The Reconstruction of the Kyrenia Ship, 1972-1975

By Michael L. Katzev

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The Reconstruction of the Kyrenia Ship, 1972-1975

Principal Investigator: Michael L. Katzev, Oberlin College, Oberlin, Ohio.

Grant Nos. 1098, 1462. In support of the reconstruction of the Greek merchant ship sunk off Kyrenia, Cyprus, sometime in the latter third of the fourth century before Christ.

With the permission and support of the Department of Antiquities of the Republic of Cyprus, work on the Kyrenia ship continued during 1972-1973 under the aegis of Oberlin College and was completed between 1974 and 1975 with the assistance of the American Institute of Nautical Archaeology. In addition to these institutions’ sponsorship, financial aid was received from the National Endowment for the Humanities, the John Brown Cook Foundation, Cyprus Mines Corporation, the National Geographic Society, UNESCO, and the American Council of Learned Societies. Cyprus Mines Corporation also provided aid through its facilities on the island. The United States Embassy in Nicosia rendered assistance in innumerable ways; and following the Turkish invasion and occupation of northern Cyprus in 1974, Ambassador William R. Crawford and his staff were constantly at the disposal of the project’s needs. Finally, a profound expression of gratitude is extended to the project’s personnel, who so devotedly dedicated themselves to the successful restoration of the Kyrenia Ship, particularly Robin C. M. Piercy, Assistant Director; J. Richard Steffy, Ship Reconstructor; Susan Womer Katzev, Photographer and Artist; Frances Talbot Vassiliadou, Conservator; Robert K. Vincent, Jr., Assistant; Gay Donati Piercy, Assistant to the Conservator.

Background

In 1965, while picking sponges at a depth of 30 meters, Andreas Cariolou accidentally discovered a mound of amphoras on the seabed. He graciously showed the mound to archeologists from the University of Pennsylvania Museum who were searching for shipwrecks off the coasts of Cyprus during the autumn of 1967. They surveyed the site and determined that a fair-size merchant ship had sunk off Kyrenia sometime in the latter third of the fourth century before Christ (Katzev, 1974a).

During two seasons of excavation, in the summers of 1968 and 1969, the Pennsylvania group completed the recording and recovery of material from
the site. The ship's principal cargo consisted of approximately 400 amphoras, which can be associated with ports of call at Samos and Rhodes. Almonds were another commodity carried aboard, and over 10,000 amazingly well-preserved specimens were found. Some 29 hopper-type grain mill blocks, surrounded by fist-size stones and bedded in gravel and beach sand, served as the ship's ballast. From fore and aft cabins the black-glazed crockery used by the crew of four on the Kyrenia ship's last voyage was raised. Seven bronze coins which were recovered indicate that the ship sank circa 300 B.C. Most fortunately about 70 percent of the merchantman's hull lay buried beneath the fine muddy sand of the seabed. After meticulously labeling and plotting each piece in situ, the excavators carefully lifted almost 5 tons of waterlogged wood to the surface (Katzev, 1970, 1973, 1975, 1976, 1978).

Every piece of wood was then the subject of detailed cataloguing, photographing of inner and outer faces, as well as drawing of these surfaces at full scale, in order to insure against the loss of any information should the timbers suffer during preservation treatment. After a year of research and experimentation, it was clear that a program of treatment using the water soluble compound polyethylene glycol (PEG) of molecular weight 4000 and gradually increasing the concentration of the solution to almost 100 percent would yield bulked, dimensionally stable wood. Tanks of galvanized steel, their interiors coated with fiberglass, were made and equipped to heat and circulate the PEG solution. And in the summer of 1971 large-scale treatment of the ship's timbers began. The rate at which the PEG was absorbed depended in part on the condition of the wood, its species, and particularly the piece's cross-sectional dimensions. Time of treatment, therefore, varied from a minimum of 8 months to a maximum of 2 years. When taken from the tanks (the last piece was removed during December of 1973), the timbers were slowly dried and cooled to room conditions. Then the wood's surfaces had to be laboriously cleaned of the congealed PEG, at which point a piece was at last ready to be used in the reassembly of the Kyrenia ship. For 99 percent of the timbers this process of treatment successfully preserved the wood without any shrinkage or warpage (Katzev, 1974b, 1979, 1980).

Reconstruction

Correlating the in situ plan of the hull on the seabed, the detailed catalogue of the wood, and the full-scale drawings of each piece (manually reduced to 1:10 scale), Richard Steffy analyzed and interpreted the data, producing a set of preliminary drawings of the ship's lines. These were graphically projected at full scale on the walls of the ship's gallery in the Crusader Castle at
Kyrenia, and this process—not dissimilar to "mold lofting"—yielded pertinent alterations to the projections. The results were then subjected to further scrutiny and criticism through building a 1:5 scale research model. From these experiences Steffy was able to prepare a more accurate version of the ship's original contours. He confirmed that the Kyrenia ship had a curved, rocker-shaped keel; and his work revealed a shallow, broad, double-ended vessel, 14.7 meters in length, 4.3 meters abeam (beam/length ratio of 1:3), and 1.4 meters in draft: a merchantman of slightly less than 30 tons burden.

Sufficient evidence for the ship's sailing rig survived to enable us to construct a model destined for sea trials. Made of fiberglass at 1:5 scale, the model was large enough to be manned. Equipped with dual steering oars, she carried a broad "square" sail, fitted with guide rings for brail lines. (Calculations indicated that the original ship had a sail measuring approximately 10.7 X 6.0 meters, or 64 square meters, with over 180 lead brail rings.) Through a series of tests we obtained viral information about the steering and handling of the ancient merchantman. For example, by manipulating the two steering oars, the helmsman found her extremely responsive to his touch; she would turn or could be stopped almost within her own length. And, while actually sailing this model, it was learned that under the best of conditions—a following wind—the Kyrenia ship might have made 4 or 5 knots. But, surprisingly enough, because the mast was set relatively far forward amidships, with one edge of her sail swung round and brailed-up she could also make amazingly good headway when pointing as close as 6 points off the wind.

The Kyrenia ship was built in the shell-first manner. To appreciate better this technique of construction, a full-scale section of the hull was built for a length of 2 meters aft amidships. In this replica the modern-day researchers used materials and tools similar to those of the ancient shipwright. The pine keel was adzed, and mortises were chiseled into the lower faces of its rabbets. After shaping a garboard strake, mortises were cut in its lower edge to match those of the keel. Then this garboard was edge-joined to the keel by oak tenons inserted in the mortises, and these tenons were locked in place with pegs. Snake by snake the hull was built up using the same tenon and peg joinery. Above the turn of the bilge the first of two thicker planks was set. The girding function of this wale evidently was fully understood by the ancient shipwright, for he placed this large plank where it was needed most—at the waterline. A cap rail provided additional stiffening at the top of the hull. In the original ship some 8,000 mortises had been cut, their bottoms carefully squared to receive 4,000 tenons. These tenons served as "mini" frames, each contributing strength to the shell construction; and our replica of the hull was indeed quite rigid before any internal framing was installed.

Fig. 2. Mr. Steffy fitting a plank to the port side of the 1:5 scale research model. In the background work proceeds on the replica—a full-scale section of the hull. (Photo by Susan Womer Katzev.)
Not until the entire shell was completed were the frames inserted. Cut from naturally curved timbers, the alternating floors and half frames were finely adzed to fit the shape of the hull; and above these, futtocks and top timbers were placed. All the frames were secured by pure copper spikes. Copper rod (generously supplied by Rome Cable, a division of Cyprus Mines Corporation) was forged into spikes and hand-hardened, driven from the outside through pine treenails to insure watertightness, and clenched over with their tips bent back and hammered down into the interior of the frames to provide their sure holding. For added strength to the hull, a stringer and limber strake were attached to the frames. Backing the main wale, the stringer served as an internal clamp as well as a shelf, supporting the few athwart beams. Similarly, the limber strake served a dual purpose, for it was rabbed to support the limber boards. Between the stringer and limber strake, ceiling planks were laid down to protect the frames from wear and tear by cargo and ballast. Finally plates of thin lead sheathing were applied to the exterior of the hull and held in place by a myriad of copper tacks. This lead sheathing had been a last attempt to make the Kyrenia ship watertight.

With the knowledge gleaned from these reconstructions, we were better prepared to reassemble the Kyrenia ship using the preserved, original wood.
melting point of 55°C. the polyethylene glycol preservative softened and became malleable. Upon removing the pieces from the oven, long wooden dowels soaked in polyethylene glycol were inserted into the holes; these dowels served as “reinforcing rods” as the pieces were joined, while the cooling polyethylene glycol slowly solidified to serve as a kind of “glue” sticking the pieces together. Also during this process the pliable frames could be rebent to their original curvatures. In adding the frames to the reassembly, their nails had to be oriented with the nail holes in the strakes before the frames could be accurately set and secured—again using stainless steel wire—within the hull. Slowly, painstakingly, the reassembly progressed; but each day the modern reconstructors were struck anew by the skill and craftsmanship of the ancient shipwright. On November 9, 1973, the last frame was put in place. However, due to the interruption in our work caused by the Turkish invasion and occupation of northern Cyprus during the summer of 1974, we were not able to complete finally the reassembly by adding the interior planks until May 19, 1975.

Fortunately, approximately 70 percent of the ancient Kyrenia ship survived to be included in this modern restoration of the oldest seagoing hull yet recovered. Through the process of reassembly much was learned about the hull’s design and construction not otherwise obtainable. It was revealed that the port side had a slightly different cross-sectional shape than the starboard. In fact, remarkably enough, the port had 5 percent more wetted surface and indeed one more strake than the starboard. Careful inspection of the workmanship on each side of the keel suggests that this imbalance was the result of two teams of shipbuilders working side by side. Evidence came to light that in the stern there was a deck upon which the helmsman stood and below which there was a locker. Most probably in the bow there was a comparable deck, serving as a platform for heaving the anchors, below which was a cuddy. Between the bow and stern decks, however, absolutely no evidence was found for decking; rather, the cargo of the Kyrenia ship seems to have been laden into an undecked hold. During the reassembly it was also possible to observe and evaluate various repairs made to the hull in antiquity. The ship had been subjected to major overhauls on at least three separate occasions. These repairs included the replacement of damaged floors in the bow and the application of a thin wood sheathing over much of the bow’s exterior in order to seal opening seams; the replacement of rotten strakes in the bow and the application of lead patches over splitting seams in the bow’s interior to make them watertight; and finally sheathing the entire outer hull with thin sheets of lead as a last attempt to cover the leaking seams and prolong the life of the ship. It is not clear how many years lapsed between these repairs, but one may conjecture that in

FIG. 5. The reassembled Kyrenia ship. (Photo by Michael L. Katzev.)
all they must have encompassed decades. Furthermore, after the lead sheathing was applied, parts of the keel’s worn shoe were replaced as many as three times, reinforcing the supposition that the Kyrenia ship had seen many years of service.

**Exhibition**

In Kyrenia’s Crusader Castle the Department of Antiquities finished restorations in the three galleries allocated as a museum for the ship’s excavation. The partly destroyed arch dividing the northernmost gallery was restored, and half of the second floor in this gallery was rebuilt to provide additional display space. Reconstruction of the collapsed groin vault in the middle gallery was completed. The walls and vault of the southernmost gallery—the Ship Gallery—were sprayed with a special compound (Lewin LSP I formula) to consolidate the soft limestone and minimize the fall of sand-size crystals onto the reassembled ship. And the floors in all three galleries were relaid with flagstone paving. The reassembly’s temporary wooden scaffolding was replaced by an iron cradle, whose rows of stanchions were set 2 meters apart, providing strong and permanent support for the ship. The government of the Republic of Cyprus provided the equipment necessary for air conditioning the Ship Gallery. Under the direction of the UNESCO advisor to Cyprus, Jacques Dalibard, this equipment was installed by UNFICYP personnel during the spring of 1976. Now a selection of finds from the excavation, culminating in the display of the reassembled ship, may be seen in these three galleries of Kyrenia’s Crusader Castle.

**Recording and Conservation**

The preliminary recording of the contents of the Kyrenia ship, undertaken during the excavation season of 1968 and 1969, was thoroughly reviewed and completed. This work included the recataloging, photographing, and drawing of all the material to a standard suitable for its final, scholarly publication. The approximately 400 amphoras were reinspected toward better describing the color and quality of their fabrics. The 29 grain mill blocks were photographed and weighed, their total weight being 1,652 kilograms; also the fist-size ballast stones were weighed, and the weight of those stones recovered during the excavation totaled 230 kilograms. Further mending of the crew’s crockery produced 20 more vases for documentation. Additions to the repertoire of plates, bowls, and pitchers included 4 casserole pots and a tiny votive lamp.

Iron decomposes rapidly under water. A concretelike formation builds up around the object. Within this “concretion” a mold is formed of the iron
original. Also, as the concretion builds up, it entraps any other objects in the environs of the iron. To determine what the iron object was originally, it is necessary to saw the concretion in half and make a cast from the mold. And to release any objects entrapped in the concretion, it is necessary to break up the concretion-like formation. Using a lapidary saw and a polysulphide rubber compound, replicas of the iron objects from the Kyrenia ship were cast; and using a vibrotool, all the other entrapped objects were released from the concretions.

In the stern locker of the Kyrenia ship some 30 iron blooms had been stacked. They formed a concretion weighing approximately 600 kilograms. Entrapped in this concretion were: a bronze ladle whose handle ends in an elegant duck’s head, a small lead bowl, 57 lead guide rings for brail lines, a wood toggle, 3 wood deadeyes, various fragments of rope, a bow drill, 11 knucklebones, a portion of a garlic clove, 18 olive pits, 764 grape seeds, 14,760 fig seeds, more almonds, pistachio and hazel nuts, et cetera. The wealth of material painstakingly extracted from this “mine” of a concretion cannot be overestimated. Its detailed analysis and interpretation will add immensely to our knowledge of seamanship and the habits of seafarers in antiquity.

Smaller concretions yielded an additional 45 replicas of iron implements. Among the most interesting objects were the supports of several gridirons, a complex key with 8 teeth, a ship’s slice, a hammer, the fluke of an anchor, and 8 spearheads. These latter weapons might explain why the Kyrenia ship came to grief. No spears were recovered from within the hull; the excavators found all of them beneath the hull, and some were bent from impact. Valuable objects were not found in the wreck, nor were any of the sailors’ personal effects. These circumstances suggest a pirate attack, the looting and scuttling of the Kyrenia ship more than 22 centuries ago.

Documentary Film

With the permission and encouragement of the National Geographic Society, the Cyprus Broadcasting Corporation shot footage focusing on the various phases of the reconstruction. The result was a premiere on March 23, 1977, in Nicosia, Cyprus, of a 54-minute, 16-mm, sound, color film entitled “With Captain Sailors Three: The Ancient Kyrenia Ship,” produced by the Cyprus Broadcasting Corporation in cooperation with the National Geographic Society. This documentary film, covering the project from the wreck’s discovery through the ship’s reassembly, is now available in Greek, English, and French editions and is actively being distributed worldwide to educational, cultural, and historical institutions.

Conclusion

The Kyrenia ship project has provided a vivid picture of a fourth century B.C. ship and her crew. What we see is a merchantman of slightly less than 30 tons burden. Well built, she was nevertheless the “tramp” vessel of her day. Trading through the Aegean and eastern Mediterranean, she had called at Samos, Nisyros, Rhodes, and perhaps Cyprus to take on and discharge cargoes as varied as wine, millstones, almonds, iron, or other more perishable materials. Undoubtedly she had made many similar voyages throughout the lifetime of Alexander the Great, her open hold filled with comparable cargoes. Indeed, for several generations of mariners it seems she had successfully plied the seas
in such commerce. But luck ran out on her last crew of four. Around the year 300 B.C. we believe pirates suddenly ended the sailing life of the Kyrenia ship. However, to our good fortune the sea yielded these secrets over 2,200 years later. Through the dedication of sponsors and project members, after 8 years of labor, thus the oldest seagoing hull yet recovered has been resurrected. It is hoped that in the years to come visitors and scholars will find reward in the exhibit of the Kyrenia ship.

REFERENCES

Katzev, Michael L.

MICHAEL L. KATZEV