

ΤΡΟΠΙΣ ΙΙ

TROPIS II

HELLENIC INSTITUTE
FOR THE PRESERVATION
OF NAUTICAL TRADITION



2nd INTERNATIONAL SYMPOSIUM ON SHIP CONSTRUCTION IN ANTIQUITY

proceedings

edited by Harry Tzalas

DELPHI 1987

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XLIII
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"AN ANALYSIS OF THE EXPERIMENTAL VOYAGES OF KYRENIA II"

Summary

KYRENIA II is an authentic replica of a fourth century B.C. Greek merchant ship excavated almost 20 years ago off the north coast of Cyprus. She was built as a cooperative effort in experimental archaeology by the Hellenic Institute for the Preservation of Nautical Tradition and the American Institute of Nautical Archaeology at the shipyard of Manolis Psaros in Perama, Greece, between 1982 and 1985. She, like her antique prototype, is 14 meters in length, capable of carrying upwards of 30 tons burden, and propelled by a single square sail.

In September of 1986 KYRENIA II sailed from the Piraeus to Paphos, Cyprus. The voyage, in part duplicating the route of her ancient predecessor, took place over 25 days, covered almost 600 nautical miles, and varied from becalmed to strong breeze (Beaufort 6) conditions. During that trip the ship sailed almost 70% of the time, during which she averaged 2.95 knots.

On the return voyage of 19 days in April of 1987, KYRENIA II covered almost 660 nautical miles in becalmed to whole gale (Beaufort 10) conditions. She sailed over 70% of the time, while averaging 2.85 knots.

The remains of a Greek merchant ship from the fourth century B.C. were excavated off the north coast of Cyprus almost 20 years ago. Approximately 75% of the ship's representative timbers survived to be raised, preserved, and reassembled for exhibition in the Crusader Castle at Kyrenia.

The Hellenic Institute for the Preservation of Nautical Tradition and the American Institute of Nautical Archaeology cooperated to build an authentic replica of the ancient KYRENIA SHIP. In November of 1982 work began at the shipyard of Manolis Psaros in Perama, Greece, and on June 22nd of 1985 KYRENIA II was formally launched. Like her ancient prototype she is 14 meters in length, capable of carrying upwards of 30 tons burden, and propelled by a single square sail.

On September 6th of 1986 KYRENIA II began a project in experimental archaeology, as she sailed from Greece to Cyprus. However, it must be noted that on this voyage her itinerary and arrival times at specific ports were strictly dictated.

6/IX/86

run 1: Mikrolimano to Sounion (Legrena)

	nautical miles	%	hours: minutes	%	average knots
sail	22.5	86.5	5:05	75.3	4.4
sail/oars					
oars	0.5	1.9	:30	7.4	1.0
towed	3	11.5	1:10	17.3	2.6
immobilized					
total	26	99.9	6:45	100.0	3.9

On a clear, warm day KYRENIA II manned by 8 was towed out of Mikrolimano into Phaleron Bay. With the wind from the northeast, first at 4 Beaufort but soon increasing to 5 and then 6 Beaufort, she set a course to the southeast on a broad reach, port tack. Between the mainland and Phleves Island in moderate seas of 1-2 meters and gusts up to 28 knots, the sail was brailled into what has come to be called a "bra" configuration. Making 4 to 5 knots, Captain Vassiliades sailed the ship close-hauled into the narrow channel between the mainland and Patroklos Island (Gaidhouroniso). Encountering strong adverse winds, which severed many lines, the crew rowed out of the narrows,* and KYRENIA II was towed around Patroklos to Sounion.

* I have been told that there are remains of shipwrecks off Patroklos Island.

8/IX/86

run 2: Sounion to Kythnos (Merihās)

	nautical miles	%	hours: minutes	%	average knots
sail	26	100	6:25	100	4.1
sail/oars					
oars					
towed					
immobilized					
total	26	100	6:25	100	4.1

With clear skies and mild to warm temperatures the run from Sounion to Kythnos was made totally under sail with a crew of 5. The wind was from the northeast, initially 4 Beaufort but gradually increasing to 6 Beaufort, and the course was southeast on a beam reach, port tack with the sail reefed about one half, through moderate seas of 2-3 meters. On this leg of 26 nautical miles KYRENIA II averaged slightly over 4 knots.

10/IX/86

run 3: Kythnos (Merihās) to (Phoinikas)

	nautical miles	%	hours: minutes	%	average knots
sail	1	3.0	1:45	19.1	0.6
sail/oars	3	9.1	:55	10.0	3.3
oars					
towed	29	87.9	6:30	70.9	4.5
immobilized					
total	33	100.0	9:10	100.0	3.6

Because of very light, variable winds and the necessity to meet a dictated schedule, this part of the journey was mostly under tow, hence contributing little data to the project of experimental archaeology.

12/IX/86

run 4: Syros (Phoinikas) to Naxos

	nautical miles	%	hours: minutes	%	average knots
sail	11.5	35.4	10:20	65.3	1.1
sail/oars	0.5	1.5	:10	1.1	3.0
oars					
towed	20.5	63.1	4:50	30.5	4.2
immobilized			:30	3.2	
total	32.5	100.0	15:50	100.1	2.1

In light, variable winds KYRENIA II tried to sail from Syros to Naxos. About one-third of the 33 nautical mile distance was covered under sail through a variety of situations. Her average speed under sail was just over 1 knot. However, since mostly towed during this journey, relatively little useful data was acquired.

14/IX/86

run 5: Naxos to Schinoussa

	nautical miles	%	hours: minutes	%	average knots
sail	23	83.6	8:15	82.5	2.8
sail/oars	0.5	1.8	:10	1.7	3.0
oars	1.5	5.5	:50	8.3	1.8
towed	2.5	9.1	:25	4.2	6.0
immobilized			:20	3.3	
total	27.5	100.0	10:00	100.0	2.75

Out of Naxos with a light north wind KYRENIA II sailed slowly west on a beam reach, starboard tack. Turning south, she ran at 3 knots with a 3 Beaufort north wind over her starboard quarter. Changing course to the southeast with a 3 and 4 Beaufort north wind she made 3 to 4 knots on a quarter reach, port tack, later altering course to the south-southeast. Then she turned east on a beam reach, port tack, under similar conditions.

Just before sunset the wind shifted to the east and became very light. KYRENIA II changed course to the north on a beam reach, starboard tack. At dusk, becalmed, she was towed into Schinoussa for an unscheduled overnight stop.

15-16/IX/86

run 6: Schinoussa to Kos (Kephalos)

	nautical miles	%	hours: minutes	%	average knots
sail	50	51.5	11:35	46.5	4.3
sail/oars	1	1.0	:30	2.0	2.0
oars					
towed	46	47.4	10:10	40.8	4.5
immobilized			2:40	10.7	
total	97	99.9	24:55	100.0	3.9

In the morning with a north wind gradually rising from 3 to 6 Beaufort KYRENIA II sailed eastward on a beam reach, port tack, attaining speeds of 5 to 6 knots. Around midday the wind fell to very light, but in the afternoon it rose again from the north-northwest to 5 Beaufort, and the ship continued her same course. After sunset, however, she was becalmed and taken in tow, through the night, to complete the second half of the voyage to Kos.

18/IX/86

run 7: Kos (Kephalos) to Nisyros (Mandraki)

	nautical miles	%	hours: minutes	%	average knots
sail	13	100	4:00	94.1	3.25
sail/oars					
oars					
towed					
immobilized			:15	5.9	
total	13	100	4:15	100.0	3.1

Manned by a crew of only four, KYRENIA II sailed the entire distance from Kos to Nisyros, 13 nautical miles. With a north wind of 2 to 3 Beaufort, on a broad to quarter reach, port tack, she averaged a little over 3 knots. This day perhaps more than any other in the voyages of KYRENIA II duplicated a day made during the last voyage of the ancient KYRENIA SHIP.

19/IX/86

run 8: Nisyros (Mandraki) to Rhodes (Mandraki)

	nautical miles	%	hours: minutes	%	average knots
sail	57	98.3	12:20	94.9	4.6
sail/oars					
oars					
towed	1	1.7	:20	2.6	3.0
immobilized			:20	2.6	
total	58	100.0	13:00	100.1	4.5

In virtually ideal conditions for KYRENIA II the passage from Nisyros to Rhodos was made almost entirely under sail. With a west wind initially 2 Beaufort, gradually increasing to 5 Beaufort, she ran with the wind until mid-afternoon, when it shifted to the southwest, and she sailed on a quarter to broad reach, starboard tack. Gradually the wind diminished, until around sunset it died completely. During this passage KYRENIA II sailed 57 nautical miles at an average speed of 4.6 knots.

25-26/IX/86

run 9: Rhodos (Mandraki) to Ro

	nautical miles	%	hours: minutes	%	average knots
sail	25.5	31.1	12:10	50.7	2.1
sail/oars					
oars	1	1.2	:20	1.4	3.0
towed	55.5	67.7	11:30	47.9	4.8
immobilized					
total	82	100.0	24:00	100.0	3.4

Out of Rhodos with a gentle breeze from the southeast at 3 Beaufort KYRENIA II sailed north-east on a beam reach, starboard tack. As the wind dropped to light during the late afternoon KYRENIA II tried to sail more easterly on a close-hauled, starboard tack. Taken in tow through the night, about two-thirds of the trip were completed. And the next morning she was rowed to the deserted island of Ro for a ceremonious stop.

26/IX/86

run 10: Ro to Kastellorizo

	nautical miles	%	hours: minutes	%	average knots
sail	7	82.4	3:35	84.3	2.0
sail/oars	0.5	5.9	:15	5.9	2.0
oars	0.5	5.9	:15	5.9	2.0
towed	0.5	5.9	:10	3.9	3.0
immobilized					
total	8.5	100.1	4:15	100.0	2.0

With a light to gentle breeze from the west-northwest the short distance between Ro and Kastellorizo was covered on a quarter reach, port tack.

27-30/IX/86

run 11: Kastellorizo to Paphos (Maa)

	nautical miles	%	hours: minutes	%	average knots
sail	178	92.7	65:10	91.1	2.7
sail/oars	4.5	2.3	3:30	4.9	1.3
oars	0.5	0.3	:15	0.3	2.0
towed	9	4.6	1:30	2.1	6.0
immobilized			1:05	1.5	
total	192	99.9	71:30	99.9	2.7

KYRENIA II made the passage from Kastellorizo to Paphos, holding a fairly steady course, in four days with a crew of five.

Out of Kastellorizo she found light wind from the northwest but made headway on a quarter reach, starboard tack, and with the assistance of oars. After noon the wind veered to the southwest and then slowly shifted to the west, gradually increasing to 5 Beaufort before sunset, and KYRENIA II sailed from a broad to quarter reach, starboard tack. During the evening the wind dropped to 3 Beaufort from the northwest, and she ran with it over her starboard quarter.

These conditions continued during the early morning of the second day. However, after sunrise the wind veered to the south-southwest, dropping to 2 Beaufort, and KYRENIA II sailed on a beam reach, starboard tack. With the wind increasing to 4 Beaufort, she maintained the same course through the afternoon and evening.

In the early morning of the third day she was becalmed. After sunrise the wind rose from the north-northwest gradually increasing to 3 Beaufort, and KYRENIA II progressively changed course to sail on a beam, broad, and quarter reach, port tack. Around noon the wind became very light and variable, and she was rowed. During the mid-afternoon with a west-northwest wind KYRENIA II ran with it over her starboard quarter. After sunset the wind slowly increased from 2 to 4 Beaufort coming from the northwest, and the ship changed course slightly to sail through the night on a quarter reach, port tack.

KYRENIA II's situation remained the same, until at dawn on the fourth day she was taken in tow to Maa.

Summary of voyage of KYRENIA II

Piraeus to Paphos September 1986

	nautical miles	%	hours: minutes	%	average knots
sail	414.5	69.6	140:40	74.0	2.95
sail/oars	10	1.7	5:30	2.9	1.8
oars	4	0.7	2:10	1.1	1.8
towed	167	28.0	36:35	19.2	4.6
immobilized			5:10	2.7	
total	595.5	100.0	190:05	99.9	3.1

Notes:

25 days in transit between Mikrolimano and Maa (6/IX/86 - 30/IX/86)

15 days — part or all — of actually sailing (60%)

September 6, 8, 10, 12, 14, 15-16, 18, 19, 25-26, 27-30

10 days in port (40%)

September 7, 9, 11, 13, 17, 20-24

number of crew on each run: 8, 5+, 6, 5+, 6, 6, 4+, 5, 5+, 6+, 5+

(+ plus observer on 6 of 11 runs)

averaging 5.5 (not including observer)

note: crew of 4 only on Kos - Nisyros run.

instruments: 2 VHF, 1 anemometer, and 1 log — always

compass on last 3 runs

7.8 or 8.5 tons of ballast (gravel), plus 2 tons of supplies and crew

(food and belongings) according to Tzalas; let's say ladened about 10 tons burden

ballast reportedly put "in front part of ship"

Through 25 days in September, 1986, KYRENIA II traveled almost 600 miles from Greece to Cyprus. Sailing 70% of this distance during all or part of 15 days, she averaged almost 2.95 knots under sail.

The return voyage from Cyprus to Greece was made during April of 1987, KYRENIA II had no set schedule for this trip, and her course was dictated only by the wind and sea. As a means of introduction may I cite the advice of a Boeotian landlubber:

There is one other sailing season for men, in spring time.

At that point, when you first make out on the topmost branches

of the fig tree, a leaf as big as the print that a crow makes

when he walks; at that time also the sea is navigable and this is called the spring sailing season.

I for my part

do not like it. There is nothing about it that I find pleasant.

It's snatched. You will find it hard to escape coming to grief. Yet still and even so, men in their short-sightedness do undertake it.

* Hesiod. *The Works and Days*, translated by Richmond Lattimore, lines 678-685.

8-12/IX/87

run 1: Paphos to Rhodes (Mandraki)

	nautical miles	%	hours: minutes	%	average knots
sail	281	93.7	94:00	95.9	3.0
sail/oars					
oars	1	0.3	1:00	1.0	1.0
towed	18	6.0	3:00	3.1	6.0
immobilized					
total	300	100.0	98:00	100.0	3.1

Manned by a crew of five on a warm, clear Spring day, KYRENIA II ran out of Paphos to calm, smooth seas with a light breeze variable but for the most part from the northwest. After clearing the port, she changed course on a beam reach, starboard tack, and later sailed close-hauled through the night.

During the second day she continued to sail close-hauled, starboard tack, with the wind gradually shifting to the west-northwest, rising to 3 Beaufort, through slightly choppy seas. I began to wonder whether Captain Glafkos Cariolou, like Odysseus, was planning a visit to the land of the Lotophagi. But after sunset, he changed tack, wearing the ship around to the north-east and sailing through the night close-hauled, port tack.

The next day she found light, variable winds mostly southwesterly, and she tried to sail on a broad to beam reach. But becalmed much of the day, she made little progress.

As dull as the third day was, the fourth was exciting. Encountering a storm with 8 Beaufort easterly gale winds and gusts of over 50 knots, KYRENIA II sailed through high seas spread with spindrift on a quarter to broad reach, starboard tack. For the first time she sailed through rain. Although heeling considerably, no water came in over her sides, and the hull remained relatively dry. Furthermore, some 35 amphoras, alas empty of wine, moldmade by Sophocles Mourides of Nicosia and representing about one-tenth of the ancient ship's cargo of Rhodian amphoras, ladened atop sacks of gravel, did not move at all.

Around noon with winds over 25 knots KYRENIA II reached speeds of at least 12 knots while sailing "downhill". Thereafter Captain Cariolou lowered the yard about 1.5 meters to lower the sail's center of gravity and reduce her heeling and speed. Shortly before the peak of the storm, he partially brailed the sail. In the afternoon and through the night it was decided to alter KYRENIA II's destination from Mandraki to Lindos, then to the south of Rhodes, and finally back to Mandraki. During the 24 hours of April 11, 1987, KYRENIA II sailed 138 nautical miles, making an average speed of 5.75 knots.

In the morning of the fifth day out of Paphos she was taken in tow for the last 18 nautical miles to Rhodes, and the crew then rowed her into the port of Mandraki.

While in Mandraki a minor leak through the lower seam of the aft Z-scarf of the main wale, port side, was dammed. Cutting partially through the shelf clamp to gain access to the area, oakum was inserted into the seam, grease was spread over the area, a leather patch tacked into place, and finally a small sheet of lead applied here, held by copper tacks. The shelf clamp was then braced by several short pieces of timber.

Provisions on board KYRENIA II for the Captain Glafkos Cariolou and crew of Costas Agathangelou, Stamatis Chrisaphitis, Nikos Mertiris, and George Pafitis were water, milk, wine, brandy (zivania), olives, olive oil, honey, salt, oregano, garlic, onions, lemons, oranges, bananas, raisins, dried figs, almonds, peanuts, hardtack (paximadia), goat cheese (haloumi), lentils, white beans, sardines, tuna, salami, and smoked pork (hiromeri). Food was not cooked aboard but ashore, where the crew ate it hot on primitive pottery with wood spoons. By the way, the Captain made a delicious lentil and onion stew. Leftovers were eaten on board simply warmed by the sun.

14-16/IV/87

run 2: Rhodes (Mandraki) to Astipalaia (Skala)

	nautical miles	%	hours: minutes	%	average knots
sail	126.6	80.1	44:23	87.9	2.85
sail/oars	0.5	0.3	:30	1.0	1.0
oars					
towed	31.0	19.6	5:37	11.1	5.5
immobilized					
total	158.1	100.0	50:30	100.0	3.1

Out of Mandraki under partly cloudy skies KYRENIA II encountered a 3 Beaufort breeze from the east-southeast and ran with it over her port quarter. After noon occasional light rain fell, and the wind gradually dropped; KYRENIA II became becalmed, and three of the crew briefly rowed her with the sail partially brailled, trying to catch wind. Later with clearing skies and cooler temperatures a variable light wind rose primarily north-northwesterly, and she sailed close-hauled, starboard tack, through the night.

The next day under gray skies KYRENIA II found a light breeze from the northeast and sailed on a broad reach, starboard tack. Captain Cariolou altered course slightly to sail past the east side of Nisyros. Through midday rain fell, becoming heavy with frequent lightning. Passing between the small islands of Strongyli and Yiali, she changed course to clear Kos. Late in the afternoon the rain ceased, the temperature dropped to a cold 8°C., and the wind increased to 3 and 4 Beaufort, gradually shifting to the north. Before sunset KYRENIA II set a close-hauled, starboard tack. Through the night a strong storm developed, reaching 8 Beaufort after midnight with gusts well over 40 knots. During a three hour period around midnight KYRENIA II averaged over 7 knots on a close-hauled tack and frequently made speeds of 10 to 12 knots. However, during the 24 hours of April 15, 1987, she sailed only a total of 78 nautical miles, making an average speed of 3.25 knots.

After midnight the tiller of her port quarter rudder broke. She altered course to the southwest to ride out the storm in the lee of Amorgos. A little before sunrise, while brailing the wet heavy sail, three-quarters of the lead guide rings became detached from the sail. As the storm was increasing in intensity with winds gusting to 50 knots, it was decided to take KYRENIA II under tow to Astipalaia.

While in Astipalaia the tiller and its quarter rudder were repaired by the shipwright Konstantinos Nikolakis, free of charge. The crew resewed the lead guide rings to the sail and mended other frayed lines. It is worth noting that the lead patch applied at Rhodes had proved effective in stopping the leak there. And we all enjoyed the hospitality of the mayor of Astipalaia and his wife on Easter Sunday.

20-21/IV/87

run 3: Astipalaia (Skala) to Syros (Ermoupolis)

	nautical miles	%	hours: minutes	%	average knots
sail	66.7	57.7	27:53	71.3	2.4
sail/oars					
oars	1.3	1.1	1:55	4.9	0.7
towed	47.5	41.1	8:39	22.1	5.5
immobilized			:38	1.6	
total	115.5	99.9	39:05	99.9	3.0

Rowed out of Astipalaia by a crew of only four, KYRENIA II found no wind and was taken in tow to northeast of Amorgos. There with light south winds she sailed through much of the afternoon on a broad reach, port tack. Later in the afternoon the wind shifted to the southwest. During a two hour period around sunset KYRENIA II sailed 50 to 60° off the eye of a 2 Beaufort wind, close-hauled, port tack, making over 2 knots speed — evidence of her ability to sail effectively into the wind.

After midnight she altered course and continued westward with very light wind. On a cool, lovely Spring morning, she was virtually becalmed. However, just before noon the wind picked up to 4 and 5 Beaufort from the south-southwest, and KYRENIA II sailed north of Naxos on a beam reach for the most part, port tack. Shortly after noon the loom of the port quarter rudder broke at its juncture to the blade. While under sail it was replaced by a spare quarter rudder, the task being completed within two hours. Later in the afternoon with the force of the wind increasing, the sail was brailed into its distinct configuration. Subsequently Captain Cariolou requested that KYRENIA II be taken in tow to the north of Syros, but finding strong winds there it was decided to take refuge in Ermoupolis.

There the quarter rudder was repaired, and they were reinforced and remounted so that their blades were parallel to the ship's centerline. Meanwhile, the crew waited for calmer weather before continuing the journey.

25-26/IV/87

run 4: Syros (Ermoupolis) to Zea

	nautical miles	%	hours: minutes	%	average knots
sail	8	9.5	3:14	20.8	2.5
sail/oars					
oars					
towed	76	90.5	12:04	77.8	6.3
immobilized			:12	1.3	
total	84	100.0	15:30	99.9	5.4

Towed out of Ermoupolis to the north tip of Syros, KYRENIA II initially found a 4 Beaufort north-northeast wind and sailed on a beam reach, starboard tack. However, the wind dropped, leaving KYRENIA II becalmed, and off Giaros she was taken in tow to Zea where she arrived early the next morning.

Sleeping on board KYRENIA II while she was at sea was relatively comfortable. In the cuddy beneath the foredeck there was adequate space for two of the crew. Here it was dry, and one was sheltered from the cool, damp, night air.

Summary of voyage of KYRENIA II

Paphos to Piraeus April 1987

	nautical miles	%	hours: minutes	%	average knots
sail	482.3	73.3	169:30	83.5	2.85
sail/oars	0.5	0.1	:30	0.2	1.0
oars	2.3	0.3	2:55	1.4	0.8
towed	172.5	26.2	29:20	14.4	5.9
immobilized			:50	0.4	
total	657.6	99.9	203.05	99.9	3.2

Notes:

19 days in transit between Paphos and Zea (8/IV/87 - 26/IV/87)

12 days — part or all of actually sailing (63%)

April 8-12, 14-16, 20-21, 25-26

7 days in port (37%)

April 13, 17-19 (Easter), 22-24

number of crew on each run: 5, 5; 4+, 5+

(+ plus observer on 2 of 4 runs)

averaging 4.75 (not including observer)

note: crew of 4 only on Astipalaia - Syros run

instruments: VHF, anemometer, log, compass

laden approximately 7 tons burden

Through 19 days in April, 1987, KYRENIA II traveled almost 660 miles from Cyprus to Greece. Sailing over 70% of this distance during all or part of 12 days, she averaged almost 2.85 knots under sail.

During her two voyages through a great variety of conditions KYRENIA II has proven her seaworthiness, speed under sail, and remarkable ability to sail into the wind. However, she was laden with only about one-third of her potential burden. I hope still at a future meeting to report her performance when loaded to capacity while sailing through the eastern Mediterranean.

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