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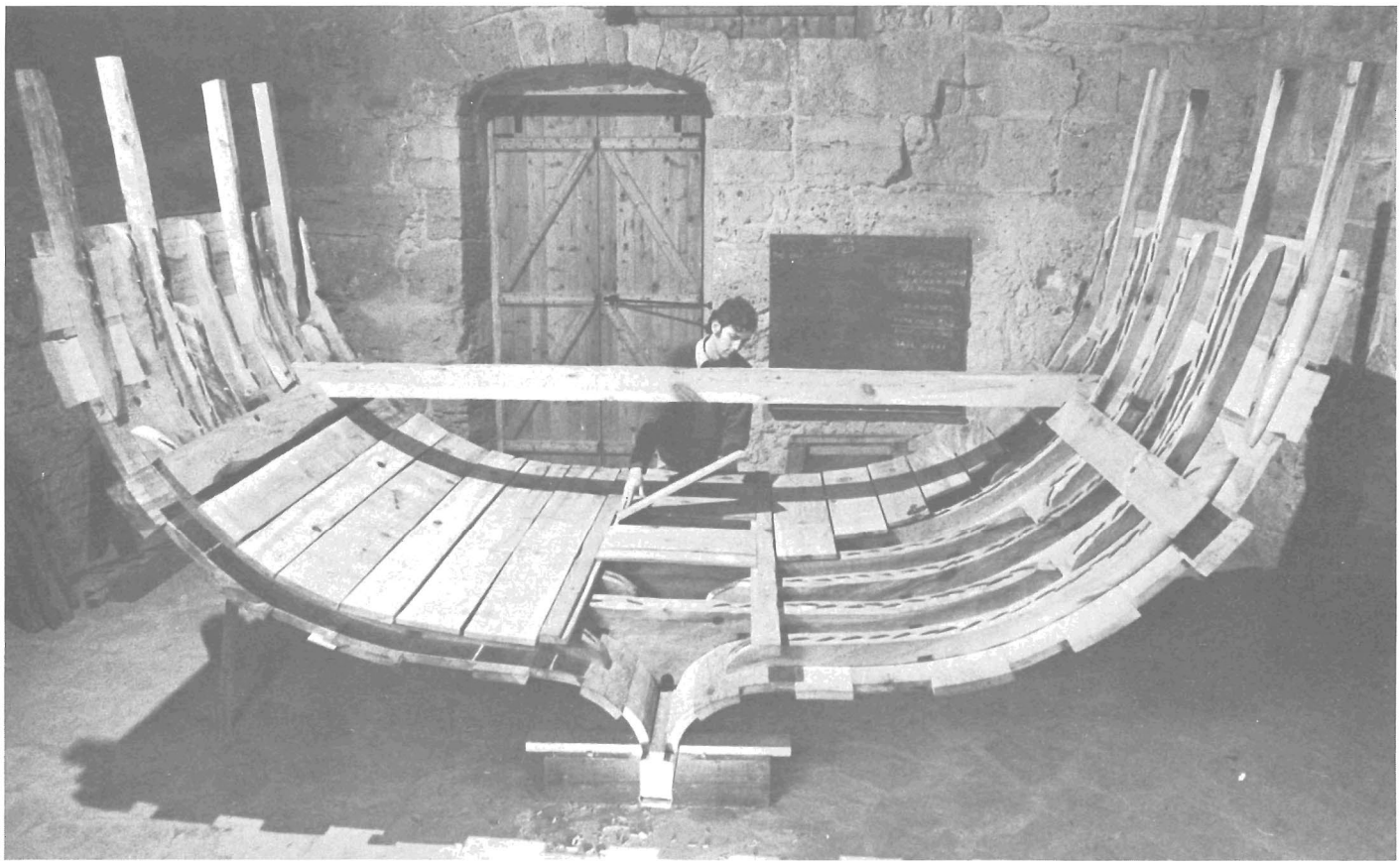
INA NEWSLETTER

Spring 1980

A REPLICA OF THE KYRENIA SHIP



Robin Piercy lifts a limber board from the almost completed replica. Photo: Susan Womer Katzev

Members of the Institute of Nautical Archaeology may be familiar with the survey and excavation of the Kyrenia Ship as well as her preservation and reconstruction through articles in the June 1970 and November 1974 issues of the *National Geographic Magazine.* In addition to the actual reassembly of the hull — using the original, preserved timbers — several other reconstructions have been undertaken. These include: 1/ a multitude of graphic reconstructions, culminating in the drawings of the ship's lines, which were mold lofted on the walls of the ship's gallery in the Crusader Castle at Kyrenia; 2/ a research model, built at 1:5 scale with comparable materials and techniques as used in the ancient hull, to help confirm or correct the accuracy of these lines' drawings; 3/ a mock-up of the aft section of the ship, constructed to be destroyed under controlled conditions in order that the hull's collapse on the seabed could be better understood; 4/ a fiberglass sailing model, also built at 1:5 scale, large enough to be manned and which, during sea trials, yielded valuable data on the ship's steering and sailing characteristics; and 5/ a full-scale replica of the hull's middle section. This latter reconstruction is the subject presented here.

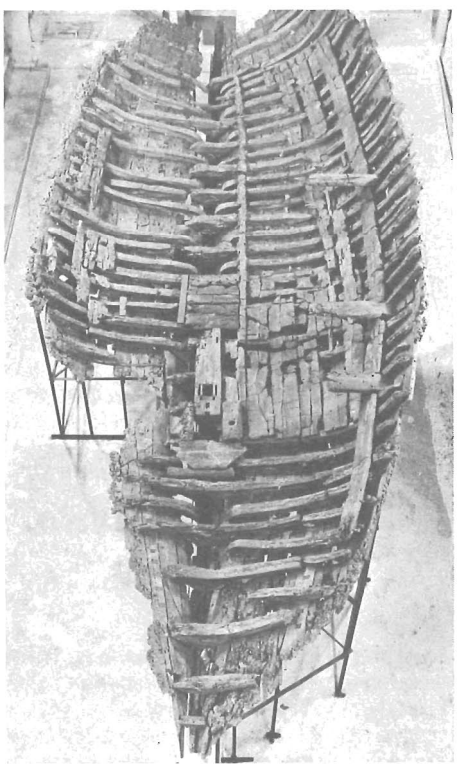
Fortunately, almost three-quarters of the Kyrenia Ship's hull has survived. The wooden remains of this fourth century B.C. merchantman have provided us with a unique opportunity to study and appreciate the skills of the ancient Greek shipwright and sailor. What was the design for this 47 foot trader? How was she built? And how

EDITOR'S NOTE

For those readers less familiar with the construction and hull terms used in the Kyrenia article, a labeled, comparative drawing has been included on page 6.

did she sail? Of course, by reassembling the hull, we have learned much that allows us to answer these questions. Such information has been obtained from the observer's point of view. But, by building the replica, we as participators have also sought to relive some of the experiences of the ancient shipwright.

In consultation with J. Richard Steffy, the reconstructor of the Kyrenia Ship and our "master" shipbuilder, we began to build the replica from amidships aft for a distance of almost 7 feet. To build at full-



The Kyrenia Ship as reassembled.
Photo: Michael L. Katzev.

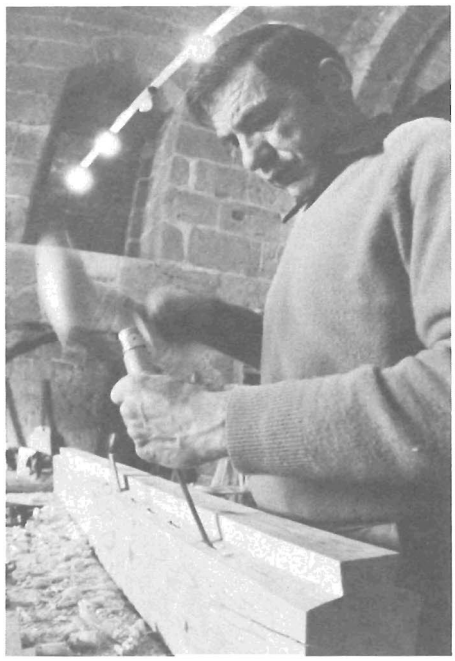
scale such a section of the ship Dick calculated we would require about 2 ½ tons of wood. After listing the dimensions needed for the keel and strakes and drawing templates for the frames, we went in search of a timber merchant. At Xeros we found just the man. He was familiar with the needs of shipbuilders, could find the necessary trees in the nearby Troodos Mountains, and would be able to rough cut the boards for us.

The U.S. Forest Products Laboratory had identified samples of the keel, strakes and frames of the Kyrenia Ship as being of the Aleppo pine group. The common pine in the Troodos Mountains is a species of this group, so the timber merchant was able to supply us with wood quite similar to that of our ancient ship. In October 1972 the trees were felled. Our merchant took great care in providing us with relatively clear wood for the keel and planks and with naturally curved timbers to follow the shapes of the frames. Stacking the boards in Kyrenia Castle, we left the wood to "cure" for several months.

For the keel Dick selected a timber cut from the heart of a tree trunk. Shaping it with a flat adze, he was careful to include a slight curve over its length. Here, aft of amidships, the curve in the ship's rocker-shaped keel is already subtly evident. The ancient shipwright must have searched the forests some time to find a tree whose trunk bent just the right amount for the 31 foot keel of the Kyrenia Ship. Next, using a flat chisel, Dick formed a rabbet on each side of the keel where the garboard, or first strake, would be fitted. With a mortising chisel he then cut closely spaced mortises (about 4 inches apart) into the horizontal faces of these rabbets.

At this stage Dick became the supervisor of the project, and his "apprentice" Robin Piercy took over the actual building. Robin quickly became skilled in the use of the adze. He had to in order to shape the garboards, for several adzes of different sizes and curvatures were needed to obtain the garboards' proper convex and concave inner and outer surfaces.

When Robin began cutting the edge angles of the garboards, he had the original ship to serve as a guide. What did the ancient shipwright use as a model? Did he have a set of plans or drawings to follow? In fact, in the Kyrenia Ship there are noticeable differences between one side of the hull and the other. These variations suggest that the ancient shipwright was building "by eye". First he worked on the port side; and realizing how he could improve his construction, alterations were made while working on the starboard. He seems not to have been using a model or

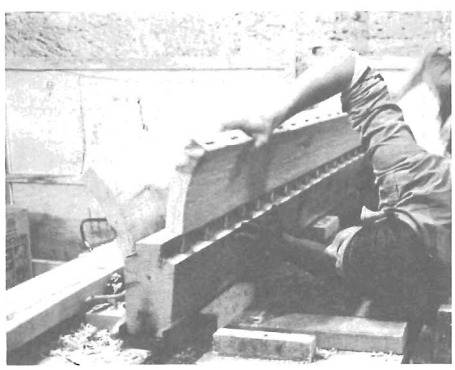


Dick Steffy cuts a mortise in the rabbet of the keel. *Photo: Susan Womer Katzev*

plans, but rather, relying in part on experience, the ancient shipwright did not hesitate to make changes at almost every stage in the hull's construction.

After being certain that the edge angles were correct, Robin with awl in hand scribed the position of the mortises to be cut into the lower edge of each garboard, by laying the plank up against its respective keel rabbet. It was most important that the mortises match as precisely as possible, for there was virtually no margin for error. When the mortises were cut, oak tenons were made to fit snugly into them. It was then time to fit the garboard. If the workmanship were acceptable, the plank would seat tightly into position with no light

Continued on page 4



Chip Vincent and Robin Piercy fit one of the garboards. *Photo: Susan Womer Katzev*

PEOPLE AND PROJECTS

After a long winter's work cleaning, analyzing, cataloguing and conserving artifacts from the Glass Wreck, George Bass, Don Frey, and graduate students Cemal Pulak, Robyn Woodward, Jay Rosloff and the rest of the INA team in Bodrum have been working around the clock with Captain Tufan Turanli to prepare the *Virazon* for the upcoming shipwreck survey and a short excavation season at Serçe Liman ... INA Board members Nixon Griffis and Sumner Gerard made separate visits to Bodrum during the last few months to observe and participate in the continuing work... Fred van Doorninck and Robin Piercy recently returned to Turkey and hope for an early start on the conservation of the Glass Wreck hull... Dick Steffy, recently back from consulting with the Canadian government team excavating the important wreck site of the Basque whaler, *San Juan* (1564), is off now to direct the Texas A&M field school at a York River, Virginia, shipwreck site. Dick will be assisted by A&M nautical archaeology graduate student Paul Hundley... Roger Smith, with a team of eight, is back in the Cayman Islands to continue the maritime cultural resource study begun last year... Don Hamilton and Vaughn Bryant (Head of Texas A&M's Anthropology Program) will join Roger for a period of work in the Caymans... Jeremy Green recently completed a second successful season at Kho Kradat, in Thailand, where the Thai government is sponsoring the excavation of a 16th-17th century oriental shipwreck.

ARIE BEN-ALI

It is with great sadness that we report the recent death of Mr. Arie Ben-Ali, the Founder and Director of the National Maritime Museum, Haifa, Israel.

Arie Ben-Ali's entire life was devoted to the Museum which under his guidance grew and developed into a well-known educational and research institution.

His passing is a great loss to us all.

BASS HONORED

In recent months Dr. George F. Bass has twice been the recipient of important honors. The National Geographic society named Bass to receive the John Oliver LaGorce Award which recognizes outstanding achievement for expeditions, discoveries, or notable contributions to any pioneering accomplishment. In making the presentation Robert E. Doyle, President of the Society, cited Bass for "advancing the science of nautical archaeology through the design and development of original techniques and devices, thereby adding greatly to world knowledge of ancient ship building and maritime commerce."

Texas A&M University President Jarvis E. Miller named Bass as one of the first to be appointed a University Alumni Professor. In making the appointment Dr. Miller noted that the Alumni Professors "all rank high in the upper echelons of their disciplines... would significantly enhance any faculty... and bring great credit to this institution." With the appointment, Bass becomes the recipient of an endowed chair at Texas A&M University.

PROFILE

Cynthia Jones Eiseman. Photo: Robin Piercy

A few weeks ago Cynthia Jones Eiseman received a letter from George Bass requesting that she come to the Bodrum Museum in Turkey to help with the processing of ceramic material from the Serçe Liman Glass Wreck. In typical fashion, disregarding the personal sacrifices, Cynthia left her position with the University of Pennsylvania Museum Publications Services and flew to Turkey once again to join in the work of the people and the Institute which have over the past thirteen years formed the focus of much of her life. Since her first involvement with nautical archaeology in 1967 as a student working on the 7th century Byzantine shipwreck at Yassi Ada, Turkey, Cynthia has been one of the hardest working and most faithful individuals associated with INA.

Cynthia Jones was raised in Berkeley, California. Attending the University of California at Santa Barbara, she received her undergraduate degree in Classics in 1966. Moving east, she divided her time over the next few years between work and academic pursuits, attending Bryn Mawr College briefly, and ultimately earning her Ph.D. in Classical Archaeology from the University of Pennsylvania.

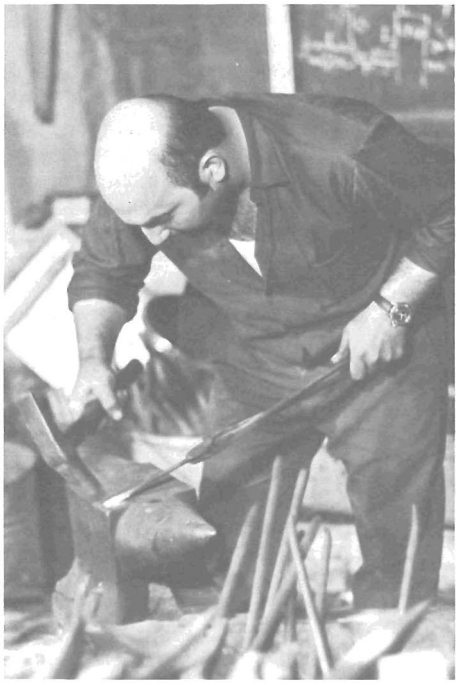
During the summers of 1970 and 1971, Cynthia worked as recorder on the excavation of a late 5th century B.C. shipwreck at Porticello, Italy, under the direction of David I. Owen. Eventually, the Porticello shipwreck became the subject of her Ph.D. dissertation, as well as the topic of her several popular and scientific articles on the amphoras, inkpots, and lead ingots recovered from the site (see *INA Newsletter* 6:4 "The Porticello Shipwreck").

Cynthia's association with nautical archaeology has had some surprising effects on her life. In 1969, while handling some legal details for Bass, she met Jim Eiseman, a young lawyer for a firm retained by the University of Pennsylvania. Three years later they were married and for years Jim supplied vital counsel to INA, smoothing any troubled waters around legal matters.

When the Institute of Nautical Archaeology (originally the American Institute of Nautical Archaeology) was founded in 1974, Cynthia was appointed Executive Director by George Bass, reflecting his confidence in her abilities. She soon found herself working day and night as the Institute began its early struggle to survive. As the senior INA staff member, Cynthia devoted endless hours to the organization and implementation of operating procedures which would allow the Institute to function efficiently. Every summer from 1974 to 1977 she left the office to work as a staff member in the field, joining INA projects at Yorktown, Virginia, and Yassi Ada, Şeytan Deresi, and Serçe Liman, Turkey. In addition to her administrative duties and field work, Cynthia took on the creation of this Newsletter, editing every issue from 1974 to Spring 1979 and ensuring a flow of information to Institute members and supporters.

When the Institute moved its headquarters from Philadelphia to College Station, Texas, Cynthia was forced to curtail some of her involvement with INA, while still remaining an active member of the Board of Directors. Recently she has directed more attention to her various academic activities, particularly the completion of her dissertation.

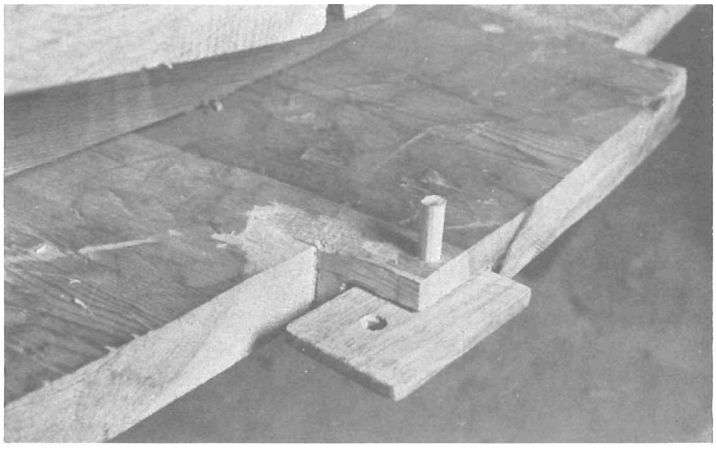
In her rare free moments Cynthia is a ballet *aficionado* and a skilled gourmet cook. In this latter activity, perhaps reflecting her approach to life in general, a close associate describes Cynthia as "a bold experimenter in the culinary arts."



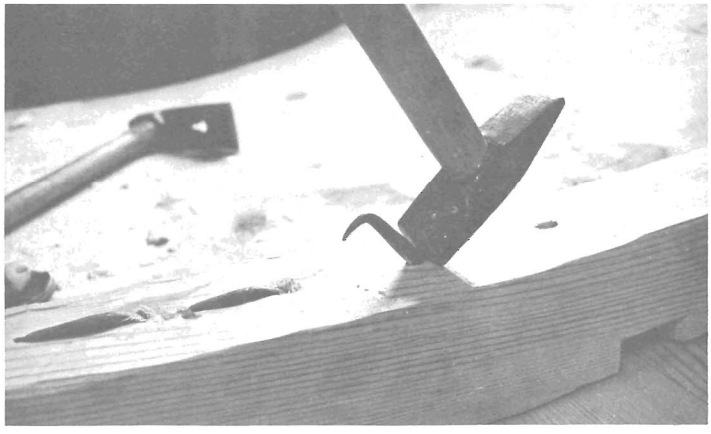
Local blacksmith, Takis Christodoulou, shows how to forge a spike's pointed end.
Photo: Gay Piercy

Copper spikes and pine treenails. Photo: Susan Womer Katzev

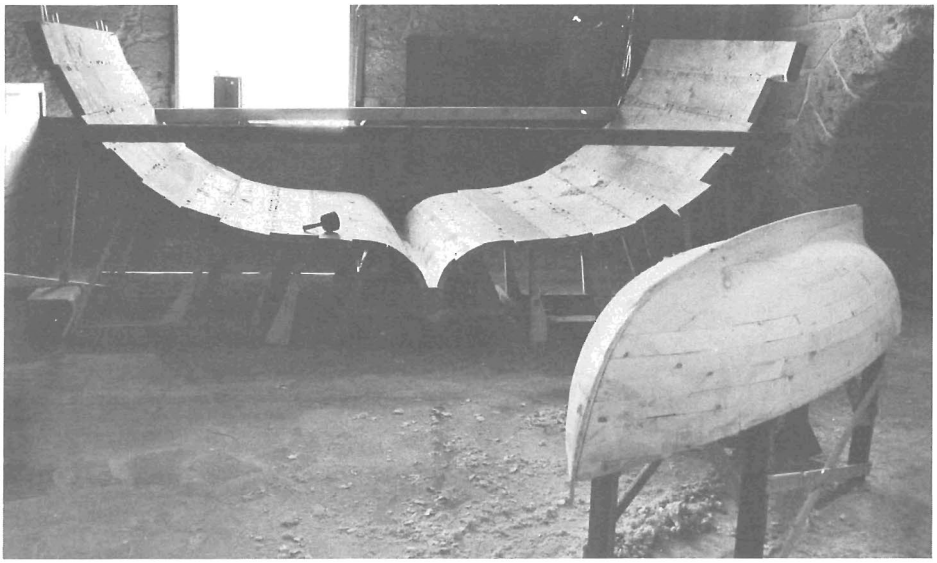
Michael Katzev hammers a spike into place.
Photo: Susan Womer Katzev



Cut-away of oak tenon held in a mortise by a peg. Photo: Susan Womer Katzev



Clenching a spike. Photo: Susan Womer Katzev



The replica shell with the second wale, strake twelve, installed. In foreground, the mold for a 1:5 scale fiberglass sailing model. Photo: Susan Womer Katzev

coming through the seam. Being somewhat inexperienced, we had several fittings. But finally, after a couple of taps with the mallet, the garboard snapped smartly into place over the tenons. Next, holes were drilled perpendicularly through the keel and garboard to cut through the centers of each half of the tenons. Certainly the ancients used a bow drill; but, after trying a brace and bit, we decided it would be more expedient for us to use an electric drill. Into the holes tapered pegs of oak were driven. These pegs locked the tenons firmly in place. The result was a secure, watertight planking seam.

The keel and garboards gave the center of the Kyrenia Ship's hull a deep V-bottom to increase its lateral resistance in the water. The second and several subsequent strakes were laid to flatten the bottom and thereby increase the ship's cargo carrying capacity. To maximize this flatness as rapidly as possible the ancient shipwright had made the edge angle between the garboard and the second strake the sharpest of the entire hull. So, in the lower edge of the second strake, Robin had to take special care that he cut the mortises at an exact complementary angle to those in the top of the garboard in order that the tenons would hold these two strakes in proper alignment forming a tight seam. The second strake could then be edge fastened to the garboard, and each successive strake was similarly added edge to edge, using mortise - tenon - peg joinery.

At the fourth strake Robin confronted a new challenge. In modern ship construction, where strakes are drawn against frames, if a strake is long enough to require several planks, the butts between the planks are vertical and overlie a frame. In ancient ship construction, where the hull is built shell-first, the absence of frames required the use of diagonal planking butts, or scarfs, and these scarfs like the joints between strakes were also mortised and tenoned together. After consultation with Dick, it was obvious to them both that Robin initially had to set the plank whose diagonal tongue was lower and then fit the continuing plank whose diagonal butt overlay the first, joining the scarf between the two with tenons pegged in vertically cut mortises.

Between strakes six/seven and seven/eight the rounded turn of the bilge was encountered where the problem of more acute edge angles again had to be handled. Also, with strake eight another, longer, diagonal butt had to be fitted.

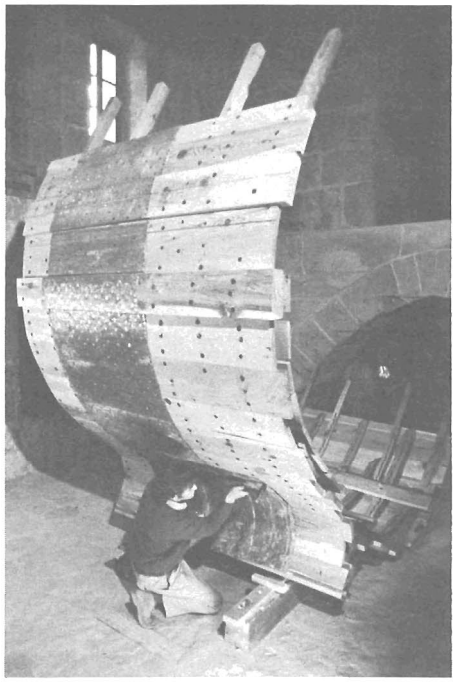
With the tenth strake we come upon a plank more than twice as thick (3 inches) as its predecessors. This is the first of two heavier planks, called wales. We are also at the load waterline of the Kyrenia Ship, a point of stress and potential distortion in any ship. It is clear that the ancient shipwright thoroughly understood the function of wales. Installing this main wale where it was most needed, he used it like a girder strengthening the hull at a very critical point in the shell's construction.

Next there is a plank of standard thickness before we reach the second wale, strake twelve, then another strake of standard thickness and finally a rail cap which helped to stiffen the top of the hull.

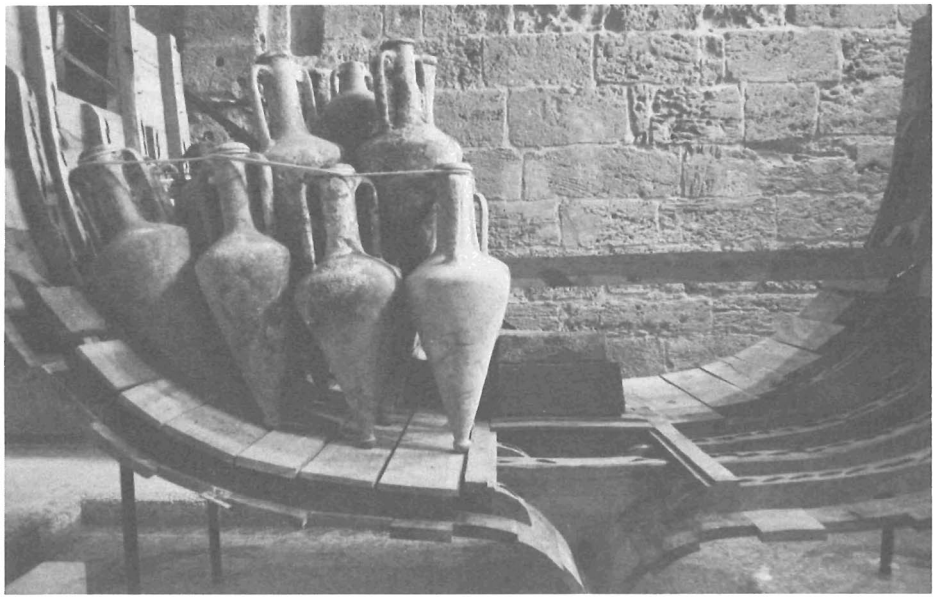
Having built up the entire shell by edge-joining the planks, we were very impressed at how rigid the replica was even before any internal frames were installed. The primary structural feature of the Kyrenia Ship was its outer planking, and the integral strength of the hull was directly dependent on its mortise and tenon joinery. Each of the more than four thousand oak tenons inserted in these joints contributed its share to stiffening the structure; in effect each tenon served as a mini-frame. Analogous to our national motto *e pluribus unum,* the ship's whole was made strong by its many parts. Our experience in edge-fastening the replica's strakes clearly revealed to us how much strength could be imparted to a hull through this method of construction. Our only criticism of this excellent system would be the great amount of labor involved, but excessive labor cost might not have been a major concern to the ancient shipwright.

With the completion of the shell Robin began to trim its interior and exterior surfaces with a broad blade adze. He sought to emulate the smooth finish on the Kyrenia Ship's hull, and day by day his strokes became less perceptible and his craftsmanship approached the fineness of the ancients' artistry. Then, using the templates made from the original frames, he selected timbers over 3 inches thick, cut from naturally curved pine limbs, and on them scored the shapes of the frames. Of course, his predecessor most probably did not use templates but rather the shell's curves to guide him. We experimented by cutting the timbers with a frame saw like those used in antiquity but soon tired from the labor and hefted the wood to our local carpenter to use his heavy-duty — electric — band saw. However, once the frames had been roughly cut, Robin still had to adze their bottom faces so that they would fit tightly against the shell's shape.

The ancient shipwright lined his hull with a framing pattern of floor timbers alternating about every 10 inches with half-frames.



Robin Piercy applies lead sheathing.
Photo: Susan Womer Katzev



The replica partially laden with amphoras and grain mill blocks. *Photo: Susan Womer Katzev*

Those floor timbers spanned the keel extending as far as the eighth strake, where the bilge turned. In order to fill the deep V-bottom space formed by the garboards and second strakes, a chock was tenoned to the lowest surface of each floor. However, no part of any chock ever touched or was nailed to the keel; instead a notch cut in the bottom of the chocks served as a clear passage for the bilge water. The line of the floor timbers was continued to the uppermost strakes by futtocks; but the futtocks were not directly connected to the floors. Between the floor timbers and spanning the turn of the bilge were the long, gracefully curved half-frames. Continuing their line, but similarly not connected to them, were top timbers which may have extended above the rail cap in order that weatherboards or canvas could be mounted on them to screen off heavier seas.

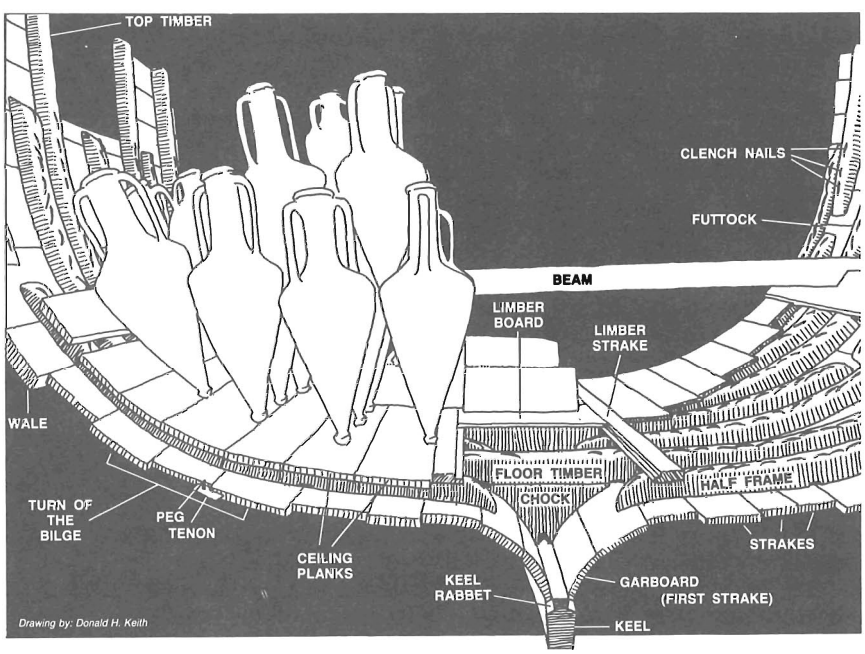
All the frames were secured by pure copper spikes. For the replica, Rome Cable, a division of Cyprus Mines Corporation, generously supplied us with copper rod. After cutting the rod to appropriate lengths, we used the local blacksmith's forge and on his anvil fashioned round heads and pointed ends. Then each spike had to be laboriously work-hardened. With a frame clamped in position, we drilled holes — again using an electric drill — through the frame and outer planks. A long treenail (trunnel), whittled from straight-grained pine, was inserted into each hole, and a spike hammered from the outside through the treenail's center. With every blow the spike expanded the treenail, eventually making the hole watertight. When driven home, the tip of the spike was bent and the end hammered down into the top face of the frame, clenching it like a staple and providing a sure hold. So fastened, the frames added lateral strength which a fully ladened hull would need to resist the ever-present water's pressure.

Like the ancient shipwright, we then turned to the inner planking. Port and starboard a strake was installed backing the main wale. Here it served as an internal clamp, providing longitudinal strength, and as a shelf, supporting the few athwart beams. One of these was placed just aft of amidships. Two small limber strakes provided little to the internal strength of the hull, but being rabbeted they did serve as ledges supporting the limber boards. These transverse boards were easily removable in order to facilitate the periodic cleaning of the bilges. Between the shelf clamps and the limber strakes, ceiling planks were laid down fore to aft to protect the hull from wear and tear by cargo and ballast. On the port side of the replica we only added a portion of the ceiling planking so that the framing pattern would be clearly visible to the viewer.

Finally Robin applied broad, thin (about 1/16 inch thick) sheets of lead over part of the replica's exterior. The sheets were held in place by lines of copper tacks. However, the Kyrenia Ship did not receive this coat of lead sheathing until late in her life. Rather, it was part of her last major overhaul. The sheets covered the entire hull and were laid overlapping from stern to bow, keel to rail cap. Serving the dual functions of caulking the weakening old hull and armoring it against shipworm, this lead sheathing had been a final attempt to make the Kyrenia Ship seaworthy.

Our reasons for building the replica were multiple. By reproducing the ancient shipwright's construction we sought to know better his techniques and tools as well as the method of shell building. Our efforts taught us that as available and seaworthy as Aleppo pine must have been, its sappy and knotty qualities make it a difficult and ornery wood to work. Indeed, our experience gave us an even greater appreciation of our shipwright's expertise and causes us to admire all the more the results of his labor. Furthermore, we thought that the replica would aid in the museum visitors' understanding of the sequence of shell construction and recognition of the parts making up an ancient hull. Lastly, planned as the focal point of the center gallery of the ship's museum, it was intended that some of the amphoras and grain mill blocks recovered in the excavation would be loaded in the replica, vividly showing how the cargo and ballast had originally been stowed in the Kyrenia Ship.

Michael L. Katzev



CAMPECHE SHIPWRECK

In a time when underwater archaeological resources, particularly shipwrecks, are being torn apart by professional, investor-financed treasure hunting companies and amateur sport divers alike at an unprecedented rate — often with the knowledge and even consent of the governments in whose waters they lie — the following story may seem more like a fairy-tale than reality.

On July 5, 1979, the Institute of Nautical Archaeology received a letter from Mr. V. Farley Sonnier, sport diver and attorney from Lafayette, Louisiana. While diving in Mexican waters the month before he and several friends had accidentally discovered three old cannons and an anchor lying in shallow water near a tiny, remote reef in the Gulf of Campeche. One of the cannons was bronze and twelve-sided in section, rather than round. Chipping away some of the marine concretion, they uncovered a date: the first two digits were *15*, the third was illegible, and the fourth appeared to be a *2*. The divers realized they had discovered an important find, and decided it belonged in a museum, rather than in a private collection. Upon returning to Louisiana, they contacted INA for advice.

INA advised Mr. Sonnier to contact the Instituto Nacional de Anthropologia e Historia, the official government agency for the coordination of archaeological investigations in Mexico. The excellent underwater photographs taken by Sonnier and his group of the visible artifacts on the site prompted officials in INAH to mount an expedition to the reef to probe its archaeological potential and to raise the bronze cannon which was now exposed on the bottom and in danger of being removed illegally.

On November 20, 1979, INA Research Associates D. H. Keith and R. C. Smith and Professor D. L. Hamilton flew to Merida, Yucatan, to provide technical assistance to the expedition. Here they were met by Norberto Gonzáles Crespo, Director of the southeastern regional division of INAH, under whose geographical jurisdiction the reef lies. Sonnier and Mr. Ned Weeks, one of the divers who had been with him in June when the site was discovered, had also been invited to ensure that the site could be re-located. Official director of the expedition was archaeologist Pilar Luna Erreguerena (see *INA Newsletter* 6:2, "La Media Luna"), who had only recently returned to Mexico from Turkey where she had been participating in the excavations at Serçe Liman. Naval architect and specialist in early colonial Spanish ship construction, Señor Jesus Bracamontes Aviña joined the group as technical consultant.

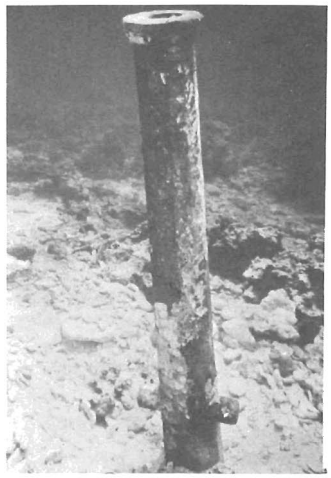
At the port city of Campeche the expedition boarded the Mexican Navy minesweeper DM-019 for transportation out to the isolated reef. Despite a brisk wind from the north and choppy seas, the site was located almost immediately the first day, and the bronze cannon was rigged, raised off the bottom with ten 55-gallon oil drums, and floated out to the DM-019 for lifting. The expedition's good luck ran out suddenly when in the process of lifting a cable parted and the cannon plunged back into the sea and disappeared.

The second day was spent towing divers in depths to 120 feet in a fruitless search for the lost cannon; but the expedition had not come equipped to make numerous repetitive deep dives, and the search was abandoned in favor of concentrating on the site itself to determine if it represented the remains of a shipwreck, or only an assortment of objects intentionally jettisoned to save a stranded vessel which subsequently escaped disaster. The presence of numerous ballast stones and iron fittings on the bottom in the vicinity of the remaining two cannons and anchor convinced the archaeologists that the site was indeed a shipwreck.

Threatening weather forecasts and the absence of any safe anchorage near the reef terminated the expedition prematurely at the end of the third day. Señor Bracamontes commented with a wink that the ghost of the Spanish admiral who went down with his ship here was protecting his artillery well! The expedition returned to Campeche empty-handed.

On February 11, 1980, the director of INAH authorized the creation of a new department within the Institute, the Department of Underwater Archaeology, and Pilar Luna was designated as its chief. She swiftly organized a return expedition to the reef to document the site completely and to raise diagnostic material which would aid in the dating and identification of the mysterious shipwreck. The archaeologists were assisted by three divers and equipment provided by the Department of Science and Technology of the Sea. At Luna's request, INA sent D. H. Keith to join the expedition in the capacity of consultant. The Mexican Navy once again made the DM-019 available as the principal support vessel, and Pemex, the national petroleum company of Mexico, released the commercial diving vessel *Mercurio del Golfo* and four commercial divers to assist in the recovery of the lost bronze cannon.

The second expedition spent twelve days at sea during which time the "ghost of the Spanish admiral" was finally defeated. The bronze cannon was re-located and successfully raised after a six day search, and on the last day of the expedition the enormous fourteen foot long anchor and one of the two iron cannons remaining on the site, which had been laboriously chiseled out of the imprisoning coral, were raised intact. The entire site was mapped with more accuracy and a small airlift was employed to determine what lay beneath the sand and broken coral debris filling the space between the coral formations.



The bronze cannon moved to an upright position in preparation for lifting.
Photo: V. Farley Sonnier

The two cannons, anchor and other small finds were taken to the archaeological conservation facility in Merida for cleaning, treatment, and close examination. After this process, which will likely require a year or longer for the large iron objects, they will be placed on display in the Museo de Armas y Marinería in Campeche. As more is learned about the date and origin of these artifacts, a return expedition to the site may become necessary.

The discovery and initial investigations of this shipwreck site represent an all too infrequent occurrence, paralleling in some ways the early history of the Kyrenia Ship excavation. Both these sites were fortuitously discovered by responsible sport divers who, after careful consideration, deliberately chose to contact professional archaeologists. The potential historical value of both sites was appreciated immediately by the local and national governments in whose waters they lay. Finally, both required the patient cooperation of several different professional and lay groups willing to work together to achieve a common goal.

Donald H. Keith

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

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