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Author(s): Susan Katzev

Source: *Near Eastern Archaeology*, Vol. 71, No. 1/2, Ancient Cyprus: American Research (Mar. - Jun., 2008), pp. 76-81

Published by: [The American Schools of Oriental Research](#)

Stable URL: <http://www.jstor.org/stable/20361350>

Accessed: 12/07/2013 17:01

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# The Kyrenia Ship: Her Recent Journey

Susan Katzev

**T**he pristine mound of about eighty amphorae discovered at the bottom of the Aegean Sea by Andreas Cariolou in 1965 held particular promise in the eyes of archaeologist Michael L. Katzev, who would go on to direct its excavation. Most shipwrecks then known in the eastern Mediterranean had come down on rocky terrain where their wooden hulls lay exposed to decay and attack by marine life. Here, off Kyrenia, a flat seabed of silt overgrown with *Poseidonia* grass surrounded the Hellenistic amphorae. Conditions were ideal for preserving an ancient seagoing vessel and this would be the breakthrough that nautical archaeology had been waiting for.

The young and innovative team that Michael Katzev assembled in 1968 and 1969 indeed uncovered what is still the best-preserved wooden ship known from Greek antiquity, complete with its last cargo and the accoutrements of shipboard life. As Michael's wife and the excavation artist, I enjoyed being one of those fifty-four excavators. Our team advanced underwater archeological techniques by using lightweight plastic piping instead of metal to divide the site into grids. We then freed the photographer to "fly" over the excavation, snapping a pair of stereo photos in an instant. What seemed so modern then is archaic now, as scientists from Woods Hole Oceanographic Institute have used robots to map a field of 350 amphorae in under two minutes.

But what remains of this excavation's lasting and still-current contribution to shipwreck technology is the successful raising and preservation of the ship itself, culminating in its being reassembled for exhibition in Kyrenia Castle. Once the wooden architecture of the hull began to emerge on the seabed during the second season of excavation, the team could see dramatic darkening of golden timbers in a matter of days as oxygen reached the wood for the first time after twenty-three centuries in anaerobic mud. We felt the tremendous responsibility of uncovering a seventy-percent-intact ship, and focused all attention on saving it. Lest the timbers not survive ascent and handling topside, we recorded them on the bottom in multiple systems of overlapping measurements before dismantling the hull. Through October storms, the pieces ascended to be rushed into the temporary holding tanks that we were constructing within the castle and in our dig house basement. As the excavation closed, conservator Frances Talbot Vassiliades, fresh from the London Institute's conservation program, took responsibility for the delicate



The Hellenistic wreck site lay less than a mile from Kyrenia harbor at a depth of ninety feet. Photo by Michael Katzev.



J. Richard Steffy reassembled the ship, pinning the wax-treated timbers together with stainless-steel rods. All photos by the author unless otherwise indicated.

wood. She adapted a wax preservation technique being used in Scandinavia. To her great credit she insisted on using this polyethylene glycol in its strongest form and in taking the extra time to saturate the Kyrenia timbers one hundred percent. The conservation in heated tanks of the chemical took two years. Today the reassembled Kyrenia ship stands strong after forty years due to this diligence and to climate control, which is all important to its health.

By 1974 the ship was safely preserved and reassembled to its original shape by J. Richard Steffy in a handsome gallery of the Kyrenia castle, and study of its contents was underway. Director Katzev spent six years in the libraries of Athens researching the ship's contents, returning to the U.S. to write and intending to publish the entire contents of the ship himself. His twenty-five reams of research notes testify to his fascination with every aspect of the finds. Meanwhile, Steffy continued interpreting the thousands of full-scale tracings of the ship's timbers in his separate study of the design and building history of the ship.

The death of Michael Katzev in 2001 intensified the need to bring the project to final publication. As Michael's wife, I have become the coordinator of this effort, assembling a team of specialists who will enlarge upon Michael's research adding their own insights and using the intervening forty years of fresh scholarship. Because there is still much to be learned from the Kyrenia Ship, our ongoing and innovative analyses are adding greatly to the two-volume final report to appear in the Ed Rachal Foundation Nautical Archaeology Series of the Texas A&M University Press in association with the Institute of Nautical Archaeology.

### The Ship's Recent Journey

Once Katzev's research was in the hands of the various authors and Gloria Merker had accepted overall editorship for the publication, it was important to show each author where his material had been located within the wreck.



The replica, Kyrenia II, on a voyage between Cyprus and Athens. Her single broad square sail, typical of those seen in ancient vase painting and relief sculpture, was raised upwards like a Venetian blind by the vertical lines seen here. The lines ran through rings sewn to the sail. Over 150 such lead rings were found in the excavation.

Starting with the site plans as completed in the field, Laina Wyld Swiny (who was originally responsible for recording the hull for raising) and I have spent five years poring through the excavation records to update old plans and create new ones. This was possible because Michael's field notes were consistent and clear, and the site photography by John Veltri was thorough, well preserved by archival processing, and had been stored over the years in a strictly climate-controlled environment.

While revising plans of the amphora cargo, Laina Swiny and I found it difficult to discern distinct levels in stacking of the jars. The ship had rolled onto its port side once it reached the bottom, so that starboard-side amphora cargo shifted into the port pile, leaving a confusing intermingling. With the goal of understanding the original stacking pattern and loading process, we decided to dispense with miniature models and instead work with the bulk and weight of the originals. Our goal became to replicate all 384 amphorae in their different shapes and load them onto a full-scale replica of the Kyrenia merchantman. This was to be the first of many practical experiments our curiosity led us to explore. In essence, when we had a theory, we tested it.

Two full-scale replicas of the Kyrenia ship were available to us. The most authentic one was "Kyrenia II," built in the ancient shell-first method in 1985 by Manolis Psaros and Michaelis Oikonomou in the Psaros shipyard, Perama, Greece. However, after long years of sailing and worldwide ambassadorial travel, Kyrenia II was soon to become a museum piece herself. In 2003, she arrived in Cyprus as a gift of her sponsor Harry Tzalas and the Hellenic Institute for the Preservation of Nautical Tradition in Greece to become the centerpiece of the innovatively designed "Thalassa Museum" of the sea in Agia Napa, Cyprus. While Kyrenia II would soon be lowered through the retractable roof of her new home we looked to a just-launched Cypriot replica whose captain, Glafkos Cariolou, was ready to experiment. ready to experiment. Funded by the Kyrenia Chrysocava Cultural Foundation and built at the Avgousti yard in Limassol, this ship replicates Kyrenia II in every way except for her modern method of construction. "Kyrenia Liberty" sails each summer with one of three captains and crews, all professionals in other fields, who donate their time to learn ancient sailing skills and to pass them on through school programs, lectures, and voyages such as their appearance at the 2004 Olympics. Here was our sailing vehicle and crew ready to learn through loading our ancient cargos.

At their pottery workshop outside Limassol, the Pandeis family recreated all the transport jars from the wreck, with father Kikis and son Nikos working only from drawings. The five stages they used in throwing the main cargo of 220 large Rhodian amphorae exactly mirrors what we had observed in the ancient jars. A separate study for the final report by Tania Panagou measured how closely the potters had come to replicating the dimensions and capacities of the originals. She found that the Pandeis family accurately reproduced every amphora type except the predominant Rhodian shape, which had been made slightly greater in size and capacity.





An "army" of inverted Rhodian amphorae flanking Nikos Pandeis waits to dry. He holds one just out of the wood-fired kiln behind him. The Pandeis family restored this kiln, long in disuse, to recreate the Kyrenia Ship's cargo. *Photo by Radomir Cvetic.*

But in the loading experiments that followed, we were able to compensate for this defect. Though we loaded most of the jars empty, we compensated for their weight (if filled with wine) by adding extra ballast of beach pebbles around the three rows of replicated millstones that lay centered over the keel.

Artist Kleanthis Moustakas, a crew member from *Kyrenia Liberty*, masterminded and executed two differently configured loadings of amphorae into the ship. In each case he topped off approximately three layers of jars with smaller ones nestled in on top at random angles. When the ship sailed with them out of the old port of Limassol, she carried twelve metric tons, with this weight concentrated low in her hold. All the upper level amphorae were empty, and these were mounded noticeably high. The sheer volume of the jars excavated from the wreck was not fitting comfortably into the conjectured hull. Moreover, had the upper jars been filled with a liquid, as we believe they were, *Kyrenia Liberty* would be dangerously unstable in high winds.

Had the ancient ship sunk from overloading? Ship reconstructor Dick Steffy was intrigued. In the sailing replicas he had already added two extra outer planks to what was physically preserved of the hull's height. Both *Kyrenia II* and



Viewed from the bow, Kleanthis Moustakas, in white, nestles in another Rhodian amphora. Notice how many amphorae on the dock still await loading.



Kerynia Liberty had earlier proven extremely seaworthy while carrying approximately ten tons, but neither had sailed with the full seventeen tons of materials found in the ship during excavation. Perhaps some evidence had been overlooked? Perhaps the ancient hull had been higher still?

Something that had bothered Steffy all these years about the framing pattern now made sense. He already knew that the ship had been remodeled in antiquity, but now he suspected that it had also been heightened to carry heavier loads—that is, to become an amphora carrier. He reexamined the excavation's full-scale drawings of the uppermost frames and saw that these were reused to heighten the ship, probably at the same time that its mast was repositioned to sail with more cargo. Buoyed by this insight, Steffy worked to understand why the Kyrenia hull is not symmetrical, and has recently discerned that the keel was flat on top, not curved as first thought. He sees its design in joining to the stempost as a marvel of technology and extremely innovative for its time.

The experiments of loading Kerynia Liberty in November 2004 also gave us the chance to test how our ancient crew

of four might have moved cargo in and out of the open hold. The twenty-nine volcanic millstones found during excavation weighted on average fifty-seven kilograms each, while each ancient Rhodian amphora, if filled to the base of its neck with wine, weighed forty-nine kilograms. To load in a full amphora two men on the dock passed it down to two men in the hold, who walked it to the man in charge of stowing it. We found this hand-to-hand method laborious and apt to cause breakage.

A far more efficient technique, we discovered, was to hoist each amphora or millstone using the lifting boom called a "mast derrick" mounted at the base of the mast on Kerynia Liberty. An iron hook identical to one found in the excavation hung down from the derrick to grab a simple rope sling around each item. Now one man dockside could slip a sling under the two handles and simply guide the hanging amphora to a second crewman standing on a crossbeam, who, in turn, guided it to the stower below. A fourth man, our captain, positioned near the mast, worked the ropes and pulleys like a modern crane operator. This operation took only twenty seconds from lift-off dockside to touch down in the hold. We cannot say convincingly that



From the stern steering deck, imagine how top heavy the ship would be if these amphoras were full.



The mast, with a black iron collar can be seen on the far upper right of this photo. The "derrick," similar to a boom, is attached to that collar and is mostly out of the picture overhead. Seen in the background, the captain uses pulleys to swing the derrick and raise and lower cargo into place. Kleanthis receives the jar, guided to him by Philip Swiny on the crossbeam.



the Kyrenia Ship had such a mast derrick, but considering the complexity of lifting devices used at this time on land, it seems reasonable to assume one. With it, our four sailors could have loaded all seventeen tons into the ship with minimal effort and minimal breakage in just two and a half hours.

In the many hundreds of amphora-carrying shipwrecks now known in the Mediterranean, evidence of how their jars were stoppered is rarely preserved. Further experiments with our replicated Rhodian amphorae showed that they must have contained a commodity heavy enough to sink them. Had they been empty they would have floated away as the ship went down. Whatever sealed their mouths has been lost to us. No traces of wood, cork, pinecones, bark, fired or raw clay, or other forms of known shipwreck stoppers survived. Considering the ship's fine state of hull preservation this was a puzzle.

Looking for something that would leave no trace, we first tried packing raw clay into an amphora mouth over a sheet of linen. The clay shrank and lost its seal. There was no practical way of keeping the clay soft. We next soaked linen in melted beeswax (obtainable only by a male from our team visiting a Cypriot monastery). When the saturated cloth was tied around the amphora mouth it became brittle and leaked. We tried and failed to find a softener to keep the beeswax flexible and watertight.

Animal skins seemed another possibility. From the last remaining tannery on the island, we bought sheep and goat skins. The thinner goat skins, softened in water overnight and, cut to size, worked very well. We stretched the skin over the amphora mouth and tied it with twine around the neck just under the lip. We could invert an amphora filled with water, and nothing leaked out. This was a perfect solution to stoppering amphorae in transit. The skins were cheap, and no traces would be found after fish had nibbled them away under water.

In our excavation days of the late 1960s the wonders computers could perform were unknown to us. Now, through the expertise

of visual reality expert, Donald Sanders, of the Institute for the Visualization of History, we have begun using the computer as a learning tool. After imaging the ship as it sank, we can witness its "virtual disintegration" on the seabed in the series of dramatic collapses, which Steffy describes in his upcoming volume of the report. Cargo and equipment will scatter and settle until the wreckage lies still and becomes sealed under silt, sand, and the final blanket of grass. As the ship sinks, we will place cargo, equipment, and small pottery where we think they rode originally. Each item can be given its proper weight in sea water and will roll according to its shape. Once the hull falls apart in virtual reality, we will see where these items have shifted, tumbled, and ended up. If that is not where the excavation found them, we will place them differently the next time, fast-collapse the ship, and keep moving them until we achieve the right result. If this works, it could also become a very useful tool in visualizing the original location of objects after the collapse of ancient buildings from fire, flood, earthquake, or abandonment.

The ongoing work of the Kyrenia ship project shows that an older excavation can be brought to new life if the original recording of the site was meticulous and thorough, as was the work of Michael Katzev and his team. The passage of time has brought new tools to our aid. Virtual reality enriches our ability to interpret the data. The two replicas of the ship have been especially helpful for recreating the capacity, travel speeds, and logistics of how the crew worked on an ancient cargo ship such as this. Sailing in light to gale-force winds, Kyrenia II, being built shell-first, proved how strong this ancient method of ship construction had been. Kyrenia II was about the same age as her ancient prototype when she retired; and interestingly enough, being so authentically built, she opened up in her bow late in life just as the ancient ship had, and for the same reasons. Furthermore, we have been able to identify correctly the ship's woods with the help of Nili Lipschitz, a scholar whose

specialization, dendroarchaeology, had not existed when the ship was first excavated. Non-intrusive sampling of a large percentage of the pottery has been accomplished, and we await results of the organic residue analyses to reveal what the amphorae, casseroles, and small cabin pottery once contained.

I have touched on the first of our experiments aimed at learning some of the practical aspects of life on board. The final excavation report, when published, will include the results of these as well as additional innovative experiments, including finding surprising uses for wooden toggles at a sailmaker's in Maine, grinding grains with Kyrenia millstones, and sinking wine-filled amphorae stoppered with corks and skins to watch the seals implode. Our understanding of the excavated material will be all the richer for it as the old ship makes her final journey towards publication.



After several experiments to determine what material might have sealed the amphorae, we found goat skin to work. Tied on wet, the goat skin shrank tight as a drum as it dried.





Computer imaging shows the two lowest layers of amphorae as they lay within the collapsed hull. Notice in this view from the bow how the ship has split apart along the keel. Over the keel on the port side some of the three rows of rectangular millstones are seen, with amphorae piled over them. Imaging such as this is a step towards visualizing how the ship fell apart after sinking. Photo by VIZIN.

## Acknowledgments

I would like to thank the following institutions that have sponsored our work: the Cyprus Department of Antiquities, Oberlin College, the University Museum of the University of Pennsylvania, the Institute of Nautical Archaeology, and the Hellenic Institute for the Preservation of Nautical Tradition. Financial supporters were: The Cook Foundation, Cyprus Mines Corporation, the National Geographic Society, the National Endowment for the Humanities, UNESCO, The Deitrich, Ford, Houghton-Carpenter and Louise Taft Semple Foundations, and untold individuals who offered generously of their time and talents. To all of these go admiration and respectful thanks from the current publication team.

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## ABOUT THE AUTHOR



Trained as a sculptor, Susan Womer Katzev was schooled at Swarthmore College, the Boston Museum School and Tyler School of Fine Arts. While working as an artist on Roman and Early Byzantine shipwrecks at Yassi Ada, Turkey for George Bass she met her future husband Michael L. Katzev.

During his directorship of the Kyrenia Ship excavation, Susan served as draftsman, photographer, and director and writer for a film documenting the project. Since Michael's death in 2001 Susan is working to bring his studies to final publication by the Texas A & M University Press.