BETWEEN CONTINENTS

Proceedings of the Twelfth Symposium on Boat and Ship Archaeology

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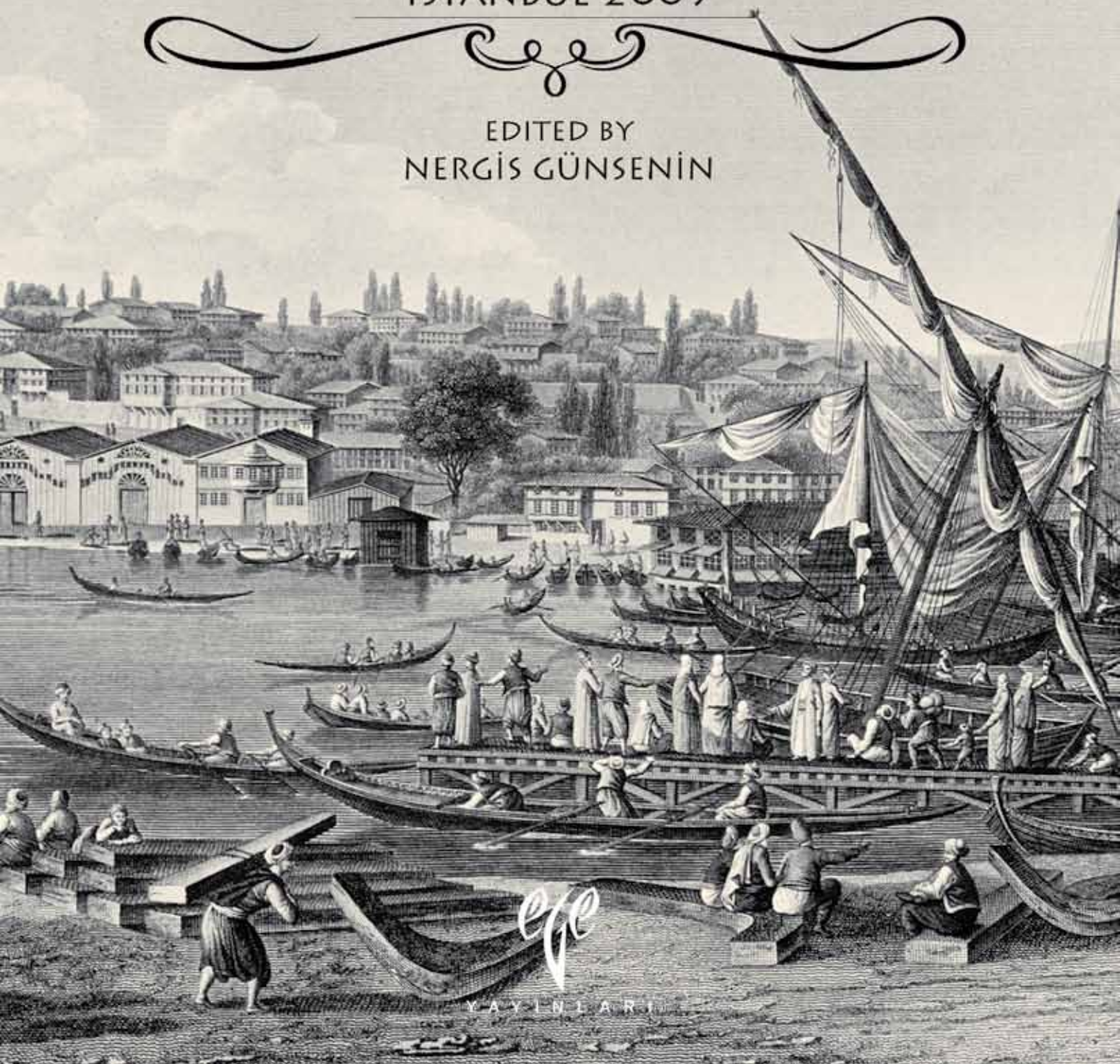
Edited by
Nergis Günsenin



YAYINLARI

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ISBSA 12

Sponsored and Hosted by the
Istanbul Research Institute of the Suna and İnan Kıraç Foundation

Under the auspices of the Underwater Technology Program at Istanbul University's
Vocational School of Technical Sciences in partnership with
the Faculty of Letters, Department of Restoration and Conservation of Artefacts

OFFPRINT

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To the memory of

Ole Crumlin-Pedersen (1935-2011)
and
Claude Duthuit (1931-2011)

Crumlin-Pedersen founder of the Viking Ship Museum at Roskilde heralded a whole new area of archaeological fieldwork and remained a seminal and inspirational figure in nautical archaeology. Duthuit not only acted as director of the Institute of Nautical Archaeology (INA), but made lifelong contributions to the field. It is thanks to his dedication and his passion that several excavation efforts, including those at Cape Gelidonya, have come to life.

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Preface

The island of Tatihou in France was the site of the first ISBSA meeting I attended in 1994. Encircled by seminal figures in our field, it was the most inspiring event of my academic career. At the time, it became clear that the attendees were eager to hold one of their future meetings in Turkey. Their wish was the driving force that finally led me to this special day.

Positioned between two continents, Istanbul was the perfect place to hold the Symposium. Throughout history, the exchange of goods and cultures between east and west, as well as north and south, was realized in the waters off the Anatolian coast, with the Black Sea to the north, the Sea of Marmara to the northwest, the Aegean Sea to the west, and the Mediterranean Sea to the south. Given the vast area of interest, we invited participants to focus on the four seas and address their pivotal role not only for Turkey but also for the rest of the world.

The Turkish coastline had already been the site of pioneering underwater excavations since the 1960s. Indeed, nautical archaeology was initiated in Turkey under G. F. Bass and further developed under the auspices of the Institute of Nautical Archaeology (INA). Today, the development of nautical archaeology and boat and ship archaeology on an international level far surpasses the initially limited field of underwater archaeology. Moreover, the discovery of the harbour of Theodosius, one of the most outstanding archaeological events of our era, has further enriched our field and added yet another dimension to our symposium.

The excavations in the harbour are still ongoing. Thirty-six shipwrecks dating from the 5th to the 11th centuries have been excavated. Their study will make an enormous contribution to our understanding of ship construction and the transition from shell-first to skeleton-first techniques. It will also allow us to re-examine Byzantine trade and the economy of the period. Furthermore, the remains revealing settlements dating back to 6500 BC, will shed new light on our understanding of the history of the ancient peninsula.

Fig. 1. Group photograph of the participants of ISBSA 12 (Photo: Engin Şengenç).

Fig. 2. Group photograph of the participants of the Amasra excursion.

The ISBSA 12 was held under the auspices of the Underwater Technology Program at Istanbul University's Vocational School of Technical Sciences in partnership with the Faculty of Letters, Department of Restoration and Conservation of Artefacts. It was sponsored and hosted by the Istanbul Research Institute of the Suna and İnan Kıraç Foundation and was held at the Foundation's Pera Museum on 12-16 October, 2009.

More than 200 participants from 24 countries attended the Symposium where 50 papers, 25 posters, and various films were presented (**Fig. 1**). This also allowed numerous young scholars to present their work and contribute to ongoing debates in our field and even launch new areas of research based on recent discoveries. The papers for the symposium were selected by the ISBSA committee from among a multitude of excellent proposals. The mission of the ISBSA is focused on ship construction. While related subjects are welcome, the main thrust has traditionally been a discussion of the ship itself.

It is our hope that the conference theme which has helped bring together numerous scholars from around the world, will also bring together the two sub-fields of archaeology which have until recently remained separate. It is believed that a genuine thematic and methodological dialogue between land and underwater archaeology can only enrich the field and uncover the mysteries of past civilizations. "Between Continents" will thus re-map our field and reset its intellectual boundaries.

Following the Symposium, an excursion to Amasra on 16-18 October offered the opportunity to visit workshops that still continue the traditional art of shipbuilding in *Tekkeönü* and *Kurucaşile* in the Black Sea Region. Participants learned methods of ship construction directly from the local shipbuilders. The Shipbuilding Program at the *Kurucaşile* Technical High School, the Amasra Castle, and the Amasra Archaeological Museum were among the local sites included in the itinerary (**Fig. 2**). Hüseyin Çoban was pivotal to the success of this excursion; his hospitality and his immense knowledge of traditional shipbuilding enriched our trip.

Like many other scholars in our field, I owe my presence here today to George Bass who not only accepted our invitation to attend the symposium but also graciously delivered the keynote address. Frederick van Doorninck, Jr., the late Claude Duthuit, Don Frey and Robin Piercy from the Institute of Nautical Archaeology further enriched

this symposium with their presence. It was a genuine honour to have them in our midst. As in all scholarly disciplines the master - apprentice relationship is central to our field. This was made amply clear during the course of this symposium.

However, our field is based not only on scholarly research. The constant interaction between nature and humans is an inextricable part of it: sailing on a fickle sea, working in the hostile underwater environment, and living in often difficult conditions are among the challenges that make our field so special.

May God save sailors and nautical archaeologists for future research and many more symposia!

Acknowledgments

I would like to express my sincere thanks to Suna, İnan and İpek Kıraç, founders of the Suna and İnan Kıraç Foundation, and Özalp Birol, General Director of the Suna and İnan Kıraç Foundation Culture and Art Enterprises; they made it possible for us to hold the meeting at the Pera Museum. The hospitality of the museum staff was also central to the success of this meeting.

My thanks also go to Gülru Tanman of the Istanbul Research Institute whose help and friendship made it easier to navigate through a complexity of organisational issues. Erkan Bora, also of the Istanbul Research Institute, deserves special thanks for his assistance, not only during the Symposium, but also during the excursion to Amasra. Else Snitker welcomed everyone with her endless energyand friendly, familiar countenance.

I want to express my gratitude to Zeynep Kızıltan, directress of the Istanbul Archaeological Museums, who made it possible for us to visit the Yenikapı excavation site.

Commandant Ali Rıza İşipek generously opened storerooms of the Istanbul Naval Museum, which is presently under construction. Thanks to him, participants had the opportunity to see the sultans' *kayıks* and the famous *kadırga*.

The *Setur* Travel Company team contributed to a remarkable organisation.

My heartfelt thanks also go to Carlo Beltrame, Ronald Bockius, Anton Englert, and Fred Hocker, who shared their invaluable experience as previous ISBSA organisers.

I would also like to acknowledge Ayşın Akyor for providing much needed editorial help with the English text.

Finally, my sincere thanks go to Rezan Benatar for her valuable intellectual and editorial contributions. She not only helped create a seamless text but also attempted to make rather complex material intelligible to the reader.

The success of a symposium is always determined by the contributions of its participants. I would like to sincerely thank each and every one of them for an intellectually stimulating exchange.

This volume is published by Ege Yayınları which has a long-standing commitment to archaeological research. I would like to thank its owner Ahmet Boratav for his interest in our work. My thanks also go to Hülya Tokmak for her patience with the layout of the manuscript.

3. Middle Bronze Age Boat of Mitrou, Central Greece

Aleydis Van de Moortel

Find Context and Excavation

In August 2007, the disintegrated remains of a small wooden boat were partially exposed in a 4.5 x 4.5 m trench (LE792) at the prehistoric site of Mitrou, a small coastal islet located on the southern shore of the North Euboean Gulf, in the central Greek region of East Lokris[1] (Figs 3.1-3). In the Bronze Age, the site was not an islet, but it was situated on a headland overlooking the sea. The vessel was oriented roughly north, northwest to south, southeast, and situated at +3.09 to +3.36, at a depth of about 2 to 2.30 m below the modern surface (Fig. 3.4). Since this is only the fourth boat with substantial hull remains discovered in the prehistoric Aegean, and the only local boat dating to the Bronze Age, it is a very important find for our understanding of early Aegean boatbuilding. Only the lower part of the hull is preserved, appearing as a black stain in the moist clayey earth. Macroscopic examination of the boat stain did not reveal any surviving wood. Before the bottom of the boat was uncovered and identified, a few faint black streaks had been encountered 15 cm higher, at c +3.25. In hindsight, these are likely to have been disintegrated parts of the hull or its contents.

Fig. 3.1. Central Greece with the location of Mitrou (B. Lis & T. Ross).

Fig. 3.2.
North scarp of trench LE792 with section of the boat, immediately after excavation (Photo: S. Vitale).

Fig. 3.3.
Impression of the excavated part of the Mitrou boat, three weeks after excavation (Balloon photo: K. Xenikakis).

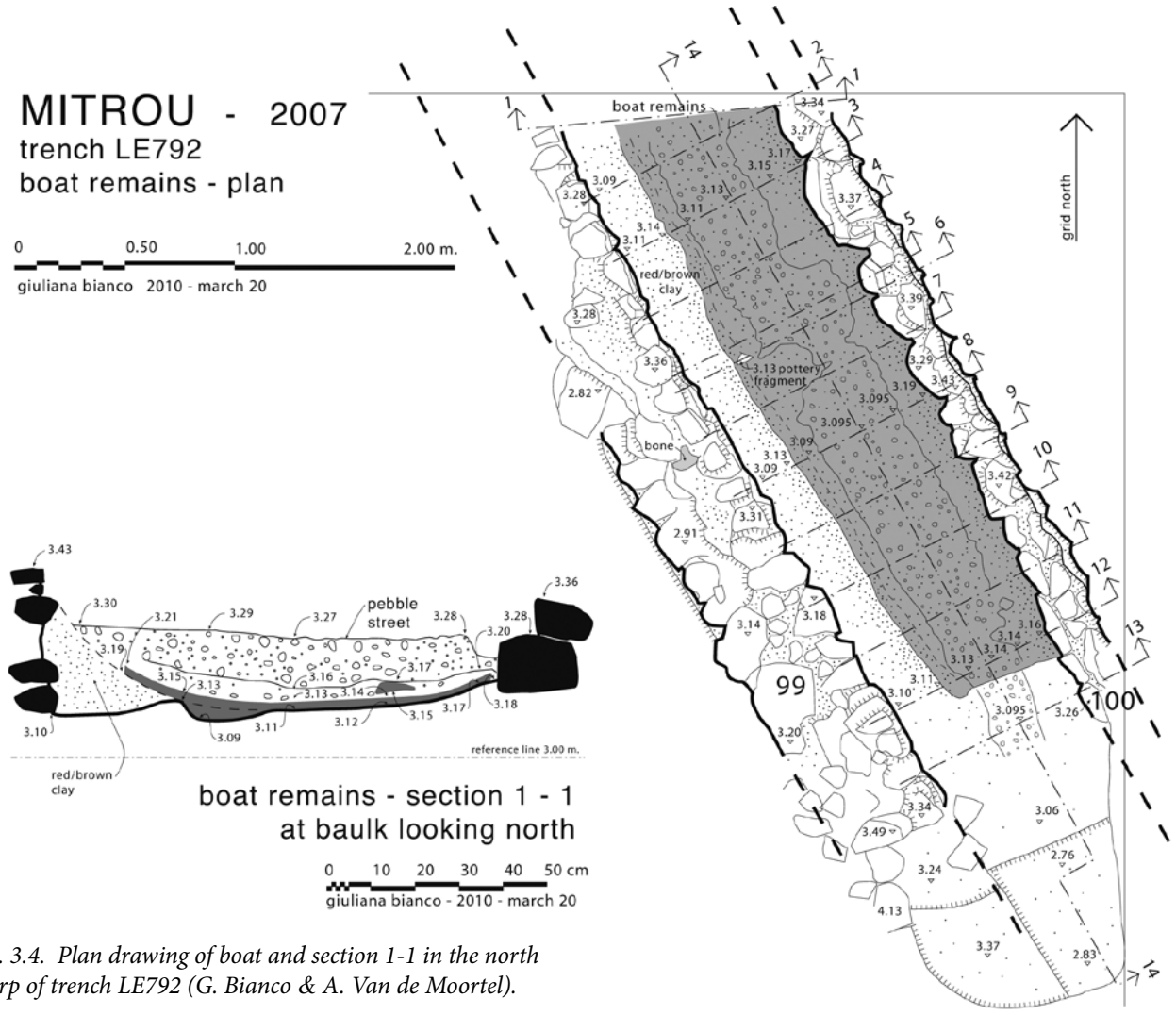

Fig. 3.4. Plan drawing of boat and section 1-1 in the north scarp of trench LE792 (G. Bianco & A. Van de Moortel).

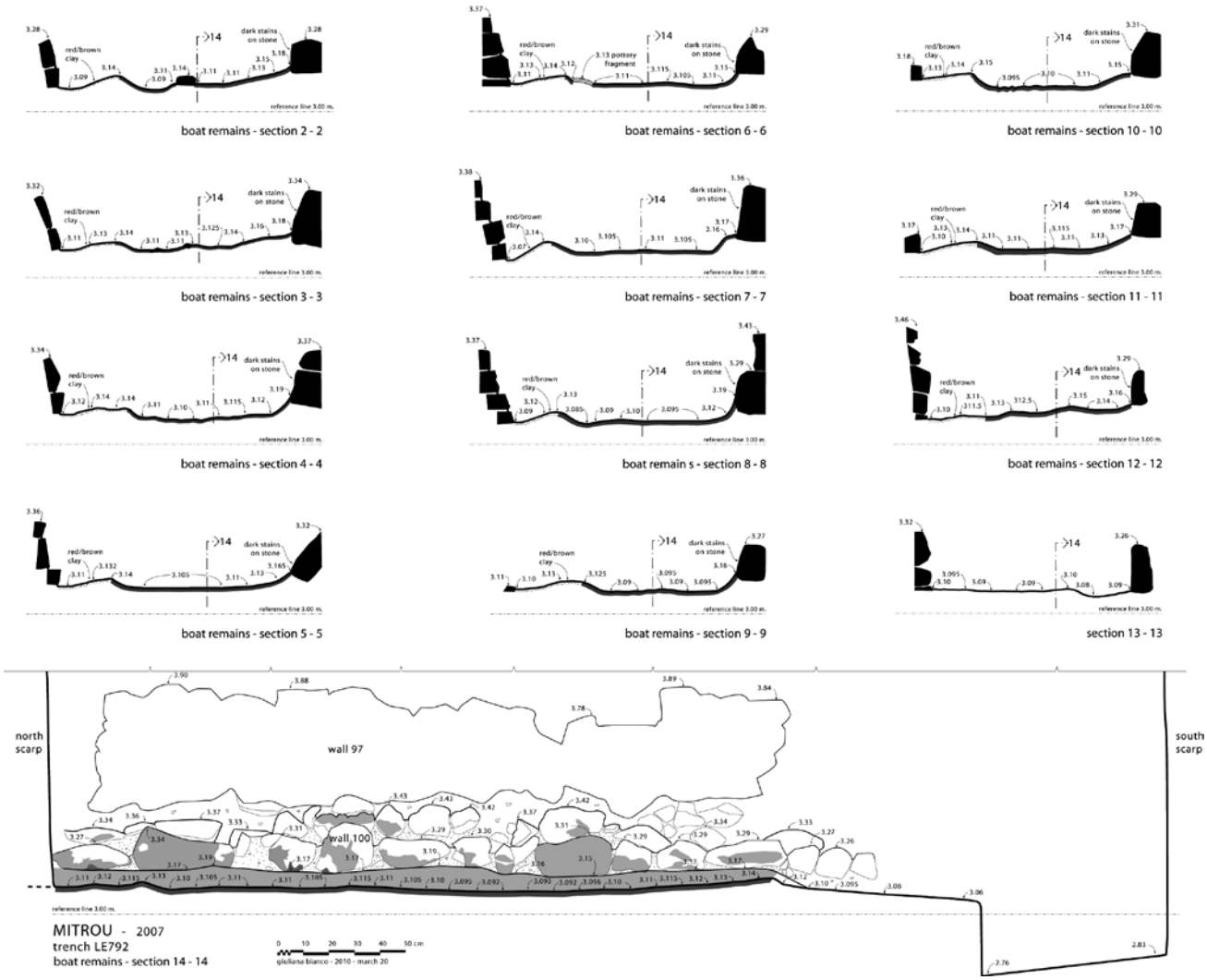

Fig. 3.5. Cross sections and longitudinal section of Mitrou boat (G. Bianco).

At the time of its identification, the bottom of the boat had already been exposed and its top surface had been leveled by the excavators. Since nothing could be learned from the top surface, we decided to excavate the bottom and record the shape of its imprint in the earth. Five large samples were taken of the black earth across the width of the boat stain, about 1 m from its southern extremity, and two more samples were taken further north for purposes of wood identification and ^{14}C dating. To judge by the shape of the bottom's imprint, we uncovered about half the length of the hull; the rest lies untouched in the unexcavated area north of trench LE792, awaiting future excavation. The north scarp of the trench shows a section of the midship area at a 110 degrees angle to the longitudinal axis of the boat (Fig. 3.4). Three more samples were taken from this section: one from the hull itself; one from a presumable bilge keel projecting below its west side; and one from a plank-like element lying within the hull (see below).

Upon excavation we found that the boat had been resting on an 80 to 90 cm wide rough gravel road or alleyway within the prehistoric settlement. This road had been flanked by buildings on either side. Walls 99 on the west and 100 on the east once must have had a mudbrick superstructure, but now only their fieldstone socles survive *in situ*. The mudbrick apparently had melted and washed down after the very bottom of the boat had flattened, but before it decomposed, because it preserved the curvature of the hull at this location, as can be seen in the trench scarp (Fig. 3.2). Because of this lucky preservation, we are able to trace the curvature of the west side of the hull in the scarp beyond the surviving edge of the black stain to a height of +3.36. Further south, however, the upper part of the red clayey strip did not clearly mark the shape of the hull, and it was only schematically recorded before being dug away.

It is clear from the cross sections and longitudinal section that the bottom of the boat had flattened

considerably before decomposing (Figs 3.4-5). On the east side, the hull now ends against the lowest excavated part of wall 100. Black stains of decomposed wood on that wall revealed, however, that the hull had once rested against it; these stains faded considerably after exposure to the sun. Pieces of gravel and an occasional pottery fragment projecting within the road likewise indicate that the hull had sagged (see below).

Date

No ^{14}C dating has yet been done, but the boat's stratigraphic position and associated pottery show that it had been deposited early in the Middle Helladic II phase (early 19th century BC) -the second ceramic phase of the Middle Bronze Age on the Greek mainland. A few dozen pottery fragments found within the black earth of the boat stain (unit LE792-094) were datable to the Middle Helladic I and Middle Helladic II Early phases. For an as yet unknown reason these fragments are marked by dark jagged thin lines on their surfaces[2]. The gravel road below the boat and the bottom part of the red clayey strip to the west were not excavated because we wanted to preserve the shape of the hull's imprint. South of the boat, we dug a 60 x 70 cm sounding through the gravel road and obtained a *terminus ad* or *post quem* of Middle Helladic II Early for the road's construction (unit LE792-097; Fig. 3.5, section 14-14). This pottery was extremely worn and not marked by dark lines.

Still in the Middle Helladic II Early phase, the boat had been covered by two subsequent roads, the older one consisting of a layer of earth and pebbles (top elevation +3.17/3.25; units LE792-088 and LE792-096) and the younger one of a c 10 cm thick layer of earth and cobbles (top elevation +3.25/3.35; stratigraphic units LE792-084 and LE792-095). The pottery of these Middle Helladic II Early roads was likewise very heavily worn and devoid of dark lines. The strip of red clayey sediment to the west was excavated together with the Middle Helladic II Early roads, so that we were not able to obtain a separate date for it. One may assume, because of the good preservation of the boat stain, that the hull had been covered fairly soon after its abandonment. Thus it is safe to conclude that the boat had been deposited early in the 19th century BC, and that it must have been built c 1900 BC.

Description of the Hull and Associated Finds

From the preserved remains it is clear that the Mitrou boat had an elongated, lanceolate shape. The exposed part in its current condition is 3 m long, 90 cm wide, and 25 cm high. The total hull length is estimated to be 5.5 to 6 m. Since the boat originally rested against both courses of wall 100 to the east, its original width must have been at least 1 m. The southern hull extremity is blunt and 48 cm wide in its flattened condition; its original width is likely to have been less. The hull section in the north scarp of the trench shows a fluid curvature flattened amidships, but its width is exaggerated because of its position at a 110 degrees angle to the longitudinal axis of the boat (Fig. 3.4). The hull thickness in the scarp is consistently 2 cm, which is unusually thin for a Mediterranean boat. Of all ancient Mediterranean vessels reported in the literature, only the c 11 m long Roman coastal vessel from Herculaneum, covered by Mt. Vesuvius' eruption in AD 79, has such extremely thin planking (Steffy 1994: 67-71). Even though the bottom of the Mitrou boat was flattened and irregular over most of its length, its southern extremity displays a gentle rise of 6 cm to a height of +3.15 over a distance of 85 cm. This rise was preserved because it was resting on a small accumulation of pebbles.

No keel has been identified. The hull section in the scarp shows on the exterior a thin timber with rounded section, 18 cm wide and 3 cm thick, located about 10 cm to the west of the estimated centreline of the boat. It seems to be attached to the hull by an unidentified organic fastener. Its section is asymmetrical, with a thicker western half. This timber's imprint continues further south along the edge of the strip of red clayey earth, curving in plan view from the northwest to the southeast. Because of its asymmetrical cross section and horizontal curvature, it cannot have been the keel of the boat. Being thicker than the hull, it appears to be a thin bilge keel, protecting and reinforcing the hull's bottom. A similar timber may have been located on the east side of the hull. Its imprint is perhaps seen in sections 4-4, and 6-6 to 11-11, curving inwards in plan view (Fig. 3.5). If this was indeed a second bilge keel, it was more poorly preserved than the first.

No frames or other internal reinforcements of the hull were identified during excavation, and none are visible in the hull section in the trench scarp. It is possible that these will be found whenever the northern half of the boat is excavated. Inside the hull, just east

of the putative centreline, a flat wooden object with rounded section, 10 cm wide and about 3 cm thick, is visible in the trench scarp; it likewise is asymmetrical in section, its western half thicker than in its eastern half. This object may be a plank of the upper part of the hull, but given its feeble width and the shape of its section it is more likely to be a paddle or oar. A similar object found in a medieval boat stain at Snape, England (c AD 600) has been interpreted as a possible paddle (Filmer-Sankey, Pestell & Marsden 1995: 85, figs 3-4). No other evidence was found for the mode of propulsion of the Mitrou boat. The earth in the scarp just above the hull is dark grey and it is slightly lighter in colour and looser in texture than the dense black hull stain. Its dark hue suggests that organic material was lying inside the boat. When this is excavated in the future it may provide further clues to its propulsion or use.

Hull Construction: An Expanded Logboat?

Even though the hull of the Mitrou boat was flattened, its shell remained coherent, displaying a continuous line of constant thickness with a smooth curvature at its western end. It is conceivable that this boat had been built with wooden planks of equal thickness, since straight-sided planks have been attested in house architecture in northern Greece since the Early Neolithic (Marangou 2003: 14; Hourmouziades 1971: 174, fig. 13; Ridley & Wardle 1979: 195). Boats have different requirements from buildings on land, however, and the earliest wooden craft in many cultures were made by carving wood into shape and not by assembling hulls with planks (Crumlin-Pedersen 2009: 395; 2010: 42-60). Indeed, the earliest boat models and boat remains from the Aegean, found in Middle/Late to Final Neolithic contexts in northern Greece, represent logboats (Marangou 2003).

If the Mitrou boat had been made with planks, these would have been remarkably thin for this period. All other Bronze Age boats from the Mediterranean region with known plank thicknesses -the 15 m long seagoing vessel of Uluburun, probably of Levantine origin, and Egyptian river craft of various sizes had much thicker planking (Pulak 1999: 210, 218, fig. 2; Ward 2000). Thin hull planking (c 2.5 cm) first appears in the first millennium BC, starting with the 7th -century Punic vessels of Mazarron (Neguerela 1995; Fitzgerald 1995). There is no evidence for how the planks of the Mitrou boat would have been joined. Edge-to-edge fastening of planking was ubiquitous in ancient Mediterranean boatbuilding, and there is no reason that the Mitrou boat would have been an exception. No metal fasteners have been found. The extreme thinness of the hull does not exclude the use of mortise-and-tenon joinery, since the equally thin-walled Herculaneum boat of the 1st century AD had planks fastened with this technique (Steffy 1994: 67, figs 3-56). Such internal wooden fasteners would not easily be noticed in a boat stain. There is mounting evidence, however, that mortise-and-tenon joints were not used in the Aegean until the late 6th century BC, and the only technique used in this region prior to that time was continuous lashing of plank seams waterproofed on the interior with rolls of organic caulking (Pomey 1997; 2003; Beltrame 2000: 92; McGrail 2004: 134-138; Polzer 2004). No traces of such lashing or caulking have been identified in the Mitrou boat. It is conceivable that no such caulking had been used or that it had rotted away before the wood of the hull had been covered with earth.

Even though it cannot be ruled out that the Mitrou hull had been built with planks, its characteristics suggest a different construction. Its remarkably feeble, even thickness and fluid transverse and longitudinal curves are typical of logboats of which the sides have been bent out with the aid of fire and water (Crumlin-Pedersen 1991: 241-261, figs 85, 86, 88, 118, 121, 122; 2006, figs 5, 16; 2010: 49-51). Such expanded logboats have never before been identified in the archaeological record of the Aegean or even the Mediterranean, and they have not been documented ethnographically in this region. Nevertheless, the remains of the Mitrou boat closely resemble in shape and relative thickness those of some 25 ancient and medieval expanded logboats identified in northern Europe, such as the ones from Slusegård in Denmark (Crumlin-Pedersen 1991: 241-261, figs 85, 86, 88, 118, 121, 122; 2006, figs 5, 16), Snape in England (Filmer-Sankey, Pestell & Marsden 1995, figs 2-6), and Weklice in Poland (Ossowski 2003). Like the Mitrou vessel, the boats from Slusegård, Weklice, and Snape had been preserved as dark stains in the ground; the two medieval boat stains of Snape are particularly close in hull shape and thickness to that at Mitrou. The blunt extremity of the Mitrou boat is paralleled on the medieval Utrecht-type boats from the Netherlands (Van de Moortel 2003; 2009c).

The expansion process requires advanced woodworking skills and produces hulls that are broader, and thus more stable than ordinary logboats. Expanded logboats also have more graceful curves that

make them more seaworthy. Conversely, this means that the parent tree trunk from which the logboat has been cut is much narrower than the expanded logboat. If the Mitrou boat was 5.5 to 6 m long, and we assume that it had been cut at 1.30 m from the ground-which is fairly standard practice nowadays- it must have been extracted from a tree trunk at least 6.80 to 7.30 m long. To reconstruct its girth, we first take the curved width of the hull. At a minimum the Mitrou logboat was 97.50 cm wide and 34 cm high amidships, and its curved width about 1.3 m (Fig. 3.7). Since its wood structure is not preserved, we do not know how much of the original log's circumference had been occupied by the logboat. The ethnographic literature on expanded logboats provides a wide variety of possibilities, from c 50% to c 90-95% (Petersen 2000, figs 8A, 28; Crumlin-Pedersen 2006, fig. 19 and personal communication; Itkonen 1941, VIII, figs 27, 33). In Table 3.1, tree diameters are reconstructed for these two extremes and for a case in-between. These calculations show that the tree needed to make such logboat would not have been exorbitantly large.

Curved width of logboat	% of parent log	Girth of parent log	Diameter of parent log	Diameter of parent trunk (+ sapwood, bark)
1.30	50%	2.60	0.83	0.98
1.30	75%	1.73	0.55	0.70
1.30	90%	1.44	0.46	0.61

Table 3.1. Hypothetical reconstructions of diameter of parent tree trunk at c 4.30 m above ground, based on the assumption that the Mitrou boat was an expanded logboat (Measurements are in meters).

Wood Identification

No microscopic analysis has yet been done of the samples from the Mitrou boat stain. However, gas chromatography analysis carried out by Andrew Koh of Tufts University on all our samples yielded significant results for the hull in the scarp (sample no. 3423) and the possible paddle (sample no. 3433). Both chromatograms show pronounced and quite broad peaks at 9.4 minutes, probably representing pyrogallol, a version of gallic acid produced by prolonged heating in the presence of water. A much smaller peak at 15.7 minutes is likely to be gallic acid (Fig. 3.6). These results are strongly indicative of tannins, and allow us to identify the wood with great likelihood as oak. This identification is supported by the deep black hue of the boat stain[3].

Even though oak was rarely used for ship planking in the ancient or medieval Mediterranean, some cases are known (Casson 1971: 213, no. 54, Hocker & Scafuro 1996: 8; Steffy 1994: 93[4]), and Theophrastus in the late 4th century BC mentions its usefulness for the keels of *triereis* (*Historia Plantarum* 5.7.1-3; Meiggs 1982: 118). All of the expanded logboats from northern Europe likewise were made of oak (Van de Moortel 2003; 2009c). The presence of pyrogallol in the Mitrou boat may well be a valuable criterion indicative of expansion, since this process would have involved the use of fire and water for a significant length of time (Hornell 1948; McGrail 1978: 38-39; Petersen 2000: 87).

Hull Reconstruction

Since the transverse curvature of the hull is preserved only in the trench scarp, and the fore-and-aft rise of the bottom can be surmised only close to its southern extremity, there is insufficient evidence for a full three-dimensional reconstruction of the hull lines. Only a schematic minimum reconstruction of the midship section is presented here, based on the hull curvature retained by the red clayey earth to the west and the black stains on wall 100 to the east. The result is a low hull with the typical parabolic transverse curvature of expanded logboats (Fig. 3.7). The bottom of the reconstructed hull has been raised slightly so that it rests on top of the gravel in the road, at +3.14. Its height is only 34 cm, which seems too low for a small seagoing vessel, and would allow it to operate only in very calm waters. The slightly smaller boat Slusegård 1072 (L = 5.13 m), which sailed in the Baltic, has been reconstructed to a height of 42 cm. By adding a hypothetical 16 cm-wide washboard to the Mitrou hull, its height is raised to about 50 cm, giving it a more acceptable freeboard of 25 cm at a draught of 25 cm. Remains of such washboard may have been excavated some 15 cm above the boat's bottom (see above).

Since we do not know the original length of the hull, and we cannot reconstruct the hull lines, we can only obtain a very approximate estimate of its cargo capacity. If we accept that the submerged volume of the Mitrou boat equals about one-quarter of that of the 4th -century BC Hjortspring boat from Denmark -which is comparable in terms of hull shape and plank thickness- and if we know that the Hjortspring boat could carry about 1 ton at a draught of 25 cm (Crumlin-Pedersen & Trakadas 2003: 90 and

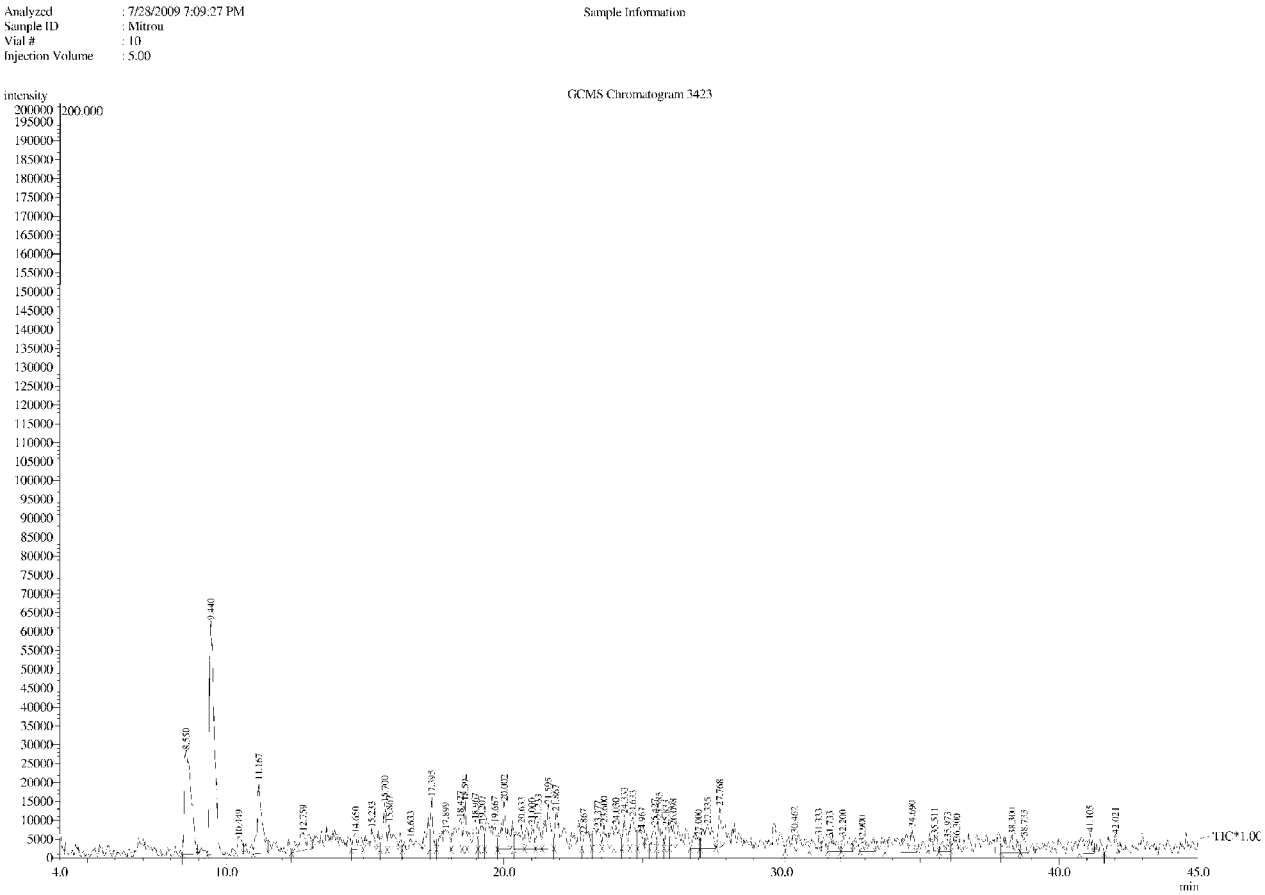

Fig. 3.6. Chromatogram of sample 3423 from logboat in trench scarp (A. Koh).

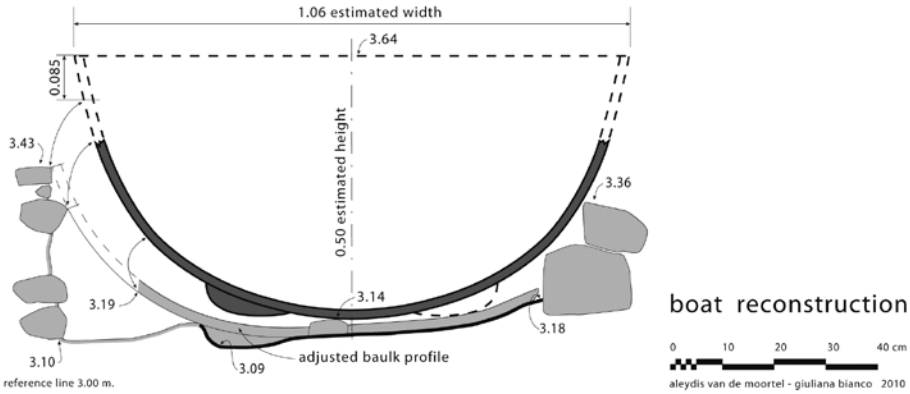

Fig. 3.7. Schematic reconstruction of midship section (A. Van de Moortel & G. Bianco).

passim), then a cargo capacity of roughly 250 kg for the Mitrou boat seems plausible. This means that the Mitrou boat may have carried up to 4 paddlers and some belongings, or fewer persons and more goods. If more strakes were added, its cargo capacity would have increased accordingly.

Significance of Find

The boat stain was found in a small road or alleyway within the early Middle Helladic village of Mitrou, some 40 m from the present seashore, and somewhat further from the coast in the Middle Bronze Age. The boat must have been stored and abandoned there for reasons unknown. Its modest size and shape suggests that it was a local fishing craft or small transport vessel used in the relatively protected waters of the Euboean and Malian Gulfs. It could have sailed as far as the Pagasitic Gulf in Thessaly, which borders the Malian Gulf to the north, but it is unlikely that it would have ventured routinely into the open Aegean Sea. Thus it must have been a locally built vessel. Pollen studies indicate that deciduous oak trees suitable for a logboat of this size or for building planked ships would have been available at that time in the hills and mountains of the Euboean,

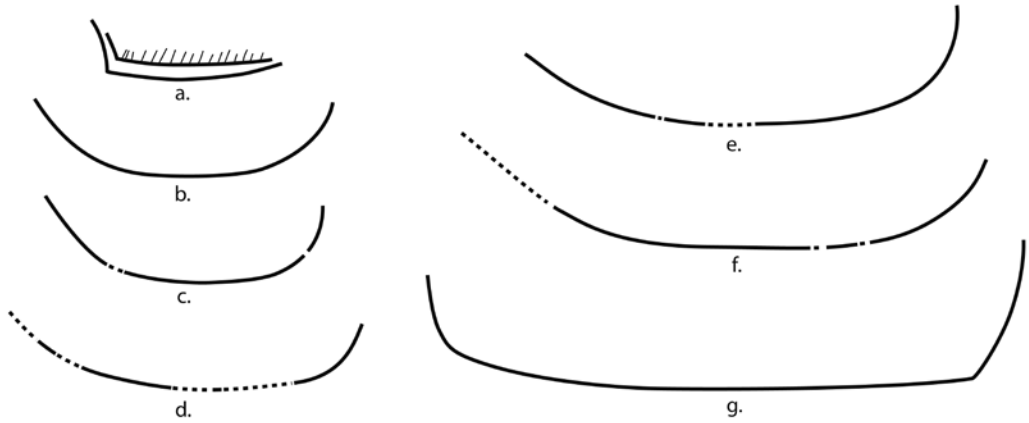

Fig. 3.8. Asymmetrically curving bottoms of Bronze Age Aegean ship images and a later Greek ship: a) Orchomenos, Early Helladic IIB askos fragment (after Basch 1987: fig. 172); b) Archanes Anemospilia, Middle Minoan III seal (after Sakellarakis & Sapouna-Sakellaraki 1991: fig. 128); c) Akrotiri, Late Cycladic I Miniature Ship Fresco, small boat (after Basch 1987: fig. 234b); d) Akrotiri, Late Cycladic I Miniature Ship Fresco, small boat, 'admiral's ship' (after Basch 1987: fig. 241); e) Akrotiri, Late Cycladic I Miniature Ship Fresco, small boat, medium oared boat (after Basch 1987: fig. 255); f) Akrotiri, Late Cycladic I Miniature Ship Fresco, small boat, large ship (after Basch 1987: fig. 235a); g) Kyrenia ship, exterior planking, 4th century BC (after Steffy 1994: figs 3-38). Bows to the left; not to scale (A. Van de Moortel & G. Bianco).

Malian, and Pagasitic Gulfs (Woldring 2003; Greig & Turner 1974).

This is the fifth boat ever discovered in the prehistoric Aegean, and only one of four boats with substantial hull remains. The outlines of three Late and Final Neolithic logboats have been uncovered at Dispilio, on Lake Kastoria in Macedonia, but they have not been excavated (Marangou 2003). The wreck of a small Late Bronze Age seagoing merchantman dating to the 12th century BC has been excavated off Cape Iria, in the Argolic Gulf. This boat is estimated to have been 9 m long, but had only tiny amounts of wood remaining, and its provenance is uncertain (Vichos 1999). Thus the Mitrou boat is the earliest seagoing vessel ever found in the Aegean and the only Bronze Age boat that may safely be accepted as being local to this region. Even though it is preserved only as a stain, it is a highly significant find for our understanding of Bronze Age boatbuilding in the Aegean.

Among the handful of Early and Middle Bronze Age boat representations known from the Greek mainland, the one most closely comparable to the Mitrou boat in shape, date, and provenance is a longboat incised on an Early Helladic IIB pottery fragment from Orchomenos, located only 20 km southwest of Mitrou (Figs 3.1, 3.8a; Basch 1987: 83, fig. 172; Wedde 2000: 315, no. 415). This longboat, shown in profile, has a gently curving bottom and sheerline, and was propelled with at least 17 pairs of paddles or oars. [The two prominent converging incised lines above the boat bear no relation to the hull, but represent decoration typical of the handle of this vessel type -a Boeotian askos[5]]. Its bottom curvature is asymmetrical, rising less steeply towards the bow -which I interpret as the high extremity- than towards the stern. In my research on the expanded logboat bottom elements of the medieval ships of the Utrecht type, I have come to the conclusion that such asymmetrical hull curvature is the result of expansion, and is caused by the fact that the lower end of a tree trunk is wider and has less flexible wood fibers than the higher end (Van de Moortel 2009b: 324-325; Jensen 1999: 74, fig. 4.7). During the expansion process, as the sides of the logboat are bent out, both extremities rise, but the one that was cut from the lower end of the tree rises less steeply than the other. Because of its asymmetrical curvature, it seems that the Orchomenos boat is either a very large expanded logboat or a planked boat descending from such expanded logboat. Ethnographic research elsewhere has shown that is not uncommon for planked vessels to imitate, at least for some time, the shape and other design features of their logboat ancestors (Manninen 1927; Humbla & von Post 1937; Crumlin-Pedersen 1972).

Hulls with curved bottoms also appear in Crete from the late Prepalatial period onwards, and by the Neopalatial period the crescent hull shape dominates Minoan ship representations (Wedde 2000: 315-348; Basch 1987: 99-105). Most crescent-shaped hulls were engraved on seals, and are too small to show details of their curvature. An agate seal from Archanes

Anemospilia, however, shows a hull with asymmetrical curvature, its bow rising more gently than its stern (Fig. 3.8b). Similar asymmetry is displayed more clearly by the large and small vessels of the miniature ship fresco of Akrotiri, which have been painted on larger surfaces (Figs 3.8c-f; Basch 1987: figs 232, 234, 235a, 241, 255, 267; Wedde 2000: nos 616, 618, 619). The smallest craft of this fresco may be vessels of the size of the Mitrou boat, and perhaps represent expanded logboats. The largest ship, however, must be at least 20 m in length to judge by the presence of 21 of paddlers on one side, and must be planked craft. Because of their similar asymmetrical curvature, it is proposed here that Minoan and 'Minoanizing' crescent-shaped planked vessels in the Bronze Age Aegean descended from expanded logboats. Later Greek and Roman seagoing merchantmen with rounded hulls often display asymmetrical bottom curvatures as well, such as the Kyrenia ship (Fig. 3.8g). They also have gracefully curving hulls with thin planking built for flexibility and they have floor timbers laid symmetrically about the centerline – a feature that is typical for boats derived from expanded logboats. Thus the possibility should be considered that ancient Greek and Roman ship construction ultimately derived from the expanded logboat.

Notes

1 The Mitrou Archaeological Project is co-directed by the author and Eleni Zahou, archaeologist of the 14th Ephorate of Prehistoric and Classical Antiquities; it is conducted under the auspices of the American School of Classical Studies at Athens. For preliminary reports, see Van de Moortel & Zahou 2003-2004; 2011; Van de Moortel 2007; 2009a. The 2007 excavation season was financed by the University of Tennessee (Department of Classics, College of Arts and Sciences, Office of Research, Office of Graduate Studies), the National Endowment for the Humanities (Grant No. RZ-50652), the Institute of Aegean Prehistory, the 14th Ephorate of Prehistoric and Classical Antiquities, Colby College, the University of Evansville, the University of Kansas, and private donors, as well as by two field schools administered by College-Year-in-Athens. Any views, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect those of the National Endowment for the Humanities. The author is grateful to conservators Haris Zahariou and Christos Vaporakis for their meticulous care in preserving the boat's imprint for future study.

2 The pottery was first dated and described by Patrick M. Thomas and Jeremy B. Rutter. The Middle Helladic II Early date was determined by Christopher Hale, who is developing the Middle Helladic ceramic chronology at Mitrou.

3 Koh, e-mail October 10, 2009. The possibility of oak because of the wood's black hue was first suggested by Henri D. Grissino-Mayer of the University of Tennessee. The author is grateful to Dr. Grissino-Mayer for advising chemical analysis.

4 The author thanks Frederick M. Hocker for bringing this to her attention.

5 The information on the Boeotian askos from Orchomenos was kindly provided by Yannis Fappas, archaeologist of the 9th Ephorate of Prehistoric and Classical Antiquities at Thebes. The pottery fragment is exhibited in the Archaeological Museum at Chaironeia.

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