legal problems (jurisdiction, ownership, insurance, etc.) and environmental remains are especially well done, as is the section on setting up the increasingly complex system of notebooks, catalogues, databases, and photo logs that are required on any archaeological project. Coverage is thin on some of the specifics of surveying and mapping, and I would have liked to have seen a section on recording hull remains, but overall the thoroughness of the text is nothing short of amazing. At times, the authors have been too general in an attempt to cover all possible situations, and more illustrative examples or case studies would have helped (only one topic, the construction of photomosaics, included a case study). Some help is provided in the appendices, which offer technical specifications for airlifts and water dredges, extensive information on cannon recording, and a list of useful addresses.

Because the book is written rather specifically for British divers, some sections (such as the discussion of legal jurisdiction) will have little application internationally, but I recommend this work strongly to anyone, amateur or professional, who would like to have either a good introduction to the theory and practice of nautical archaeology or a field handbook for technical matters. I do hope that the authors will correct the grammatical problems in the title; the use of "underwater" as an adverb, instead of "under water," is consistent throughout the book.

Available from Archetype Publications, 31-34 Gordon Square, London WC1H 0PY, for £25.00. ■

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tion being measured. I later found that the mastaba of Mereruka—including the boat construction relief—had been published in 1939, but as far as I know it had gone unnoticed by nautical archaeologists.

The reliefs from the tomb of Ti and the mastaba of Mereruka present us with information about Egyptian ship construction technology and methodology that is currently not available from other sources. The ancient Egyptians may have used some form of control other than just the eye of the shipwright to determine hull shapes. Perhaps the reliefs depict an early phase of naval architecture. For now I return to the library to try to understand these reliefs and to expand the story of ancient shipbuilding.

#### Acknowledgments

My research in Egypt was funded by the Jordan Institute for International Awareness at Texas A&M University. Thanks to Dr. Fred Hocker for originally suggesting that I study the Ti relief. Mr. Steffy and Dr. Hocker answered innumerable questions and were an inspiration for my work. Special thanks to David Grant for his support and witticisms. I received a tremendous amount of help during my research in Egypt from Dr. Kent Weeks, Dr. Donald McDonald, John and Debbie Darnell, Dr. Zahi Hawass, and the library staffs of the American University, the American Research Center, and the Oriental Institute in Cairo. Thanks also to Mike Fitzgerald, Cheryl Haldane, Claire Calcagno, Mrs. Jessie Jordan, and Ursula Cuzzi.

#### Suggested Reading

Haldane, C.

1988 Boat Timbers from El-Lisht: A New Method of Ancient Hull Construction. *Mariner's Mirror* 74:141-152.

Lauer, Jean-Philippe

1976 *Saqqara; The Royal Cemetery of Memphis*. London.

Lipke, P.

1984 *The Royal Ship of Cheops*. Greenwich.

Petrie, F.

1917 *Tools and Weapons*. London.

Sliwa, J.

1975 *Studies in Ancient Egyptian Handicraft: Woodworking*. Krakow.

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## News & Notes

### ESSAY CONTEST

To promote scholarly research into Maryland's maritime history, the Maritime Committee of the Maryland Historical Society and the University of Baltimore Educational Fund are sponsoring their **Fourth Annual Maritime Essay Contest**. The two organizations provide the following information and guidelines:

Cash awards of \$300, \$125, and \$75 will be given for the three top papers in the competition. Winning entries will be considered for publication in the Society's *Maryland Historical Magazine*.

Appropriate subjects include all aspects of Maryland seafaring (ships, sailing vessels, steamboats, small craft and their equipment, cargoes, passengers carried on Maryland vessels, maritime shipping, ports, economics, naval activities and maritime law). Papers should rely on primary source materials and should not exceed 6,000 words. In preparing their essays, contestants should follow the contributors' guidelines listed in the spring 1989 issue of *Maryland Historical Magazine*.

Contestants must submit four copies of their papers to:

The Maryland Historical Society  
201 W. Monument Street  
Baltimore, MD 21201

For further information, call Byrne Waterman or Cathy Rogers at the historical society: 301/685-3750.

### New Mapping Software

INA will soon acquire a new tool for its excavations. Software used by a number of nautical archaeologists in Europe was introduced to the Institute by Mr. Nick Rule, who developed DSM (Direct Survey Measurement) mapping software in conjunction with nautical archaeologists on the *Mary Rose* project. During the last week of October Mr. Rule gave a demonstration and a series of lectures on the system's use of statistical analysis to streamline site mapping. His talk, "Good Plans From Bad Measurements: The Use of Statistical Best-Fit Algorithms in the Mapping and Recording of Archaeological Sites," demonstrated how the system can point out errors excavators make when measuring artifacts for site maps. In "Mapping the *Mary Rose*: The Development of Computer-Aided Surveying Methods on Henry VIII's Flagship, Sunk in 1545," he described the development of computer-aided mapping methods during the excavation of the Tudor ship.

Mr. Rule has worked on a number of archaeological projects and is now employed as a senior consultant at Logica PLC, England's largest software developer.

### Columbus Caravel Replica

Faculty and staff from the Nautical Archaeology Program at Texas A&M University brought their expertise in historic ships to a sixth-grade class at the Oakwood Middle School, in College Station, Texas. The children, as part of a Columbus Quincentenary program, built a life-size replica of the

*Nina* with the help of nautical archaeologists.

Full-size sailing replicas of Portuguese-built caravels visited Corpus Christi and Galveston, Texas, in 1992. Dr. Dave Cheney, who spent three weeks rigging and subsequently sailing on the caravels, came to the Nautical Archaeology Program on October 23 to give an illustrated talk on rigging and sailing the replicas.

### Lectures in Portland

Don Frey, INA's vice president and administrator of Mediterranean activities, spoke at Oregon's Portland Art Museum on November 18 about his lengthy experience with surveying and excavating shipwrecks in Turkey.

Originally a physicist, Don Frey began his association with nautical archaeology in 1969, when he volunteered to work on the Roman shipwreck at Yassi Ada. He then went on to learn about and teach the application of physics to archaeology. He has been with INA for a number of years, serving as president until 1988, and participating in excavations and surveys in the Mediterranean.

George Bass, INA's archaeological director, will also speak in Portland this year. He has been invited to participate in the Institute for Science, Engineering and Public Policy's Resident Scholars Program as a speaker in the Science, Technology and Society Lecture Series. The lecture series and related events are cosponsored by Oregon Public Broadcasting, Portland State University, the Oregon Committee for the Humanities (an NEH local affiliate), as well as various corporations.

Dr. Bass's talk, "Bronze Age Splendor," will take place January 8, 1993,

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at 7:30 p.m. in the Arlene Schnitzer Concert Hall. INA members are welcome to attend. For further information call 503/224-8499. Tickets will cost \$17.50.

## Proceedings Available

The *Underwater Archaeology Proceedings from the Society for Historical Archaeology Conference*, from the meetings held in Kingston, Jamaica, in January of 1992, are now available. The volume, edited by Donald H. Keith and Toni L. Campbell, includes 25 papers covering a range of subjects. Fifteenth- and sixteenth-century ships and maritime trade; small craft in South Carolina; Caribbean underwater archaeology; advances in international underwater archaeology; and technology, theory, and analysis are addressed in the *Proceedings*.

The volume is available for \$17.50, plus \$1.75 for postage and handling (\$2.25 for international mail), from the Society for Historical Archaeology, P.O. Box 30446, Tucson, Arizona 85751-0446. Orders should be accompanied by a check or purchase order.

## AIA Meetings

The 94th Annual Meeting of the American Institute of Archaeology will be held December 27-30, 1992, at the New Orleans Hilton Riverside and Towers. George Bass will deliver a talk, "The Shipwreck at Ulu Burun, Turkey: 1992 Excavation Campaign," at the conference.

## Lisht Publication

A recent volume of the Metropolitan Museum of Art Egyptian Expedition publications includes an appendix on ship timbers found at Lisht during excavations at the Middle Kingdom pyramid of Senwosret I. The appendix, "The Lisht Timbers: A Report on Their Significance," is written by Cheryl Haldane, a doctoral student in the Nautical Archaeology Program. It appears in *The South Cemeteries of Lisht, Volume III: The Pyramid Complex of Senwosret I*, by Dieter Arnold.

The appendix includes a detailed discussion and catalogue of some of the timbers and should be a valuable reference for nautical archaeologists.

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To make a single lay (strand) of rope, I gathered ten to fifteen single fibers together, twisting them slowly between my fingers in a clockwise manner. I was careful to do this evenly and uniformly. Additional fibers were continually added to the center of the twist, thus extending the length of the lay.

To "lay up" a three-lay cord, I attached three strands--all the same diameter, length, tightness and direction of twist--to three separate hooks on a simple rope-spinning machine, designed to work much like devices used hundreds of years ago. At the opposite end, I tied the strands together and used a three-slotted cork-sized piece of wood to keep the strands separated and tensioned. To tighten the strands, the crank was turned. The direction of the turn usually is dictated by the natural "twist" of the fiber used.

The person who creates the lays must ensure that the strands are twisting evenly but separately. One hand holds the cork-sized piece of wood to keep the tension, while the other hand holds the loose turning material. It is essential to "feel" the fibers twisting together; this helps maintain evenness. After the cord is finished, it is laid out, straightened, and then coiled in a spiral for storage.

The Kinneret Boat model required about 90 feet of rope, in keeping with the 1:10 scale--the original boat probably required up to 900 feet.

## Suggested Reading

Mackay, Ernest.

1916 Note on a new tomb (No. 260) at Drab Abu'l Naga, Thebes. *Journal of Egyptian Archaeology* 3:125.

Seymour, John.

1984 *The Forgotten Crafts*. Knopf, New York.

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## Studies in Nautical Archaeology

Copies of the first volume in the new monograph series, *Studies in Nautical Archaeology*, published by the Nautical Archaeology Program at Texas A&M University, are still available. *Those Vulgar Tubes: External Sanitary Accommodations Aboard European Ships of the Fifteenth Through Seventeenth Centuries*, by Joe Simmons, examines contemporary ship depictions and models, descriptions in the historical literature, and archaeological evidence from the perspectives of both hygiene and hull form and construction. The result is an illuminating look at the nature and development of prominent external waste-disposal features on ships. The volume surveys evidence of such features back to ancient times in the introduction. Forty-five line drawings by the author, one original by David Macaulay, and seven black-and-white photos illustrate the text in lively and informative fashion.

*Vulgar Tubes* is available to INA members at a discount price of \$9.00. For further information write to Mike Fitzgerald at the INA address, or call 409/845-6398.

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