

ΤΡΟΠΙΣ ΙΙΙ

TROPIS ΙΙΙ

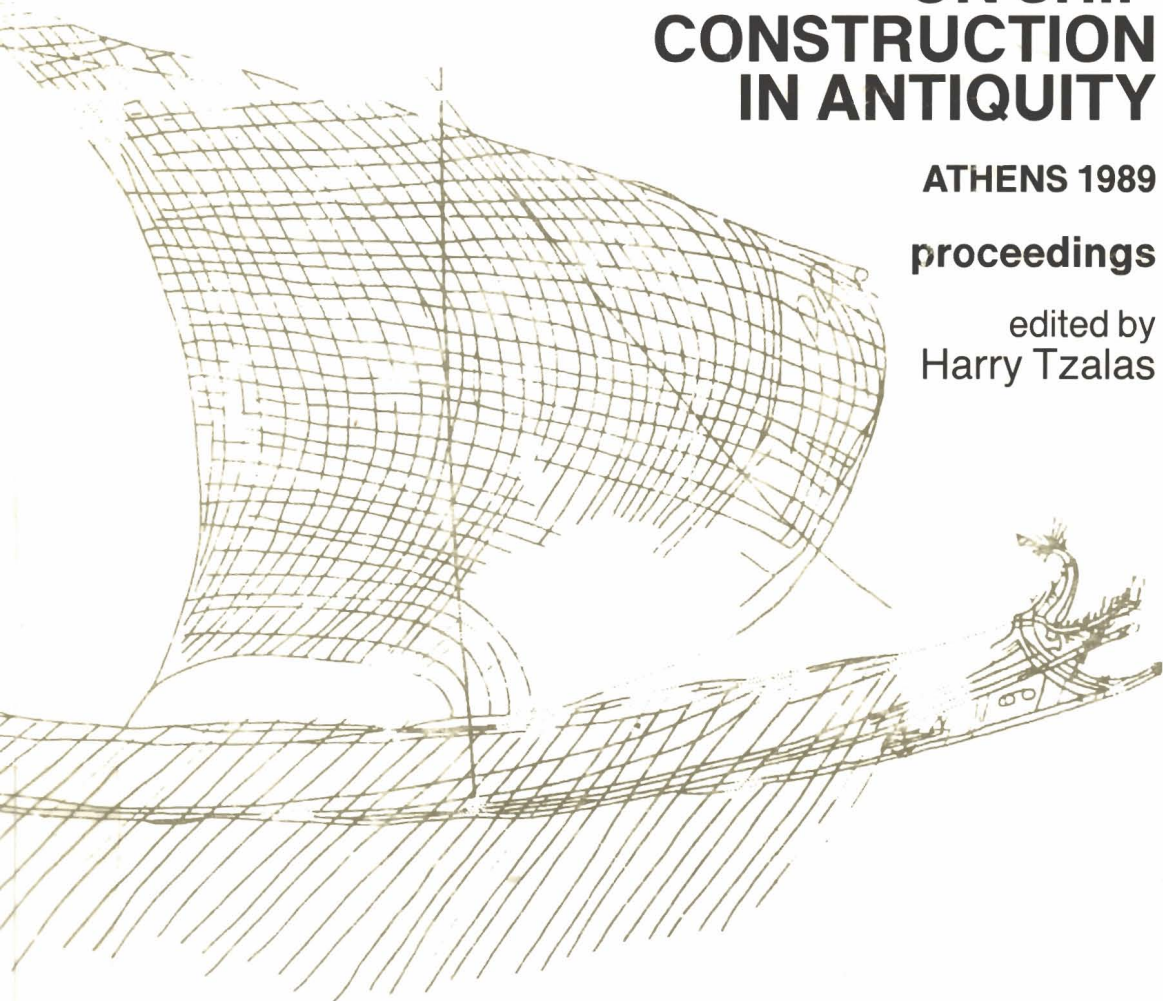
HELLENIC INSTITUTE
FOR THE PRESERVATION
OF NAUTICAL TRADITION

3rd INTERNATIONAL SYMPOSIUM ON SHIP CONSTRUCTION IN ANTIQUITY

ATHENS 1989

proceedings

edited by
Harry Tzalas



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OF NAUTICAL TRADITION

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EVGENIDOU FOUNDATION
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*Εις Μνήμην Μελίνας Μερκούρη
Melina Mercouri In Memoriam*

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| Hadjidaki, Elpida | Piracy in the Hellenistic Crete, in the light of the excavation of the ancient port of Phalassarna.
cf. The Classical and Hellenistic Harbor at Phalassarna: A pirate's port? A dissertation ... for the degree of Dr PhD by Elpida Hadjidaki. <i>U.M.I. Dissertation</i> (1988), <i>Information Service</i> . Ann Arbor, Michigan 48106, 1992. |
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ΚΕΙΜΕΝΟ ΧΑΙΡΕΤΙΣΜΟΥ
ΤΟΥ ΠΡΟΕΔΡΟΥ ΤΗΣ
ΟΡΓΑΝΩΤΙΚΗΣ ΕΠΙΤΡΟΠΗΣ
κ. ΧΑΡΗ ΤΖΑΛΑ
ΓΙΑ ΤΟ 3^ο ΣΥΜΠΟΣΙΟ

ADDRESS
OF THE PRESIDENT OF THE
ORGANIZING COMMITTEE
MR. HARRY TZALAS
FOR THE 3rd SYMPOSIUM

Κύριε Γενικό Γραμματέα του Υπουργείου Πολιτισμού, Κυρίες και Κύριοι,

Είναι η τρίτη φορά από το 1985 που έχω την τιμή να απευθυνθώ σε ένα τόσο διακεκριμένο ακροατήριο με την ευκαιρία της έναρξης του Συμποσίου Αρχαίας Ναυπηγικής. Ειλικρινά χαίρομαι βλέποντας μέσα σ' αυτό το αμφιθέατρο φίλους και συναδέλφους που είχαν παραστεί στις προηγούμενες συναντήσεις, το 1985 στον Πειραιά και το 1987 στους Δελφούς.

Επιστήμονες και μελετητές από 16 χώρες συγκεντρώθηκαν εδώ έχοντας ένα κοινό ενδιαφέρον: το αρχαίο πλοίο. Όλοι μας θέλουμε να μάθουμε όσο γίνεται περισσότερα για το πώς κατασκευάζονταν τα πλοία και πώς ταξίδευαν από τα βάθη της Ιστορίας. Είναι πράγματι ενθαρρυντικό για τους συνεργάτες μου αλλά και για μένα, που δουλέψαμε σκληρά τα τελευταία πέντε χρόνια, ώστε να καθιερωθεί το συμπόσιο αυτό ως ένα από τα κυριότερα γεγονότα στο ημερολόγιο της ναυτικής αρχαιολογίας, όταν βλέπουμε το συνεχώς αυξανόμενο ενδιαφέρον.

Mr. Secretary General of the Ministry of Culture, Ladies and Gentlemen,

This is the third time, since 1985, that I have the privilege to address such a distinguished audience at the opening session of the "Symposium on Ship Construction in Antiquity". I am so pleased to see in this amphitheater colleagues and friends who were present at our previous meetings of 1985 in Piraeus and of 1987 in Delphi.

Scientists and scholars from 16 countries are gathered here because of a common interest: the ancient ship. We all want to learn more about how sea crafts were built and how sea crafts sailed since the dawn of history. It is really rewarding for my colleagues of the Organizing Committee and for myself who have worked hard during the last five years to establish this symposium as an acknowledged event on the international calendar of Marine Archaeology, to see the continued, increased interest that it generates.

Ο μεγάλος αριθμός ανακοινώσεων υποχρέωσε φέτος τους διοργανωτές να αυξήσουν τις ημέρες των εργασιών από τρεις σε τέσσερις. Έχοντας διαβάσει τις περιλήψεις των ανακοινώσεων, μπορώ να σας πω ότι προβλέπεται ένα πολύ ενδιαφέρον Συμπόσιο.

Ως Πρόεδρος της Οργανωτικής Επιτροπής, θα ήθελα να ευχαριστήσω όλους τους συμμετέχοντες που δέχτηκαν την πρόσκλησή μας. Θέλω να ευχαριστήσω, επίσης, το Υπουργείο Πολιτισμού της Ελλάδος, που έθεσε κάτω από την αιγίδα του το φετεινό αλλά και τα δύο προηγούμενα συμπόσια. Οι θερμότερες ευχαριστίες μου στα μέλη της Οργανωτικής Επιτροπής και της Εκτελεστικής Επιτροπής για την βοήθειά τους.

Τελευταία θα ήθελα να εκφράσω την ευγνωμοσύνη μας στο Ευγενίδιο Ίδρυμα και τον διευθυντή του κ. Κώστα Νεστορίδη για την εγκάρδια φιλοξενία που μας προσφέρουν.

Θα μου δοθεί αργότερα η ευκαιρία να αναφερθώ στη συμπράξη Οργανισμών που προσφέρθηκαν να δεξιωθούν τους συνέδρους. Ας αναφέρω σε συντομία το Υπουργείο Πολιτισμού και το Πολεμικό Ναυτικό, τον κ. Γιώργο Δρακόπουλο του Ναυτικού Μουσείου Αιγαίου και τον κ. Ανδρέα Ποταμιάνο της Ηπειρωτικής Ατμοπλοΐας.

Και τώρα σαν Έλληνας, θα ήθελα να πω ότι το Έθνος μας, χρωστάει πάρα πολλά στους αρχαίους καταβόμαραγκούς και τους αρχαίους

The great number of proposed papers for this year, obliged the organizers to increase the days for the working sessions from three to four. Having read the abstracts of the papers, I can only say that we can look forward to a very interesting symposium.

As President of the Organizing Committee, I would like to thank all the participants who have accepted our invitation. I would like also to thank the Ministry of Culture of Greece, under which patronage the present and the past symposiums have been held. My warmest thanks go also to all the members of the Organizing Committee, as well as the members of the Executive Committee for their valuable assistance.

Last but not least, we owe gratitude to the Eugenidou Foundation and to its director Mr. Costas Nestoridis for their cordial hospitality.

I will have the opportunity at a later stage to acknowledge the contribution of those organizations who have kindly invited the participants at receptions: but let me right away mention the Ministry of Culture and the Hellenic Navy, Mr. George Drakopoulos of the Aegean Maritime Museum, and Mr. Andreas Potamianos of Epirotiki Lines.

Now as a Greek, I would like to say that our Nation owes enormously to the ancient boatbuilders and ancient mariners. We all owe a lot to their skill

ναυτικούς. Όλοι μας αναγνωρίζουμε το μεγάλο μας χρέος στη δεξιοτεχνία τους στη ναυπήγηση πλεούμενων και στην τόλμη τους να ταξιδέψουν ανά τις θάλασσες στα σύνορα των τότε γνωστών κόσμων. Ο Ελληνικός Πολιτισμός δεν μεταφέρθηκε με άμαξες αλλά με πλοία, και γι' αυτό είναι ευνόητο ότι εμείς οι Έλληνες ενδιαφερόμαστε να μάθουμε όσο γίνεται περισσότερο για την τέχνη της ναυπήγησης και του θαλάσσιου ταξιδιού.

Σας καλωσορίζουμε στη φιλόξενη μας χώρα, στη χώρα του Ξένιου Δία και στη χώρα του Ποσειδώνα, προστάτη των ναυτικών. Ας είναι η παραμονή σας ευχάριστη και χρήσιμη ώστε να ανταλλάγουν πληροφορίες και γνώσεις που θα μας βοηθήσουν να κατανοήσουμε καλύτερα την μεσογειακή Ναυπηγική ανά τους αιώνες.

Προηγουμένως αναφέρθηκα στους φίλους που πιστά ξανάρχονται κάθε δύο χρόνια στη συνάντησή μας. Δυστυχώς από το κάλεσμα λείπει ο Federico Laures-Foerster που έφυγε τον περασμένο Δεκέμβριο. Ο αγαπητός σε όλους Federico πρόλαβε, σαν κάτι να προαισθάνθηκε, και μου έστειλε την ανακοίνωσή του. Τιμώντας τη μνήμη του, θα παρουσιάσουμε την ανακοίνωσή του, τελευταία εργασία ενός μελετητή που όσο λίγοι, αγάπησε το αρχαίο πλοίο.

Παρακαλώ το Γενικό Γραμματέα του Υπουργείου Πολιτισμού κ. Μ. Τρικούκη να κηρύξει την έναρξη του Τρίτου Διεθνούς Συμποσίου Ναυπηγικής στην Αρχαιότητα.

in building sea crafts and to their ability in sailing these crafts to the limits of the known worlds. Greek civilization was not transported by carts but by ships so it is obvious why we want to learn more and more about the art of building and sailing sea crafts.

We welcome you all in the land of hospitality, the land of Xenios Zeus, patron god of hospitality, and the land of Posseidon, patron of seamen. May your stay be pleasant and may we all exchange information and knowledge that will help us better to understand Mediterranean shipbuilding through the ages.

Previously, I did refer to those friends who have been returning every second year, faithfully to our meetings. Unfortunately Federico Laures-Foerster, will not be among us this time. But Federico, who we all loved and esteemed, did send me in time the complete text of his paper. This will be read in memoriam by one of his colleagues. This was the last paper of a bright scholar, who so much loved the ancient ship. Lets raise and lets observe a minute silence in memory of Federico Laures-Foerster.

I kindly ask the Secretary General of the Ministry of Culture Mr. M. Trikoukis, to inaugurate the 3rd Symposium on Ship Construction in Antiquity.

ΚΕΙΜΕΝΟ ΧΑΙΡΕΤΙΣΜΟΥ
ΤΟΥ Γ.Γ. ΤΟΥ ΥΠΟΥΡΓΕΙΟΥ
ΠΟΛΙΤΙΣΜΟΥ
Κ. ΜΑΚΗ ΤΡΙΚΟΥΚΗ
ΓΙΑ ΤΟ 3^ο ΣΥΜΠΟΣΙΟ

ADDRESS
OF THE SECRETARY GENERAL
OF THE MINISTRY OF CULTURE
Mr. MAKIS TRIKOUKIS
FOR THE 3rd SYMPOSIUM

Κυρίες και Κύριοι,

Ladies and Gentlemen,

Μπορεί νομίζω να πεί κανείς ανεπιφύλακτα, ότι το Διεθνές Συμπόσιο για τη Ναυπηγική στην Αρχαιότητα, αποτελεί πλέον θεσμό. Το γεγονός ότι σήμερα συνέρχεται το 3ο Συμπόσιο πάνω στο θέμα αυτό, επιβεβαιώνει μία τέτοια άποψη.

Δύο μου φαίνεται πως είναι οι όψεις των τριών αυτών Συμποσίων, χαρακτηριστικές και οι δύο.

Πρώτον, ότι και τα τρία έχουν οργανωθεί στην Ελλάδα, γιατί το σημείο αυτό του κόσμου αποτέλεσε στην αρχαιότητα την περιοχή με την πυκνότερη θαλάσσια επικοινωνία, πράγμα που προϋπέθετε και ταυτόχρονα επέβαλε, την ανάπτυξη της ναυπηγικής. Η πανάρχαια αυτή ναυτική παράδοση, παραμένει ως τις μέρες μας ολοζώντανη στη χώρα μας.

Δεύτερον, ότι, όπως δείχνει η συμμετοχή τόσων πολλών ειδικών από διάφορες χώρες, υπάρχει ένα γενικότερο ενδιαφέρον για τη μελέτη των πρώτων εκείνων περιόδων του ανθρώπινου πολιτισμού.

I believe one can say unreserved that the International Symposium on Ship Construction in Antiquity has become an institution. The fact that today is the opening day of the 3rd one, confirms this assertion.

There are two sides to these three Symposiums, both distinctive.

Firstly, all of them were organized in Greece; because this part of the world had in antiquity the most frequent maritime communication, a fact that presupposed but at the same time also inflicted the development of shipbuilding. This immemorial nautical tradition, remains alive until our days.

Secondly the participation of so many specialists from different parts of the world, shows that there is a general interest concerning the study of these first periods of the human civilization.

Πράγματι, η σπουδή της αρχαιότητας αποτελεί όλο και περισσότερο αναγκαία προϋπόθεση για την ίδια την ανάπτυξη του σύγχρονου πολιτισμού, όσο διαφορετικοί κι αν είναι οι όροι κι οι συνθήκες μέσα στις οποίες ο τελευταίος εξελίσσεται.

Με αυτές τις σύντομες σκέψεις, επιτρέψατέ μου να καλωσορίσω τους προσκεκλημένους μας και να κηρύξω την έναρξη των εργασιών του Συμποσίου, ευχόμενος καλή επιτυχία στο έργο σας.

Σας ευχαριστώ

Indeed, studying antiquity is becoming more and more an essential condition for the development of the contemporary civilization regardless of the different terms and conditions in which the latter is progressing.

With these thoughts allow me to welcome our guests and inaugurate this Symposium wishing you success in your work.

Thank you.

ANCHORAGE SYSTEMS OF THE SECOND MILLENNIUM BC AT TEL NAMI

The Mediterranean coastline in Israel is very straight, sandy and shallow and it possesses very few bays of any reasonable size. In the period under discussion, the 11th Millennium BC, the knowledge of artificial harbor construction was not yet known, thus the ancients had to find other means for anchoring their vessels in this well traveled coast. A suggestion as to how the ancients might have solved the problem of the absence of natural bays was suggested by A. Raban. The theory states that ancient river mouths were used as anchorage areas (Raban 1985:11-23). This theory is constructed on a geomorphological reconstruction of the shore since nearly all the rivers and springs are sited today and thus are not useful for navigation even of small craft. Support for the theory exists in the paleogeographical studies at Akko where the Belos River might have supplied the ancients with a natural harbor (Sivan 1981) and at Dor (Sneh 1981). Tel Nami was chosen for exploration and excavation because of this theory. It was originally considered to be a small site near a body of water and a spring. It was settled almost exclusively during the 11th Millennium BC and it has suffered little destruction in later antiquity after its last settlement period somewhere in the early part of the 12th century BC. Although there is a modern destruction dating to the 20th century, it is still not extensive enough to have obliterated much evidence. It is in this area that we thus hoped to find the answer as to the type of anchorages the inhabitants of the Middle Bronze IIa and Late Bronze ages, the periods represented on the site with ceramics, used.

In order to do so we have to understand the ancient geomorphology of the Nami region. From present evidence it seems clear that the site was abandoned in the middle of the Millennium, as well as post its last settlement. Today the area does not have an excellent agricultural hinterland, and if it were not for the effort of the modern settlers, it would have been dangerous to live in the vicinity due to the swamps. Changes due to the tectonic movements or changes in sea levels would have caused great geomorphological and environmental changes. Even small sea level changes, as the evidence seems to point, would have caused the inhabitants to abandon the area. The lack of a large agricultural hinterland became of paramount importance at the period in which the ancients learned to build artificial harbors (Raban 1987:122-123) and thus Tel Nami was not settled again.

The Nami region is situated 15 km south of the modern city of Haifa, Israel (Fig. 1). It is surrounded by the Carmel Mountain range and the sea. The coastal strip west of the Carmel Mountain range is characterized by wave-like parallel series of low sandstone ridges separated by basins filled with clayey alluvium. Tel Nami is part of the westernmost ridge which is broken and partially submerged. Nami itself forms a peninsula jutting some 150 meters into the sea, and to a height of more than 8 meters above standard sea level. It is connected to the mainland by what seems to be a broad tombolo which is inundated by water during the winter storms. To the east there are two more ridges. On the easternmost one, later settlements, from the Byzantine period and onwards have been noticed and on the second, the "middle" ridge, southeast of the tell, a settlement of Middle Bronze IIa was noticed. Yet another habitation was noticed under the sand dunes, a mere 75 metres east of the peninsula. The site, which is referred to as Nami East has clear signs of Late Bronze II remains as well as the Middle Bronze IIa, the two periods of interest when anchorage systems are considered (Artzy 1986; Artzy 1990). The important feature of the area, archaeologically, hydrologically and geomorphologically is the course and outlet of the Me'arot River, originating in the Carmel Ridge, crossing the eastern Kurkar ridge and discharging into the sea in the vicinity of Tel Nami. The location of its estuary in ancient times is of an utmost importance in the study of the area. At present the spring does not have a distinct outlet, as its water is trapped and utilized to supply the local fishponds. Aerial photographs and old maps suggest that in the recent past the outlet has shifted repeatedly. Of equal interest is a marshy basin lying between Nami East and the second Kurkar ridge. This basin, now largely submerged by a series of artificial fishponds is still surrounded by thicket of reeds and other hydrophytes suggesting that the basin must have been a natural swamp, a shallow or brackish lake or a lagoon.

The international nature of Nami can be verified by the numbers of imported goods both in the Middle Bronze II periods. Among the finds of the earlier period, which has been excavated only in about 2% of the known area there are bronze goods, a bellow which seems to show bronze production in the area, imported ceramics from Cyprus, a clay "weight" with an Egyptian scarab seal (Artzy and Marcus 1990), and possible imported food stuff. (Kislev, Artzy and Marcus). From the later period which has been more extensively excavated numerous bronze objects were found (Artzy 1990b), as were ivory, gold, silver and semi-precious stones. Many of the objects could well be placed in the Aegean, Cyprus, Anatolia, Syria and Egypt. There is a sign of a possible Aegean cult practice in a 13th century sanctuary on the summit of the peninsula of Tel Nami (Artzy 1991).

During the Middle Bronze IIa, which is dated to the first quarter of the IInd Millennium BC, the habitation as we know it today was localized in at least three areas in the Nami region: Tel Nami itself, Nami East and site 104-106, which is located on the other side of the ancient body of water (Fig. 2). Of the three sites, the Tel Nami must have served as a forward station, possibly storage area for the goods which were brought aboard the boats, but it is small as can be seen in the map (Fig. 2). Nami East which is still covered by sand seems to have been inhabited in an area at least twice as large as that of Tel Nami. It is hard to know exactly its size because of the sand dunes and the later habitation, but from jetting done for geomorphological studies some estimation is possible. Part of the 104-106 site was covered by later Byzantine habitation and unfortunately much of it has been plowed in the recent years and thus not much undisturbed architectural remains can be expected. From the finds it is possible to surmise that the site was of an agricultural nature and thus might have been part of a network of regional settlements which were connected in some form.

In area D, which is located on the southeastern side of the tell, a storage area dated to this period was excavated (Artzy 1990; Artzy and Marcus 1991). It had been burned, the roof collapsed and the ceramics which contained various food stuff were left in situ. The area is located only a small distance from a possible river outlet to the sea. Across from it there is a small area with habitational remains under the sand dunes. From seismic tests (Beck 1990) as well as jetting (Marcus 1991) it is possible to say that the river estuary ran south of the main part of Nami East where it might have forms an oxbow and then continued southwest, south of Tel Nami (Fig. 2) to the sea. The small unexplored habitation would thus sit on the southwestern part of the estuary. A. Raban has suggested a possible channel which led the water to the sea (Raban 1985, 20, Fig. 8). The possibility of a channel

does indeed exist although the recreation of the geographical setting suggested by him is not possible since the river, in his reconstruction crosses part of what we know now to be the settlement of Nami East.

The question remains as to the relationship between the sea and the coast during the period under discussion. It seems highly likely from the location of some of the architectural remains that the relationship is different than it is today. Both in Nami East, area O and Tel Nami, areas G and D (Artzy 1990:75) there are buildings which could not have existed with present sea level. Some of them are partially destroyed by the sea, others are overrun with sea water in the winter storms. One has to consider the height of the ground water as well. It is hard to imagine that the Late Bronze IIb inhabitants were living in Nami East, as they would have had to, had the water been the same height as it is today. It would take only a small change in sea level, to affect the area of settlement around Nami, or any similar coastline site. If we consider the level of sea level and thus ground water level to be even 75 cm lower than it is today, we could imagine that the ancients existing in the areas mentioned above (Fig. 3).

The situation in the later part of habitation around the Nami area might be of a different nature altogether. As we know now, the site was not settled during the major part of the Middle Bronze IIb and in the Late Bronze I, from the mid 18th to the 14th century BC. It is clear from the archaeological remains that the peninsula was re-settled by the newcomers, as was Nami East (Fig. 4). Site 104-106 was left uninhabited during the hiatus. The reason for the abandonment might have had little to do with the geomorphological changes and more with the political nature of the periods, although we can not rule out either. The lack of an agricultural site of the Late Bronze II has caused us some concern. The absence is even more perplexing if one considers that in the last period of habitation, the Late Bronze IIb, dated to the 13th century BC, a rampart was constructed on the peninsula, thus diminishing the area of habitation on the tell. Furthermore, a good part of the habitational area was utilized as a sanctuary. Nami East at the same time was used as a necropolis and so far no signs of domestic architecture which could be dated to the period have been located there.

It is hard to imagine that those living in the area, involved with the sanctuary or for that matter those inferred were fed with imported food brought in as tribute, although that possibility should not be disposed of off hand. As we see the situation now, the ground water and thus the sea level are higher than they were in the Middle Bronze IIa Age, possibly of the same height as they are today or even a

small amount higher. We have to remember that the settlement was a bit higher since it was situated on the remains of previous destruction and sand which accumulated over the lengthy period of abandonment. On the peninsula, the rampart which was constructed in the 13th century BC no doubt made it possible for the inhabitants to continue living there. It is highly likely that construction of the rampart was to counter the natural elements rather than man, although we have no proof of it at this point, in Nami East the inhabitants would have had to combat water in their houses from the sea during the winter and wet floors from ground water. This may have been the reason for changing the area into a necropolis.

We would like to expound on yet another possible interpretation. In theory it could well be that the anchorage system of the Late Bronze period was not at all like that of the one discussed above the Middle Bronze IIa. Stone anchors, which should be taken as evidence of the maritime nature of the area were noticed in two distinct underwater spots of the environs of Nami; south of the peninsula as well as north of it. Anchors were located in the past by Galili (Galili 1985) and recently by members of the Nami Project about 800 meters north of the tell. The area in which they were found is in the vicinity of one of the possible estuaries of the Me'arot spring which might have served as an anchorage in the later period, namely the Late Bronze II. So far little research has been carried out in the area north of Tel Nami East. Surveys have yielded small amount of data, which might, with extensive examination and analysis help us understand the northern area in future time. In order to reach any conclusions or at least further understanding, large amounts of sand would have to be removed. Archaeological research in the coast demands greater understanding of the ancient and modern geomorphology as well as history, art and patience. In the case our coastal site one has to add technical understanding in environmentally sound sand removal, as well as scientific methods to remove it wisely before even starting to excavate. Bearing all this in mind, we hold an optimistic hope that in the future regional will solve the puzzle which is involved with the Nami area.

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ILLUSTRATIONS

- Fig. 1 Map of the position of the Nami Region.
- Fig. 2 Nami Area and its known sites.
- Fig. 3 Possible reconstruction of Middle Bronze IIa anchorage at Tel Nami.
- Fig. 4 Possible reconstruction of Late Bronze II anchorage at Tel Nami.

ANCHORAGE SYSTEMS
OF THE SECOND MILLENNIUM BC AT TEL NAME

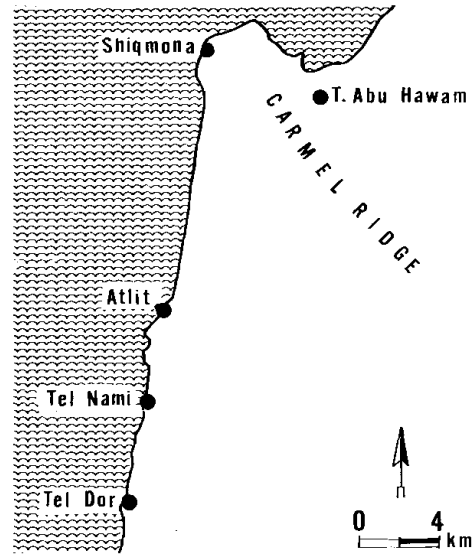


Fig. 1

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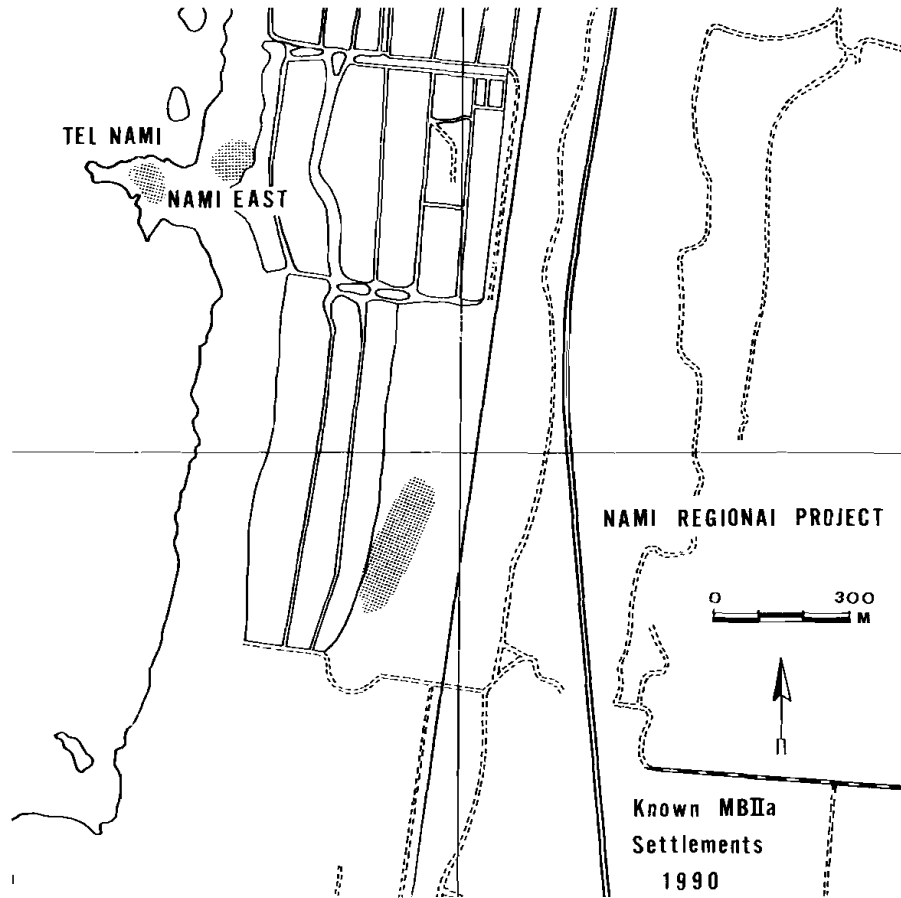


Fig. 2

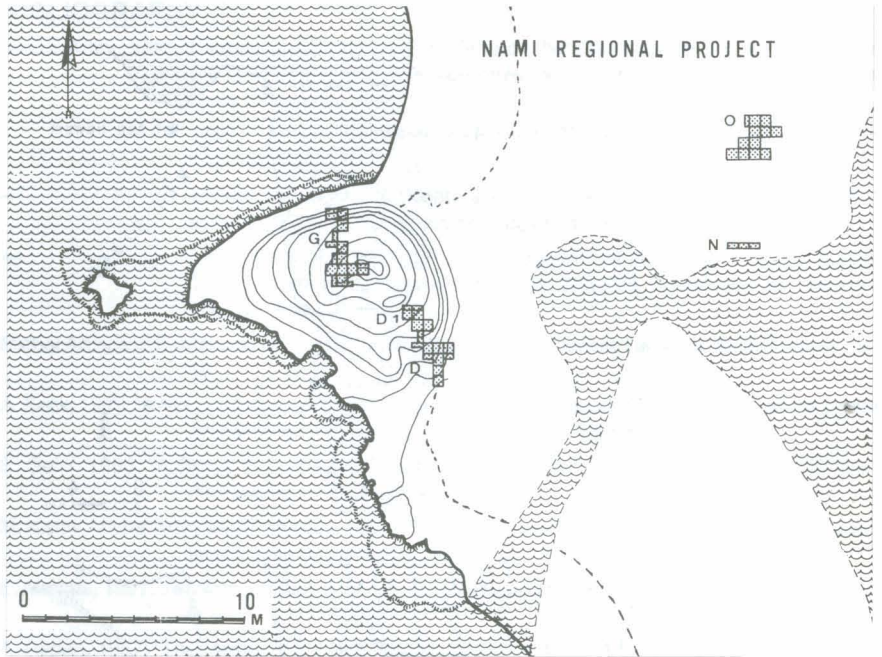


Fig. 3

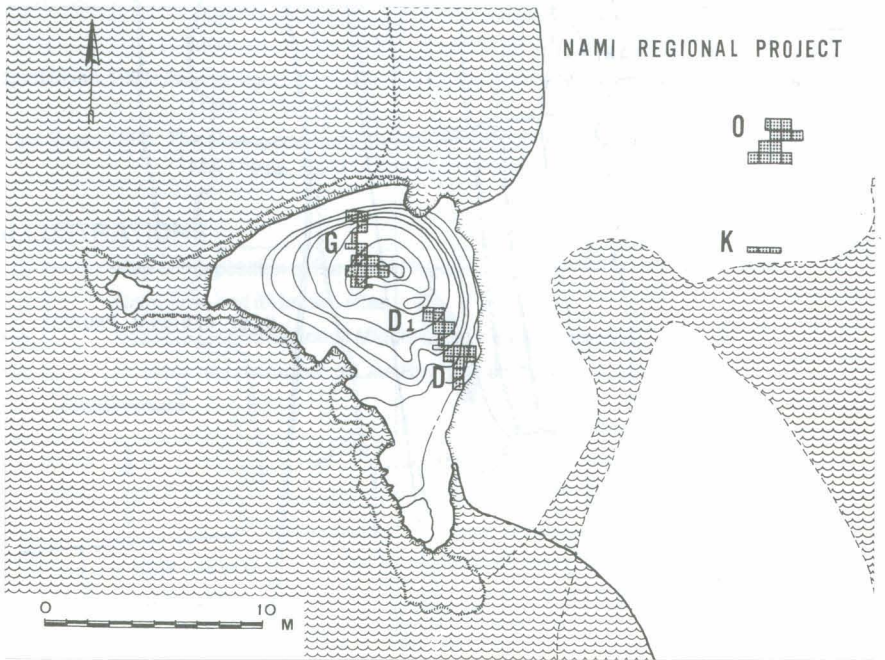


Fig. 4

NOUVELLE INTERPETATION DU DECOR DE LA LARNAX DE GAZI N° 18985

L'intérêt pour la navigation et l'architecture navale antique a considérablement augmenté au cours des dernières années, donnant naissance à des travaux majeurs tels que ceux de L. Casson et L. Basch¹ ainsi qu'à diverses manifestations internationales². Les sources qui sont à l'origine de ces travaux proviennent de la documentation archéologique, littéraire et surtout iconographique, quelles que soient les périodes. Cependant, on déplore les mêmes lacunes sur la marine militaire au deuxième millénaire av. J-C et pendant la période classique, car aucune galère n'a encore été localisée. Si leur structure est assez bien connue³, on ignore tout de ce qui pouvait être embarqué pour subvenir aux besoins des soldats au cours des expéditions militaires: vivres, armement, matériel d'appoint pour le gréement etc... Au contraire, la marine marchande est beaucoup mieux documentée, y compris à l'Age du Bronze, grâce aux deux navires échoués au Sud des côtes anatoliennes, dans le courant de la première moitié du XIVe siècle, à Ulu Burun (Kas), et à la fin du XIIIe siècle à Gélidonya⁴. Leur cargaison principale est composée de lingots en forme de "peau de boeuf" en cuivre⁵, auxquels s'ajoutent de la céramique et des objets de luxe de provenances diverses⁶. D'autres points restent obscurs sur le commerce maritime de la fin du second millénaire. La documentation disponible à ce jour ne nous donne aucun indice sur les capacités des navires helladiques et minoens. Etaient-ils aptes à effectuer de longues distances, c'est-à-dire à pratiquer une navigation différente du cabotage, mode de navigation utilisé par les navires de Kas et Gélidonya sur la majeure partie de leur trajet. On doit nécessairement conclure que ce fut le cas du fait des distances qui séparent Chypre du continent, certaines îles égéennes entre elles et les derniers confins occidentaux de la Grèce de l'Italie méridionale. Si les résultats

de l'étude du bois de Kas, mieux conservé que celui de Gélidonya, ne sont pas encore connus⁷, un certain nombre de sources écrites⁸ et de documents iconographiques nous informent sur le degré de développement de l'architecture navale dès cette époque, nous privant toutefois de toutes indications sur le type de transports qu'effectuaient ces embarcations.

Hormis les deux épaves de la côte anatolienne et les gisements isolés de lingots⁹, signalant les voies de navigation empruntées à la fin du deuxième millénaire, nous ne disposons d'aucune trace archéologique du trafic maritime pour cette époque, qu'il s'agisse du commerce d'autres matières premières que le métal ou de denrées alimentaires, marchandises mieux documentées à partir de l'époque classique. La caractéristique du commerce des lingots, entre le Proche - Orient et l'Occident, réside dans le fait qu'il s'est exercé essentiellement par voie maritime, comme le confirment la très large répartition du matériel autour de la Méditerranée, de même que la supériorité du nombre de lingots trouvés en mer¹⁰.

Tableau I

Total des sites terrestres	Epaves	Gisements isolés	Sites
42	2 ou 3	6 ou 7	34
Total des lingots terrestres		Milieu sous - marin	Milieu
+ 330		+ 265	71

Dans cette optique, les recherches sur la localisation des gisements métallifères¹¹ et des ateliers de fondeurs sont complémentaires de celles qui sont consacrées à la navigation, puisqu'aujourd'hui seul ce type de trafic maritime est attesté (Carte 1). A partir de là, on peut tenter de restituer le réseau commercial qui s'articule entre les voies de circulation reliant les zones d'exploitation et de production et celles de distribution de la marchandise. La situation des épaves, des gisements sous - marins et des gisements terrestres de lingots permet ainsi de reconstituer approximativement une route maritime entre Chypre et la Sardaigne, deux pôles importants de la métallurgie à la fin du deuxième millénaire. Par conséquent, les indices de plus en plus nombreux de relations entre l'Egée et les pourtours de la Péninsule Italique que nous fournit l'archéologie terrestre à partir de l'HR I¹² permettent de supposer que les navires, partant de Chypre chargés de cuivre, poursuivaient leur route vers l'Ouest après avoir longé la côte orientale. Le passage par Chypre est probablement évoqué dans les deux versets de

l'Odyssée ou Athéna dit: "... je vais à Témésa, chez les gens d'autre langue, troquer mon fret de fer luisant contre du bronze..."¹³. Le terme *χαλκόν* que Victor Bérard traduit par bronze est sans doute du cuivre et on peut voir dans la Témésa dont parle Athéna la Tamassos de Chypre plutôt que la Téméssa italique¹⁴, ou aucune trace d'exploitation ou de commercialisation de métal n'a été signalée. Il faut ajouter que ce commerce ne se limite pas seulement à la distribution de matières premières mais aussi à la diffusion d'un modèle d'échanges, dont témoignent les lignots en forme de "peau de boeuf" sardes de fabrication locale, provenant de 13 sites dispersés dans toute l'île¹⁵. Ce trafic revêt de ce fait un caractère particulier et laisse entrevoir l'existence d'une organisation centralisée chargée de contrôler¹⁶ et de comptabiliser les quantités de métaux produites et mises sur le marché. A l'appui de ce raisonnement, il faut rappeler la présence d'ateliers de fondeurs et de réserves de lingots dans les palais ougaritiques, chypriotes, minoens ou mycéniens¹⁷ prouvant le rôle de l'administration palatiale dans ce commerce. On s'attend par conséquent à en trouver la trace dans les tablettes en Linéaire B¹⁸, qui renferment par ailleurs des informations sur un certain nombre de denrées¹⁹.

Tandis que la destination des lingots transportés par les navires de Kas et de Gélidonya fait l'objet de débats, la thèse de l'origine chypriote des lingots de cuivre qu'ils transportaient semble désormais acceptée²⁰. En ce qui concerne la route empruntée par ces navires, il paraît acquis que celui de Kas navigait vers l'Ouest le jour où il a fait naufrage²¹. La destination de son chargement est probablement la Crète ou la Grèce du fait qu'on ne connaît pas de parallèles du matériel précieux qui était à bord autour du bassin tyrrhénien, confins des contacts avec l'Égée au XIV^e siècle. En revanche, dans le cas du navire de Gélidonya on ne peut pas aboutir à la même conclusion du fait que certains objets appartenant à l'épave, ont été également trouvés en Méditerranée centrale²². L'hypothèse d'une destination sarde, doit particulièrement être envisagée puisqu'il faut considérer que les lingots recensés en Sardaigne sont des productions locales, fabriquées d'après un prototype "égéen", introduit en Sardaigne à une date antérieure aux premières productions locales, datées des environs du XI^e siècle. Bien que la destination exacte de ces chargements reste inconnue, le nombre considérable de lingots permet de supposer que les navires devaient effectuer plusieurs escales sur leur route vers l'Occident, laissant une partie des lingots et des objets précieux dans des ports égéens contrôlés par Mycènes et Knossos et transportant le reste vers des ports de Méditerranée centrale (Carte I). Quant au gisement de Kymi²³, deux interprétations sont possibles: soit l'accès à ce port

était plus favorable, à certaines époques de l'année, pour approvisionner la Grèce continentale, soit il était destiné à la seule presqu'île eubéenne, où les ateliers de fondeurs sont connus au moins à partir du XI^e siècle²⁴.

Parmi les documents iconographiques se trouve une représentation de navire portant un nombre de détails techniques considérable. Il s'agit du navire peint sur un des grands panneaux d'une larnax minoenne trouvée à Gazi (Skaphidara), à l'Ouest d'Héracleion²⁵. (Fig. 1) Cette larnax provient d'une tombe taillée dans le rocher, datée par le mobilier céramique du MR III B (ca. 1200)²⁶. L'autre grand panneau de la larnax est décoré de deux poulpes géants placés dans un cadre tracé de façon maladroite (Fig. 1). Il est limité, comme les trois autres faces, par deux bandes ornées de lignes ondées verticales partant du haut des pieds de la larnax, jusqu'au bord supérieur. Les deux petits côtés ont une décoration similaire: la paroi est partagée en deux registres superposés, chacun de ces registres renfermant un lingot en forme de "peau de bœuf"²⁷ (Fig. 2.1). Les lingots, un peu différents les uns des autres, appartiennent à la même catégorie²⁸. La séparation horizontale pourrait être la matérialisation des étagères de rangement, telles qu'on les voit dans les fresques égyptiennes (Fig. 2.1). Les lingots sont placés en position verticale et sont entourés par un filet peint qui adopte la forme de l'objet. La signification de ce filet n'est pas établie mais on peut suggérer que l'artiste a voulu reproduire l'effet de profondeur de champ créé par la succession des lingots posés de chant dans les magasins comme c'était semblait-il le cas à Haghia Triada et à Zakros²⁹. S. Alexiou³⁰, suivi récemment par L. Watrous³¹, reconnaissait dans ce motif des autels biconcaves et non pas des lingots, faisant reposer son raisonnement sur l'absence de représentation de lingots en forme de "peau de bœuf" en Crète et au contraire sur l'abondance des représentations d'autels biconcaves. Il omettait cependant de signaler que plus de 30 lingots avaient déjà été découverts en Crète et que des processions de Crétois porteurs de tributs, et notamment de lingots, sont présentes sur plusieurs fresques et reliefs égyptiens de Thèbes, dès le XV^e siècle³². L'artisan a peint le navire au cours d'un voyage en mer, comme l'attestent le décor d'ondes et de spirales signalant la présence de vagues et d'écume dans la partie gauche, c'est-à-dire du côté de la proue.

Celle-ci est légèrement surélevée pour marquer l'effet du gonflement des ondes sur la coque pendant sa progression. On note, en outre, la présence d'oiseaux aquatiques et d'un poisson autour du navire, et surtout celle des poulpes de l'autre grand panneau. La mer est évoquée enfin par le motif d'ondes verticales qui encadre les quatre panneaux³³. Le voyage et la mer symbolisent certainement

le passage du mort dans l'au-delà, dont nous trouvons le récit chez Homère³⁴. Mais S. Alexiou envisage aussi de rattacher ce navire à l'expédition d'Idoménée, roi de Knossos, qui s'est embarqué avec "80 nefes noires" pour combattre Troie³⁵. Selon nous, une autre interprétation peut être faite, n'excluant pas pour autant la notion de voyage du défunt dans le monde des morts. Avec la larnax de Gazi, nous possédons la plus grande représentation de navire du monde créto-mycénien. L'identification du décor des deux petits panneaux que nous proposons plus haut, nous met en présence de l'unique scène de la fin du second millénaire présentant un navire accompagné d'une partie de son chargement. Le décor de la larnax où apparaissent simultanément des lingots et un navire a nécessairement été imposé à l'artisan et doit être interprété dans son ensemble. Les détails de l'architecture navale, rendus avec un souci de fidélité à la réalité, révèle le degré de connaissance des constructeurs de la fin de l'Age du Bronze³⁶, confirmé d'ailleurs par les textes d'archives en Linéaire B³⁷. On distingue nettement la quille droite, les couples, le plat bord, une préceinte, l'amorce d'un éperon et une figure de proue, dans laquelle L. Basch reconnaît une tête de cheval³⁸. La quantité et surtout la qualité de ces détails, de même que leur caractère exceptionnel pour l'époque, nous autorisent à penser que ce décor a été peint avec le souci de représenter un navire précis et une partie de sa cargaison, et non pas avec le simple but de symboliser le voyage du défunt dans l'autre monde comme le pensent S. Alexiou et L. Watrous. Cette iconographie reste unique puisque les seuls navires peints sur des larnax sont représentés sous forme de modèles de bateaux offerts au défunt et appartiennent à une époque antérieure à la larnax de Gazi³⁹. Mais, l'intérêt de ce décor réside dans le fait que les lingots, objets de commerce, n'apparaissent pas aux côtés d'un vaisseau rond, mais d'un navire de combat, comme l'atteste la quille droite⁴⁰. On sait que la flotte d'Ugarit était utilisée tantôt à des fins commerciales, tantôt à des fins militaires, comme le rappelle L. Basch: "...des navires servant normalement au commerce pouvaient être mobilisés à des fins militaires"⁴¹. Si ce cas a pu être observé encore au cours de ces dernières années⁴², l'inverse est plus difficile à envisager. On voit mal pourquoi, en temps de paix, des navires de guerre auraient été utilisés à des fins civiles, à une époque où la navigation est en plein développement et où les deux types de vaisseaux se distinguent parfaitement⁴³. Doit-on enfin mettre en parallèle le rôle de potnia d'Athéna, identifié par Chadwich à Knossos⁴⁴, peut-être à l'origine de la légende de l'Athéna Hippias d'époque classique, protectrice de la navigation, avec celui de l'Athéna Guerrière, le plus couramment invoqué à son sujet? Cela semble possible en raison de l'importance du rôle de la mer dans la diffusion du métal et du métal lui-même dans la guerre⁴⁵. Par ailleurs, aucune source n'indique la présence de navires

marchands escortant des galères pour fournir aux soldats le ravitaillement et le matériel de réparation ou de remplacement de pièces abimées⁴⁶. Aussi, la présence des lingots aux côtés d'un bateau de guerre laisse supposer que certains de ces navires transportaient quelques réserves de métal, destiné à réparer des pièces d'armement ou certaines parties du navire, endommagées au cours des combats⁴⁷. Cela explique peut-être pourquoi sur les 9 gisements sous-marins connus, 6 rassemblent entre 1 et 3 lingots seulement. En conclusion, compte tenu des caractéristiques militaires du bateau et du réalisme de la scène, on peut considérer que le défunt était un guerrier plutôt qu'un marchand ou un marin, malgré l'absence d'armes dans le mobilier de la tombe. Ce raisonnement, renforcé par la datation de la tombe, nous incite à reconsidérer le rôle de ce personnage dans un combat naval, peut-être dans l'expédition maritime lancée contre Troie, où la Crète rassemblait la troisième flotte après Pylos et Mycènes.

Catherine Aubert

NOTES

1. Casson, 1971; Basch, 1987.
2. Cf. "Collectifs" et "Catalogues" dans Bibliographie.
3. Basch, 1987.
4. Bass, 1986, 269 - 296; Pulak, 1988, 1 - 37.
5. Des lingots d'étain, de même forme ont été trouvés à Kas, cf. Bass, 1986, 176. Pulak, 1988, 18 - 10, Bass et alii, 7, et des traces d'étain décelées à Gélidonya, cf. Bass, 1967, 82 - 83.
6. Ce type de lingots, le plus répandu au cours de la deuxième moitié du second millénaire, est vraisemblablement d'origine minoenne et perpétue de façon plus ou moins précise l'étalon babylonien de 30 kg. Cf. Zaccagnini, 1986, 414 - 424 (417 - 418). Pour un point de vue récent cf. Palaima, 1989, 93 - 94 et n. 23.
7. Pour le bois conservé à Gélidonya cf. Bass, 1967, 45 - 50. La dimension des navires est évaluée à 15 m de long pour celui de Kas et à 10 m de long pour celui de Gélidonya, cf. Palaima, 1991, 299.
8. Id., 273 - 310.
9. Les gisements sous-marins peuvent être des parties de cargaisons dont les marins se seraient débarrassés en cours de voyage à cause de difficultés de navigation, ou des naufrages dont il ne reste plus traces de la coque du bateau.
10. Cf. liste détaillée des lingots avec leur contexte de provenance, Aubert, 1988, Tableau I.
11. En particulier sur la localisation des gisements de cuivre et d'étain.
12. Smith, 1987, 75 no 4-5, 77 no 9, 79 no 15, 80 no 17.
13. Chant I, 183 - 184.
14. Je remercie François Salviat pour ses commentaires sur ce passage.
15. Smith, 1987, 40 - 46.
16. Les marques incisées ou estampées sur certains lingots sont sans doute la trace de ce contrôle.
17. Par exemple à Enkomi, cf. Catling, 1979, 69 - 75; Courtois, 1982, 163 - 168. A Ras Ibn Hani, cf. Lagarce et alii, 1983, 277 et seq. A Zakros, cf. Platon, 1979, 106 - 110. Voir également Wiener, 1987, 261 - 267; Palaima, 1987, 301 - 306; Hooker, 1987, 313 - 316.

18. Palaima, 1989, 93.
19. Palaima, 1990, 91 et seq.
20. Aubert, 1988, voir en particulier la bibliographie des notes 7 et 9.
21. Bass, 1987, 722. Id., 1989, 27.
22. En particulier les trépieds en bronze, dont des exemplaires sont connus à Piediluco - Contigliano et dans plusieurs sites sardes, cf. Lo Schiavo et alii, 1985, 36 - 50. Sur les deux exemplaires trouvés à Gélidonya, cf. Bass, 1967, 107 - 109.
23. Ce gisement doit être considéré comme un chargement d'épave du fait qu'on a trouvé 19 lingots groupés à proximité du port Cf. Svoronos, 1906, 161 - 181 (168).
24. Popham et alii, 1980, 93 - 97.
25. Larnax no 18985, conservée au Musée d'Héracleion, Crète. Hauteur: 0,68 m; largeur: 0,39 m; longueur: 0,85 m. Alexiou, 1973, 3 - 12. Basch, 1987, 144 - 149.
26. Trois autres larnax et des statuettes en terre - cuite à corps cylindrique ont été trouvées dans la tombe, cf. Alexiou, 1972, 86 - 98.
27. Il existe une autre larnax ornée de lingots sur les petits côtés à Ierapétra (Crète occidentale). Elle ne présente pas le même décor sur les autres panneaux.
28. Définition des types par Buchholz, 1958, 92 - 115; Bass, 1967, 52 - 61.
29. Platon, 1974, 232, fig. 39.
30. Alexiou, 1973, 3 - 12.
31. Watrous, 1991, 293.
32. Notamment la Tombe 119 (1490 - 1436), peut-être la plus ancienne portant ce type de scène, cf. Bass, 1967, fig. 62.
33. Watrous, 1991, 289.
34. Odyssée, IV, 563 - 568.
35. Alexiou, 1972, 94; id. 1973, 7. Homère, L'Iliade, II, 650 - 652.
36. Basch, 1987, 144 - 145. Déjà dans Alexiou, 1973, 3 - 7.
37. Palaima, 1991, 298 - 299.
38. Basch, 1987, 145 - 146.
39. Watrous, 1991, 290.
40. Je remercie Lucien Basch pour ses observations.
41. Basch, 1987, 149.
42. Guerre des Malwines.
43. Artzy, 1985, 138.
44. Il s'agit de la tablette V 52 dans laquelle quatre divinités sont mentionnées: Athéna potnia, Enualios (Ares), Paian (Apollon) et Poseda (o) (Poséidon), toutes liées à la guerre ou à la navigation, cf. Chadwick, 1976, 88 - 89.
45. Ce rôle était tenu antérieurement par l'obsidienne. Sur le commerce de l'obsidienne, cf. Tzalas, 1989, 11 - 20 et récemment Basch, 1991, 45 - 46.
46. La présence de vaisseaux ronds aux côtés de navires de combat est attestée sur le relief daté du règne du roi Sennacherib, à Ninive où flotte militaire et flotte de commerce évoluent simultanément. Mais il ne s'agit pas ici d'un déplacement de troupes pour un combat naval au cours duquel les galères étaient assistées par des navires marchands, chargés du ravitaillement des soldats. Sur l'interprétation de cette scène, cf. Basch, 1987, 311 - 318.
47. Le travail du métal est attesté dans l'épave de Gélidonya par la présence d'un creuset à bord.

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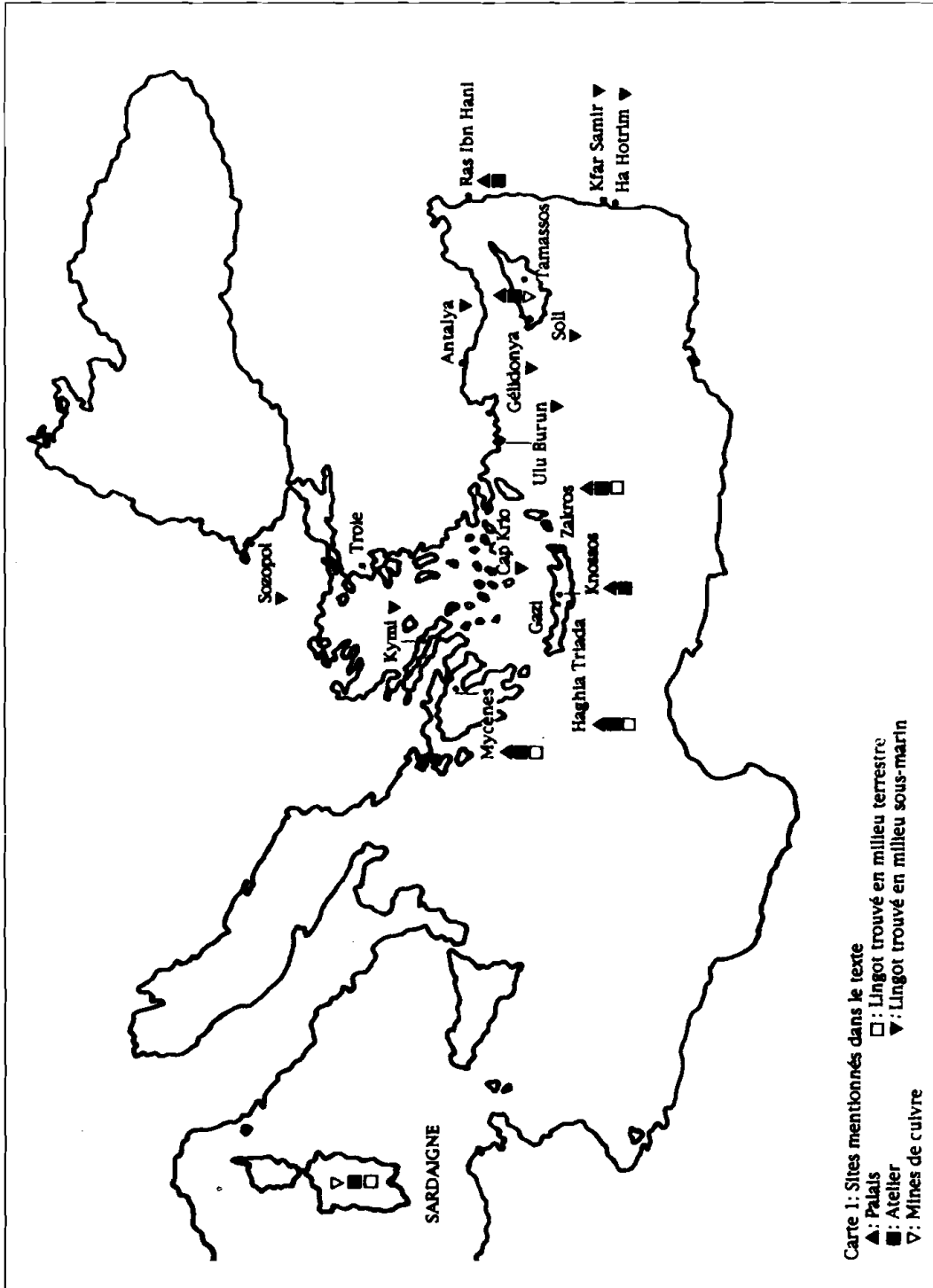
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FIGURES

- Carte 1 Sites mentionnés dans le textes
Fig. 1 Gazi, Musée d'Héracléion, no 18985
Fig. 2.1 Gazi, Musée d'Héracléion, no 18985
Fig. 2.2 Thèbes, Tombe de Puyemrê



Carte 1

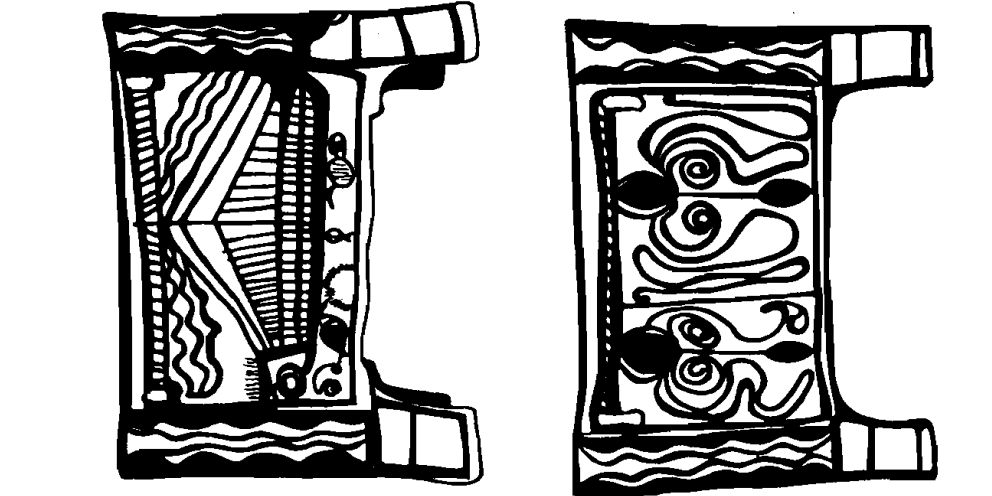
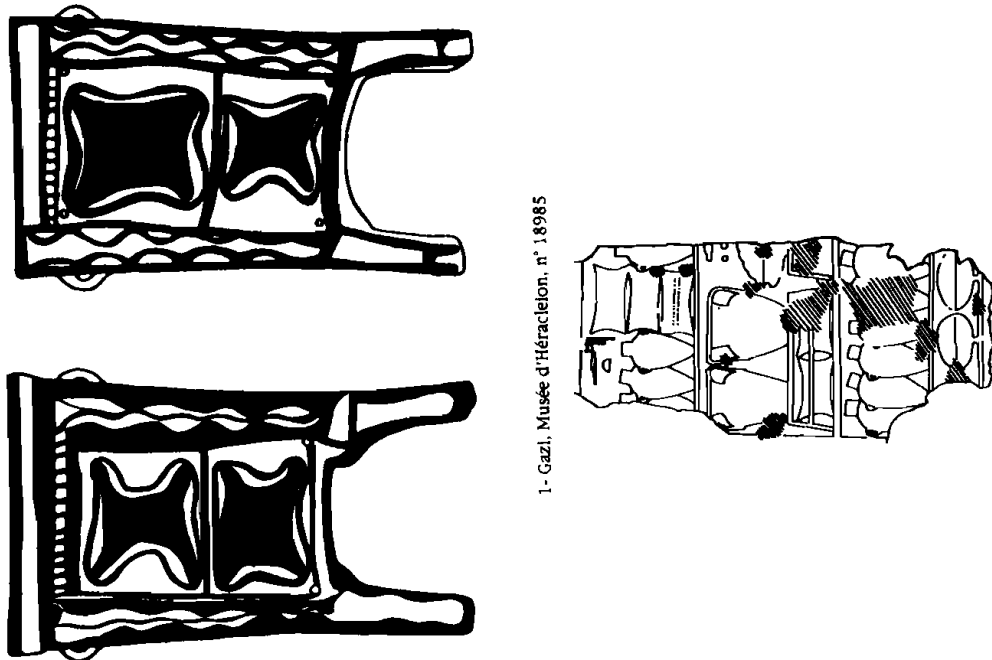


Fig. 1



1- Gazi, Musée d'Héracléion, n° 18985

2- Thèbes, Tombe de Puyemré (1490-1436)

Fig. 2

**LE “NAVIRE INVAINCU A NEUF RANGEES DE RAMEURS”
DE PAUSANIAS (I, 29. 1)
ET LE “MONUMENT DES TAUREAUX”, A DELOS**

Dans sa description de l'Attique, Pausanias écrit (I, 29.1) :

Τοῦ δὲ Ἀρείου πάγου πλησίον δείκνυται ναῦς ποιηθεῖσα ἐς τὴν τῶν Παναθηναίων πομπήν. Καὶ ταύτην μὲν ἤδη ποῦ τις ὑπερεβάλετο· τὸ δὲ ἐν Δῆλῳ πλοῖον οὐδένα πω νικήσαντα οἶδα, καθῆκον ἐς ἐννέα ἐρέτας ἀπὸ τῶν καταστρωμάτων.

“Près de l'Aréopage, on montre un navire qui a été construit pour la procession des Panathénées. Il a été surpassé (par un autre) depuis. Mais on n'a jamais vaincu le navire qui se trouve à Délos et qui accueille neuf rangées de rameurs, en-dessous, auprès (ou: à partir) des ponts”.

L'un des aspects curieux de ce texte est qu'il établit une comparaison entre un *navire* qui n'était qu' une pseudo-coque montée sur quatre roues et ce qui était manifestement un vrai navire de combat: la raison de cette association d' idées est loin d'être évidente et nécessite au moins une tentative d' explication, qu'on trouvera plus loin.

Au vrai, jusqu'en 1987 on n'avait guère mis en doute que le navire de Délos était un *vrai navire*. A cette date, J.Tréheux, “remis sur la voie droite par F.Chamoux”¹ a trouvé comme “explication évidente”² que le navire délien était, lui aussi, un char processionnel, accordant toutefois à A.Boeckh, dans ses *Urkunden über das Seewesen des attischen Staates* (Berlin, 1840) la priorité de cette identification³. En fait, ce qui troublait Boeckh (op. cit., pp.76-77) était qu'il n'existait, à son avis, aucun rapport (*Keinen Zusammenhang*) entre *die Enneres zu Delos* et le char des Panathénées. Et qui ne serait troublé par le curieux *Zusammenhang*, le rapport que voit clairement Pausanias - même si de tels rapprochements abrupts ne manquent pas dans son oeuvre: ce n'est pas un motif suffisant pour approuver Boeckh, car il est évident que Pausanias tenait le navire de Délos pour un *vrai navire*, pour trois raisons.

1. Il écrit du navire proche de l'Aréopage qu'il n'a jamais été surpassé depuis. Depuis quand? Depuis, sans doute, sa dernière visite, ce qui implique qu'il sait fort bien que depuis lors, cet "engin" a été remplacé par un autre, plus perfectionné dans l'art de la machinerie. Mais du navire *ἐν Δῆλῳ*, il écrit qu'il n'a jamais été vaincu. Or on se demande comment un char processionnel peut être *vaincu*. Cette différence ne se remarque guère dans la traduction que donne de ce passage J. Tréheux, qui rend *ὑπερεβάλετο* par "on en a fait de plus grands" - alors que le char proche de l'Aréopage pouvait être surpassé autrement que par sa taille - et *νικήσαντα* par "surpassé", ce qui ne me semble nullement justifié.
2. Le navire de Délos ne possède pas seulement un pont, mais plusieurs, ce qui se comprend mieux si l'on considère une "hyper-galère" telle que l'Isis dont l'image a été récemment découverte en Crimée et dont les multiples ponts sont très caractéristiques⁴. D'ailleurs, le navire de Délos n'aurait-il possédé qu'un seul pont, voilà bien un élément dont sont privés les chars processionnels athéniens dont les images ne manquent pas⁵.
3. Les neuf files de rameurs doivent s'entendre, étant donné leur nombre impair, par côté, soit dix-huit rameurs par "tranche" de navire (et peu importe ici ce qu'il faut entendre par tranche). Quel char pourrait être mu par de telles tranches de "rameurs figurants"⁶? Or nous verrons que cela ne pose aucun problème pour un "vrai navire".

On verra aussi plus loin pourquoi il est douteux que Pausanias, qui écrivit vers le milieu du 2^e s. de notre ère⁷ ait pu voir le navire de Délos; s'il en est bien ainsi, faut-il une meilleure preuve de l'aura prestigieuse de ce vaisseau sacré, encore vivace dans la mémoire collective grecque et romaine: Pausanias n'éprouve nul besoin d'être plus explicite auprès de son public de lecteurs que l'on dirait, de nos jours, "cultivés".

W. W. Tarn, le premier, identifia celui-ci comme le navire amiral qu'Antigone Gonatas dédia à Apollon en ex-voto après sa victoire sur les amiraux de Ptolémée II au large de Leucolla de Cos (Moschion, cité par Athénée, V, 209 e), victoire datée très diversement par les historiens modernes en 262, 258, 256 et même 245⁸. Cette identification n'a jamais été sérieusement contestée, mais l'emplacement du navire n'a cessé de faire problème.

Les premières campagnes de fouilles de l'Ecole française d'Athènes, qui débutèrent en 1873, mirent au jour un édifice sans équivalent dans le monde hellénique⁹: un bâtiment rectangulaire, long de 69 m. 40 et large de 10 m. 375; il avait l'aspect, écrit, de manière aussi juste qu'imaginées, G. Roux "d'une longue

galerie ajourée, précédée au Sud par un porche dorique, complétée au Nord par un local rectangulaire que surmontait un lanterneau ionique élevé au-dessus du toit de la galerie, si bien que, vu de profil (cet édifice) offrait la silhouette, insolite pour un monument grec, d'une église surmontée de son clocher"¹⁰. Ajoutons que la galerie contient essentiellement un long bassin revêtu de marbre, entouré de banquettes et dépourvu de toute autre construction et que le "local rectangulaire" abrite une structure trapézoïdale en granit, interprétée soit comme une base, soit comme un autel (Fig. 1 et 2). Pendant de longues années, les spécialistes s'accordaient pour attribuer ce bâtiment au 3^e s. av.J-C.

Cet édifice fut appelé "le Monument des Taureaux" en raison de la décoration de certains de ses chapiteaux en forme de protomes de taureaux géminés. Il est actuellement identifié comme le Néorion des inscriptions déliennes et il ne fait aucun doute que la galerie centrale a contenu un navire. Mais lequel? C'est ici que s'engagent les controverses¹¹. C'est en 1921 que, dans un article fameux, P.L. Couchoud et J. Svoronos déterminèrent, avec de solides raisons, la vraie destination de l'édifice: abriter un navire de guerre (Fig.3)¹². Se référant à l'article de Tarn de 1910, ils écrivaient notamment: "Ce que Tarn n'a pas reconnu, c'est qu'à Délos on trouverait peut-être justement ce qui peut rester du colossal ex-voto d' Antigone. C'est l'édifice que nous avons examiné et qui nous a paru avoir pour destination probable d'abriter un navire de guerre"¹³. Toutefois, comme R. Vallois, l' éminent spécialiste de l'architecture délienne, avait indiqué aux deux auteurs que le Monument des Taureaux "a pu être, dans l'ensemble, antérieur à Antigone Gonatas"¹⁴, Couchoud et Svoronos n'écartaient pas la possibilité d'une initiative architecturale de Ptolémée I^{er} Soter (décédé en 285). Mais en vue de la consécration de quel navire? Sur ce point, Couchoud et Svoronos restaient fort discrets.

Réagissant à cet article, Tarn suggérait que le Monument des Taureaux aurait abrité la "pentekaidékère" (πεντεκαιδεκήρης) (ou "le quinze"¹⁵) inventée par Démétrios Poliorcète en 289, capturée par Ptolémée I^{er} et dédiée par lui dans le Monument dû à son initiative¹⁶. On verra que des hypothèses tout aussi riches d'imagination seront publiées par la suite, mais il faut citer ici *in extenso* un passage de l'article de Tarn de 1922, car il annonce d'autres théories qui envisagent que le Monument des Taureaux a pu héberger successivement plusieurs navires différents:

I should imagine that there may have been a sacred ship on Delos from olden time, and that Ptolemy by his dedication supplied Apollo with a finer ἀνάθημα in place of the old ship, and built for it a finer house, which may have replaced an older

building on the same site. When Ptolemy made his dedication the old sacred ship may have rotted away, or it may perhaps have had associations with the hated rule of Athens which rendered a new cult-object welcome to the Delians: and similarly Antigonos, in dedicating his ship, provided a new cult-object to signify the end of Ptolemaic rule. Though an object, once dedicated, was Apollo's for ever, there was no difficulty about replacing an old ἀνάθημα intended for some particular use or purpose, by a new one, if the new one were better than the old; for example, Stratonike provided new and more valuable crowns for the statue of Apollo and for the little Graces¹⁷.

Ainsi le navire d'Antigone Gonatas aurait succédé, dans le Monument des Taureaux, à la dédicace du plus grand navire de Ptolémée Ier, dépouille du père d'Antigone, navire qui lui aurait lui-même succédé à un navire ex-voto plus ancien, très ruiné ou même réduit à l'état de souvenir à l'époque du Lagide¹⁸.

R. Vallois avança une troisième hypothèse: celui d'une dédicace initiale par Démétrios Poliorcète lui-même¹⁹. Ch. Picard se rallia à cette idée et fit du Monument des Taureaux "un trophée de la victoire de Salamine de Chypre" remportée en 306 par Démétrios sur la flotte de Ptolémée Ier²⁰. R. Vallois n'avança toutefois que l'hypothèse d'une initiative architecturale de Démétrios: le monument aurait été laissé inachevé et il serait revenu à Antigone Gonatas de mener à bien le dessein de son père en terminant la construction et, surtout, en y installant son propre navire celui que mentionnent Moschion et Pausanias²¹.

Il revint à G. Roux d'observer qu'une difficulté technique s'opposait aux vues de R. Vallois: après avoir jeté un coup d'oeil sur l'évolution de l'architecture navale militaire au début du 3e s., il aperçut que de Démétrios Poliorcète à Antigone Gonatas - ou, plus généralement, des Diadoques aux Epigones - une course au gigantisme s'était produite, et il tira les conclusions suivantes: "... le navire d'Antigone était plus grand que celui de Démétrios: c'était un de ces mastodontes que se complurent à construire les souverains hellénistiques. Il excédait les dimensions du bassin prévu pour un navire long de 45 m. au maximum. La construction du *Néôrion* était trop avancée pour que l'on pût songer à agrandir l'édifice. On ne pouvait non plus raccourcir le vaisseau. On se résigna donc à loger sa poupe dans le *thalamos*²², sur l'emplacement réservé d'abord à un autel... Afin ... d'éviter à la longue un affaissement, sinon un effondrement de la poupe en porte-à-faux, on construisit sous elle, en l'appuyant directement sur les fondations du dallage, le monument trapézoïdal, simple étai de pierre revêtu de marbre dont

nous voyons les pauvres restes aujourd'hui (Fig. 2). La précaution fut efficace: le navire était encore, au IIe siècle de notre ère, une des curiosités de Délos. Car on ne voit pas que le "vaisseau de Délos", τὸ ἐν Δήλῳ πλοῖον, le plus grand (il avait neuf rangs de rames !) que Pausanias avait vu au cours de ses voyages et qu'il mentionne au passage comme un monument notoire, ait pu être un autre que celui d'Antigone abrité dans le *Néôrion*, seule consécration de ce type et de cette importance connue dans l'île. Placé dans un local trop petit pour lui, qu'il emplissait de sa masse, il devait paraître, par contraste, plus énorme encore: 55 m. de long environ, soit 20 m de plus qu'une trière athénienne! On ne s'étonnera pas qu'il ait fait sur Pausanias une forte impression."²³ Nous voici donc revenus au navire d'Antigone, mais à quel prix: la démolition d'un autel. Ceci n'est d'ailleurs pas le plus grave: R. Vallois, Ch. Picard et, surtout, G. Roux, ne considèrent que la longueur du navire. Or il va de soi, pour des raisons élémentaires de stabilité, qu'une augmentation importante de la longueur s'accompagnait nécessairement d'une augmentation de la largeur; logiquement, G. Roux, qui se refusait, à très juste titre, à raccourcir son vaisseau, aurait dû prévoir, parallèlement à l'occupation du providentiel "local rectangulaire" (ou *thalamos*), un déplacement latéral des murs de la galerie centrale, dont on ne relève aucune trace. Tarn, lui, avait bien vu que le Monument des Taureaux était bien trop étroit pour qu'on y loge une "hyper-galère", mais il résolvait le problème en imaginant que le vaisseau avait été amputé de ses "structures porte-rames" (*outriggers*), partie essentielle de tout navire de guerre grec, à partir de la *trière*²⁴. Une telle désinvolture surprend: il est temps de cesser de considérer le *Néôrion* comme le lit de Procuste.

Et pourtant, les avatars intellectuels "posthumes" du *Néôrion* ne sont pas terminés avec le traitement que lui fait subir G. Roux en 1981. En 1987, J. Tréheux a présenté un (ou deux) nouveau(x) candidat(s) à l'hébergement dans le *Néôrion*, sur les bases suivantes:

1. Dès 1986, J. Tréheux démontrait que la stèle du Musée de Délos inv. 160, publiée en 1912 dans les IG, XI 2 sous le n° 219, et qu'il date de 272 ou de 271, relatait, notamment, un salaire payé à deux ouvriers pour avoir enduit de poix les boiseries du *Néôrion*, qui était donc achevé à cette date. Ce qui permet à J. Tréheux de conclure: "Le compte 219 condamne irrémédiablement la thèse de R. Vallois et celle de G. Roux"²⁵, c'est-à-dire: le *Néôrion* n'a jamais, même s'il a été mis en chantier par Démétrios Poliorcète, pu abriter le navire d'Antigone, puisque la date de la bataille de Cos ne peut être abaissée avant 262, alors que le monument était terminé et qu'aucun navire ne pouvait plus y être introduit.

2. “Quel type de vaisseau pouvait tenir dans une cale de 45 m sur 5 m?”, se demande plus tard J. Tréheux²⁶, qui répond aussitôt: “Aucun calcul ne paraît capable de répondre à cette question”²⁷.
3. Dans ces conditions, il était logique que J. Tréheux se tourne vers les inscriptions déliennes relatives au *Néôrion* pour y chercher le nom que les autorités du sanctuaire donnaient au navire. Ce nom se trouvait à la ligne 16 de l’inscription délienne n^o 1403 (un inventaire du Néôrion daté de peu après 166 av. J.-C.), mais il est perdu à jamais. Vallois avait cru pouvoir restituer une trièrèn, mais telle n’est pas l’opinion de J. Tréheux qui commente ainsi la si fâcheuse lacune: “Neuf lettres selon toute probabilité, dix à la rigueur. Cet indice élimine tous les composés de -ήρης inférieurs à onze et supérieurs à douze, à l’exception de l’*εικοσήρης*, qui est hors de cause. Le vaisseau du *Néôrion* était une *ένδεκήρης* ou une *δωδεκήρης*”²⁸ et c’est à Démétrios Poliorcète, grand inventeur de navires aux combinaisons de rames très diverses, que J. Tréheux, attribue, “sans hésitation”, le *Néôrion*²⁹.

Il est fort difficile de savoir pourquoi J. Tréheux est absolument sûr qu’une “endékère” ou une dodékère n’était pas large de plus de 5 m 50, condition nécessaire pour tout candidat à l’hébergement dans le *Néôrion*, alors qu’il se dit convaincu “qu’il faut admettre, à partir de la tétrère, plusieurs rameurs actionnant la même rame, comme sur les galères modernes. L’heptère n’aurait pas présenté sept rangs horizontaux superposés, mais sept rameurs per rame”³⁰. Quatorze rameurs de front: nous voilà bien au delà de 5m 50. Que dire d’une endékère ou d’une dôdékère? Je comprends que, donnant une suite à cet article de J. Tréheux, en 1989, G. Roux a eu “peine à l’imaginer”³¹. Dans cette suite, G. Roux propose une nouvelle lecture de la lacune de la ligne 46 (ID 1403) et propose *ιεράν τριήρη*³².

Il serait outrecuidant de ma part d’oser trancher entre des lectures différentes d’aussi éminents épigraphistes. Je note toutefois que l’endékère ou la dodékère ne s’imposent pas forcément, que *hieran trièrè* n’est pas insatisfaisant.

G. Roux, dans ce même article, propose un nouveau candidat à l’hébergement dans le *Néôrion*: “un char de luxe en forme de navire offert par un diadoque pouvait constituer un agalma offert au dieu, aussi bien que tout autre objet, et être abrité dans un *Néôrion* construit pour lui, d’autant que le vaisseau conçu pour figurer dans une procession n’avait pas nécessairement les dimensions de l’*έννère* réelle dont il représentait l’image: il fallait qu’il fût manoeuvrable à terre”³³. Voilà qui me semble peu réfléchi: en 1981, G. Roux avait justement noté que le navire du *Néôrion* n’était pas “comme ces bateaux que des marins ingénieux réussissent à glisser

à l'intérieur d'une bouteille à travers un étroit goulot"³⁴ - et voici que, selon le même auteur, un "char de luxe" long de 45 m pouvait être, à volonté, sorti du *Néôrion* pour figurer dans une procession et, après avoir "manoeuvré à terre" (opération difficile à concevoir dans les limites du *Hiéron*), être remise à nouveau dans le monument. Dès 1981, G. Roux avait condamné lui-même son futur candidat.

Il est temps, enfin, de se demander quelles étaient les dimensions prévues par les constructeurs du *Néôrion* (peu importe, pour l'instant, leur identité) pour l'espace réservé au navire qui était, ne l'oublions jamais, la raison d'être du monument. Couchoud et Svoronos proposent, pour cet espace, un rectangle de 49 m. 16 sur 8 m. 86, dimensions qu'ils n'hésitent pas à comparer à celles des "hangars à *trieres* de Zea: 37 m. de long sur 6 m. 50 de large"³⁵. Cette comparaison est fondée sur deux séries d'erreurs. La première concerne les loges de *trieres* du Pirée: 6 m. 50 est la distance qui sépare, à Zea, l'axe de la colonne supportant le toit du hangar à l'axe de sa voisine; cette distance, aux loges de Munychie, est de 6 m 25. Le diamètre des colonnes de Zea, à leur base, est de 58 cm (il n'est pas connu à Munychie). L'espace utile total à Zea est donc de 6 m 50 moins 58 cm, soit 5 m 98³⁶. Une telle largeur est remarquablement constante en Grèce, à quelques dizaines de centimètres près: 6 m 50 à 6 m 60 à Egine (5e siècle)³⁷ et 5 m 72 à Oeniadae (4e s)³⁸. Par ailleurs, D. Blackman a attiré l'attention sur le fait que l'extrémité des *neosoikoi* du côté de la mer n'a été nulle part retrouvée, au Pirée: il est donc loin d'être certain que la longueur des *neoria* retrouvée, soit 37 m., ait été la longueur totale et, par voie de conséquence, que 37 m ait été la longueur maximum d'une *trière* au 4e s³⁹. En revanche, il est permis de déterminer avec une certaine précision la largeur de la *trière* athénienne: compte tenu de la nécessité de pouvoir circuler autour de la coque, on peut estimer la largeur maximum de celle-ci à 5 m 50 environ (ce qui ne laisse guère que 50 cm de "liberté" au maximum!)⁴⁰. Une seconde erreur de Couchoud et Svoronos est d'estimer les dimensions de l'espace libre à 49 m 16 sur 8 m 86. En réalité, le bassin central de la galerie est long de 45 m 65, large de 4 m 485 et profond de 0 m 57⁴¹. Certes, le vaisseau reposant dans le bassin de marbre pouvait-il, dans ses parties hautes, déborder quelque peu sur les banquettes latérales, larges de 1 m 34⁴². Toutefois, ces banquettes étaient manifestement destinées à permettre de circuler autour de l'ex-voto: un navire large de 5m 50 aurait empiété, sur chaque banquette, de 56 cm, laissant un espace libre de 78 cm, espace bien chiche pour un couloir de circulation: on ne pouvait exiger des visiteurs du *Néôrion* les acrobaties familières aux ouvriers des arsenaux du Pirée.

Ainsi, sur la seule base des dimensions de la galerie centrale, la cause aurait dû, depuis longtemps, être entendue: sauf si l'on admet, avec G. Roux, une mutilation de l'édifice initial en même temps (ce qu'avait évité le même auteur) qu'une mutilation du navire, admise avec bonne humeur par Tarn, le seul type de navire compatible avec la largeur utile du *Néôrion* est une trière grecque du 4^e s.

Peut-être dira-t-on que les *neosoikoi* du Pirée, conçus et construits pour des trières, ont été en mesure d'abriter des *tétrères*, qui apparaissent dans les inventaires athéniens de 330/29 et des *pentères*, que l'on aperçoit pour la première fois dans des inventaires de 325/4⁴³. Mais n'oublions pas qu'en 330 (huit ans avant la catastrophe d'Amorgos), Athènes possède 392 *trières*⁴⁴ et 18 *tétrères*: ces dernières ne forment donc que moins d'un pour cent de l'effectif total de la flotte athénienne. Certes, la situation évolue, mais lentement, puisqu'en 325/4, la flotte comprend 360 *trières*, 50 *tétrères* et 7 *pentères*: c'est-à-dire que les *trières* constituent encore 86% de la flotte. Les inventaires contemporains donnent un chiffre total de *neosoikoi* inférieur à l'effectif total des navires: 372 (82 pour Munychie, 196 pour Zea et 94 pour le Kantharos)⁴⁵. Or on n'insistera jamais assez sur le fait qu'un nombre infime de ces loges de navires a été retrouvé et que leur restes ont été insuffisamment étudiés par les fouilleurs⁴⁶.

Il faut conclure que ces loges ne peuvent fournir aucun renseignement sur les dimensions des *tétrères* et des *pentères* athéniennes, dont on sait, avec certitude, que leurs rames différaient de celles des *trières*⁴⁷. Il est plus vain encore de spéculer sur les restes des loges du Pirée pour évaluer, comme le fait J. Tréheux, la largeur d'une *heptère* ou d'une *énnère*⁴⁸, types de navires qui n'ont jamais figuré dans les flottes athéniennes.

En 1973, J. Coupry devait aussi conclure à l'existence d'une *trière* dans le *Néôrion*, mais sur des bases entièrement différentes des miennes: il se fondait sur les inscriptions déliennes. Coupry relevait en effet que les "agrès de la *trière*" (*σκεύη τῆς τριήρους*) apparaissent dans un inventaire délien daté de peu avant 342/1, alors que ces agrès étaient encore absents d'un inventaire daté de ±354/2⁴⁹. La mention *σκεύη τριήρους* ou *σκεύη τῆς τριήρους* se retrouve dans des inventaires postérieurs⁵⁰.

Les agrès des inscriptions étaient-ils ceux d'une vraie trière ou d'un modèle? La question mérite d'être posée: Seleucos dédia à Apollon, dans le "Temple des Athéniens" (Figs 4, 12) une *trière* et une *tétrère* qui ne pouvaient être, comme Tarn l'avait bien vu⁵¹, que des modèles. J. Coupry se prononce, sagement à mon avis, en faveur de la première hypothèse⁵², suivi en cela par H. Gallet de Santerre⁵³.

J. Tréheux a fait observer que la trière à laquelle se rapportent les agrès n'est pas mentionnée et que ces objets étaient entreposés dans l'Oikos des Naxiens (Fig. 4, 6), édifice qui ne pouvait pas, bien évidemment, accueillir la *trière* elle-même⁵⁴. Il n'en reste pas moins vrai qu'un inventaire délien daté de 342 ou peu après mentionne "les agrès de la *trière*"⁵⁵ et on n'échappe donc pas à la conclusion: il existait donc bien en 342 une *trière* consacrée à Apollon. Elle se trouvait probablement en plein air, peut-être sur le chantier d'un bâtiment en cours de construction. La consécration d'une trière dans le Hiéron, tel qu'il se présentait en 350 (Fig. 4) était impossible: un emplacement aussi proche que possible du sanctuaire proprement dit ne pouvait être trouvé, compte tenu des dimensions du navire et de la présence de l'"édifice Δ" et du Prytanée (Fig. 4, 21 et 22), qu'immédiatement à l'Est de ces deux bâtiments. Pendant la construction de l'édifice destiné à l'abriter définitivement, le corps de la trière pouvait être protégé temporairement par un "hangar" de toile ou de bois, mais ses agrès étaient plus fragiles: ils nécessitaient, en attendant l'achèvement du Néôrion, une protection particulière, de même que les agrès des trières, au Pirée, étaient entreposés dans un édifice particulier, la *Skeuothèque*.

Pourquoi une (vraie) *trière* aurait-elle figuré dans des inventaires du sanctuaire délien à l'époque où Athènes dominait encore Délos, c'est-à-dire avant 314? A titre d'hypothèse, J. Coupry avançait une explication qu'il est difficile de contredire: c'est entre 345 et 342 que les Déliens déposent une plainte auprès de l'Amphiclyonie de Delphes contre les droits qu'Athènes s'arrogeait sur Délos. Or Apollon Pythien débouta les Déliens: "cela valait bien qu'Athènes offrît en souvenir à Apollon Pythien, sur l'île de Délos, et quelles que fussent l'origine et la qualification précises de cette offrande (on supposerait plutôt un navire d'origine athénienne qu'une prise de guerre), en tout cas comme le symbole même de cette situation maritime que Pytho approuvait, une *trière*"⁵⁶. Cette hypothèse peut-elle être conciliée avec les données archéologiques et stylistiques du *Néôrion*?

Une réponse définitive ne peut être fournie qu'avec la publication complète du Monument des Taureaux, que prépare Christian Llinas⁵⁷. En l'attendant, notons quelques éléments de réponse qui, du moins, ne sont pas défavorables.

- En 1963 et 1964, Chr. Llinas a procédé à des sondages à l'intérieur et le long des murs extérieurs du Monument⁵⁸; comme le résume Ph. Bruneau⁵⁹, le remblai intérieur, au vu des tessons les plus récents qui s'y trouvaient contenus, daterait de la fin du IV^e ou du premier quart du III^e siècle, le même auteur ajoutant: "la datation de la céramique de la

fin du IV^e siècle et du début du III^e siècle est fort incertaine, surtout à Délos où fait défaut toute couche solidement attribuable au III^e siècle⁶⁰. Certes, les critères stylistiques sont fragiles, mais comment n'être pas attentif à cet avis qu'émet J. Marcadé en conclusion de son étude de la décoration sculptée du *Néôrion*: "A notre avis, si le Monument des Taureaux n'est pas une dernière construction de l'époque amphictyonique, on se gardera en tout cas d'en abaisser beaucoup la date: à en juger d'après la sculpture décorative, les constructeurs - si ce ne sont pas les Athéniens eux-mêmes - semblent bien avoir voulu se poser en héritiers de la longue gloire d'Athènes terra marique"⁶¹.

Il est vrai qu'il serait malaisé de faire remonter la construction du Monument des Taureaux à l'année même de l'apparition dans les inscriptions de la *σκεύη τῆς Τριήρου* en raison de l'état des finances d'Athènes à cette époque, alors qu'une date proche de 330 n'aurait rien d'inconcevable. Existe-t-il des raisons d'expliquer cet écart? Sans tomber dans le travers du *wishful thinking*, il me semble raisonnable d'approuver J. Coupry lorsqu'il écrit à propos de cette ultime manifestation de l'orgueil impérial et naval d'Athènes: "... le temps qu'on en ait conçu l'ordonnance et le décor, les difficultés et les malheurs d'Athènes aussitôt survinrent (guerre indirecte depuis 342, et ouverte depuis l'automne 340, entre Athènes et Philippe, défaite de Chéronée en 338). On comprendrait qu'il ait fallu attendre, par exemple, les effets de la restauration financière de Lycurgue, qui fut aussi un restaurateur de cultes et de monuments, pour que fussent poussées et achevées - dans les derniers moments de la présence athénienne à Délos aux temps classiques - l'édification et toute l'ornementation d'un *Néôrion* consacré à Apollon Pythien et dont les sculptures pourraient n'avoir été exécutées qu'entre 330 et 314 (cette dernière date marquant le début de l'indépendance délienne?)"⁶².

Ces considérations, pour importantes qu'elles sont, me paraissent presque mineures si je les rapporte au fait que la largeur disponible du *Néôrion* exige la dédicace d'une trière athénienne du 4^e s. et ne permet l'abri d'aucun navire d'un rang supérieur.

L'hypothèse, proposée ici, de la consécration à Délos par Athènes d'une trière dans le Néôrion et non d'un navire d'un rang supérieur pose cependant plusieurs problèmes qui ne seront pas éludés.

Le premier est celui de la longueur du bassin: 45 m. Si la largeur disponible correspond à celle d'une trière athénienne, la question de la longueur est plus délicate. On a vu pourquoi la longueur retrouvée, mais incomplète, des néôria

de Zea n'oblige pas nécessairement d'estimer que la trière athénienne était longue de 37 m. Les fouilles de ces loges furent très incomplètes et il est malheureusement impossible de savoir sur quelles raisons (ou documentation) personnelles se fondait Constantin N. Rados, professeur d'histoire à l'Ecole Navale de Grèce pour écrire: "Les restes des docks athéniens, c'est-à-dire des *νεώσοικοι*, dans le port de Zea, montrent qu'à l'origine ceux-ci avaient jusqu'à cent cinquante pieds de long sur vingt pieds de large"⁶³. S'il en était ainsi, et en évaluant, avec Rados, le pied attique à 0 m 3083, on obtiendrait une longueur de 46 m 24 et une largeur de 6 m 16⁶⁴; ces chiffres étant approximatifs, on obtiendrait une quasi-identité avec l'espace libre du *Néôrion*. On n'oubliera pas qu'à Oeniadae la longueur des loges a pu être mesurée: 47 m⁶⁵. Ceci ne signifie pas qu'une *trière*, large au maximum de 5 m 50, mais à la flottaison tout au plus de 4 m 50⁶⁶ ait eu une longueur de l'ordre de 45 m hors tout: il me paraît que des raisons de stabilité s'y opposeraient. Mais il est très probable que la longueur totale de la rampe inclinée des *neosoikoi* comprenait une petite partie immergée, destinée à "recevoir" le navire, de telle sorte que la longueur totale de la rampe était forcément supérieure à celle de la *trière*⁶⁷. Deux raisons pourraient expliquer, dès lors, que le bassin central du *Néôrion*, long de 45m 80, ait été destiné à abriter une *trière* d'une longueur plus courte: ou bien cette longueur était littéralement "calquée" sur celle des *neosoikoi* du Pirée (et je songe moins aux chiffres de C. Rados qu'aux loges d'Oeniadae), ou bien un excédent d'espace était prévu pour loger, auprès de la trière, ses agrès - ces deux hypothèses ne s'excluant pas mutuellement.

Un second problème est, évidemment, celui du début et de la fin de la construction du Monument, s'il est dû à une initiative d'Athènes. Certes, on peut penser "à la période qui précéda la Guerre Lamiaque (réforme navale et militaire de Lycurgue, succès remportés sur les pirates, achèvement de la *skeuothèque* de Philon"⁶⁸, mais le début de la construction ne peut être postérieur à 322, date de la défaite totale de la flotte athénienne devant Amorgos: on voit mal Athènes entreprendre une telle construction, illustration de sa gloire sur mer, après une telle catastrophe⁶⁹. La marge laissée au début de la construction est donc étroite: elle est malaisément imaginable avant la période 338-326, au cours de laquelle Athènes avait reconstitué ses finances⁷⁰. Mais la prospérité d'Athènes, même à cette époque, n'était que relative et il est permis de douter qu'elle ait disposé des moyens de mener une aussi vaste entreprise à son terme au cours d'une dizaine d'années seulement. C'est ici, peut-être, qu'il faut songer aux chapiteaux à protomes de taureaux qui ont donné au Monument son surnom: ils sont bien singuliers pour un monument purement attique. "Ce motif", écrit J. Coupry," peut

évoquer l'art achéménide (dont la connaissance fut réveillée par la conquête d'Alexandre?)⁷¹. On peut en douter: pourquoi un brusque rappel de cette conquête à Délos, où les Athéniens n'avaient aucune raison de flatter, ou même d'évoquer, le Conquérant? En revanche, G. Roux peut avoir vu très juste en rapprochant les protomes de taureaux d'un même motif qui apparaît sur un chapiteau de Salamine de Chypre, au début du 3^e s., époque à laquelle cette région fait partie du domaine de Démétrios Poliorkète⁷². Or Démétrios visita en 301, cinq ans après sa victoire de Salamine, Délos où l'on procéda à cette occasion à des cérémonies et des sacrifices⁷³. Il est probable que cette visite se situa au cours du voyage qui, cette année-là, mena Démétrios d'Athènes à Ephèse. Ainsi pourrait se justifier une hypothèse émise en 1951 par J. Marcadé: "Libérateur" d'Athènes⁷⁴, Démétrios ... a ... pu reprendre à son compte une réalisation commencée par les Athéniens⁷⁵. J. Marcadé ajoute: "pour en faire le monument de ses victoires de Chypre". Ce propos doit être nuancé: un tel geste signifiait une usurpation au préjudice d'Athènes - et un sérieux camouflet à une cité certes très affaiblie, mais dont les ports étaient indispensables à la politique de Démétrios. Il me paraît plus exact de penser que Démétrios a pu reprendre une réalisation commencée par les Athéniens pour glorifier son image de "libérateur et bienfaiteur" d'Athènes, dans l'esprit qui avait présidé à cette entreprise, tout en y associant le rappel de sa propre gloire navale acquise dans les eaux de Salamine de Chypre: les chapiteaux du Monument n'en seraient qu'un rappel, relativement discret.

R. Vallois avait songé, on l'a vu, à une initiative architecturale de Démétrios pour célébrer sa propre victoire. Il est raisonnable de penser que, dans ce cas, il aurait, comme, plus tard, son fils, consacré à Apollon son navire amiral, qui était une *heptère*⁷⁶. Ce type de navire était propulsé par des rames maniées chacune par sept rameurs⁷⁷, selon le système appelé, dans la Méditerranée du XVI^e et du XVII^e s. *a scaloccio*. Or une galère française ordinaire de ce type, au XVII^e s., à cinq rameurs par rame, était large de 8 m 30⁷⁸: il fallait bien loger (notamment), dix rameurs de front; ces nécessités strictement techniques étaient évidemment les mêmes pour les grandes galères hellénistiques, ce qui exclut totalement l'hypothèse de R. Vallois.

En conclusion: le *Néôrion* a été construit pour abriter une *trière* athénienne et n'a jamais pu abriter un autre type de navire. Commencé par Athènes, le Monument fut vraisemblablement achevé par Démétrios Poliorkète.

Puisque le navire d'Antigone Gonatas, auquel pense sûrement Pausanias, n'a pu être logé dans le Monument des Taureaux, où se trouvait-il? Comme il s'agit d'un ex-voto, c'est forcément dans le Hiéron qu'il faut le chercher⁷⁹. La

comparaison des agrandissements successifs du sanctuaire me semble devoir conduire tout droit à la solution de ce problème.

Considérons les Figs 4, 5, et 7. On notera qu'avant la mise en chantier du *Néôrion*, la limite orientale du sanctuaire n'est pas dilimitée par un mur de péribole. Le *Néôrion* lui, sera honoré d'un mur de péribole propre, qui sera aussi celui du *Hiéron*. On observera qu'il était, en partie tout au moins, pourvu de contreforts dirigés vers l'intérieur de celui-ci (Figs 5 et 6). On relèvera aussi qu'avec l'adjonction du Monument des Taureaux et de son mur de péribole, qui rejoint la courbe formée par les murs postérieurs des "trésors" No 16 à 19⁸⁰, l'*Hiéron* acquiert une structure monumentale cohérente et bien définie, qui paraît lui avoir fait défaut auparavant. Le "centre de gravité" de l'ensemble est formé par les trois temples d'Apollon (No 11, 12 et 13).

Il revenait - et nous sommes ici entièrement en dehors du domaine des hypothèses - à Antigone Gonatas de modifier considérablement cet ensemble: il donna au sanctuaire ses limites définitives en construisant, au Nord, probablement pendant le 3^e quart du 3^e s. un portique double long de 120 m et, à l'Est, un long mur de péribole, aux contreforts extérieurs, reliant le portique à la partie méridionale du mur de péribole du *Néôrion*⁸¹, le reste de ce dernier mur ayant été arasé. En avant de son Portique, Antigone avait dressé sur une base longue de 21 m les statues de ses ancêtres mythiques ou historiques, qu'il est convenu d'appeler le "Monument des Progonoi". Le Portique d'Antigone présentait un autre élément de prestige non négligeable à Délos: il "enchâssait", en quelque sorte, en son centre, la vénérable relique qu'était la tombe de deux Vierges hyperboréennes, la *Théké* d'Opis et d'Argé (Fig. 6, no 32) - en fait un tombeau mycénien.

A la Stoa d'Antigone, désormais - et de loin - le plus grand édifice du sanctuaire, faisait face, perpendiculairement, ce qui était jusqu'à sa construction, le plus majestueux bâtiment du *Hiéron*, le *Néôrion*, monument entièrement dédié à la défunte gloire navale d'Athènes. Un tel plan n'est certes pas dû au hasard, mais tel qu'il se présente sur la Fig. 7, il donne l'impression d'un net déséquilibre entre la partie occidentale du sanctuaire, encombrée de constructions de toutes espèces, et la partie orientale, où subsiste un vide - apparemment total - entre le *Néôrion* et le mur Est du péribole. Ce vide est d'autant plus sensible que devant le Portique d'Antigone s'alignaient une soixantaine de monuments votifs⁸²: pourquoi pas plus loin ?

H. Gallet de Santerre écrit: "La place ne manquait pas à l'Est du 'Monument des Taureaux', où s'étendait une zone à peu près vide de constructions depuis

l'origine..."⁸³, après avoir noté que "l'exploration complémentaire de juin 1948 avait confirmé que l'ensemble du terrain n'avait jamais été bâti"⁸⁴. "Depuis l'origine" est quelque peu flou; les fouilles ont mis au jour, à l'endroit marqué d'un X, Fig. 6, un mur courbe dont Gallet de Santerre nous dit que "sa structure comme le niveau auquel il est arasé paraissent lui assigner une date reculée, sans qu'il soit possible de préciser davantage ... qu'il soit mycénien, géométrique ou archaïque, il n'a jamais dû, semble-t-il, servir exclusivement de rempart à la ville ... Était-ce donc le péribole d'un ancien sanctuaire? On l'a cru parfois, et il est assez vraisemblable qu'à l'époque classique il y avait là une sorte de bois sacré"⁸⁵ - un *ἄλλος*.

L'origine du "bois sacré" est singulière: elle repose essentiellement sur le fait qu'au cours des fouilles de 1880, Th. Homolle, dégageant la région en surface lors de l'établissement du plan du *Néôrion*⁸⁶ n'avait rien trouvé entre celui-ci et le mur Est du péribole. Et c'est en raison de ce "rien" qu'il avait, avec l'architecte Henri-Paul Nénot, supposé qu'il y avait là un bois sacré, seule explication de ce qui était, malgré tout, perçu comme une anomalie: l'absence de toute construction dans un sanctuaire qui en regorgeait, partout ailleurs. Nénot, dans son plan de 1882 (Fig. 9) n'hésita pas à donner à son "bois sacré" une forme géométrique aux contours très précisément définis, ce qui témoigne d'une belle audace intellectuelle. Il faut attendre des fouilles de 1904 une exploration plus approfondie, dont on lit les résultats dans le rapport de la même année: "Dans l'espace triangulaire compris entre le péribole, le "Sanctuaire des Taureaux" et le "Portique des Cornes"⁸⁷, il est notable qu'on n'a rencontré aucun vestige d'édifice. Il est donc assez vraisemblable que cette région non-bâtie était plantée d'arbres et qu'elle formait, à l'intérieur du *téménos*, une sorte d'*ἄλλος* ou bois sacré, comme l'avaient conjecturé MM. Homolle et Nénot"⁸⁸. L. Bizard, dans un rapport de 1908, sera plus précis encore: "Rappelons, en terminant cet exposé, qu'en 1904 de grands travaux de déblaiement ont été accomplis à l'Ouest du péribole⁸⁹ dans la partie du *téménos* comprise entre cette enceinte et le Monument appelé "Sanctuaire des Taureaux". Il est notable qu'on n'a trouvé là aucun vestige de construction: la découverte de trois puits (Fig. 7, A, B, C,) et d'un réservoir a été le seul résultat de cette exploration; il y a donc quelque apparence que cette région du *téménos*, dont la terre est particulièrement noire et remplie de racines d'arbres, n'était point bâtie, mais plantée, et qu'elle formait, à l'intérieur du sanctuaire, une sorte d'*ἄλλος*"⁹⁰. Une fois de plus, l'absence de toute construction est jugée "notable", mais on ne pouvait, au début de ce siècle, procéder aux diverses analyses auxquelles on n'eût pas manqué de soumettre, de nos jours, les racines d'arbres, dont rien ne permet d'affirmer avec certitude, ni même avec vraisemblance, qu'ils auraient été d'époque mycénienne, classique, hellénistique, romaine ou byzantine.

On voit donc que l'existence du "bois sacré" n'est qu'une explication facile, faite a priori dès 1880, de l'étrangeté d'un espace vide; cette explication, qui ne repose sur aucune base archéologique sérieuse, n'a plus été remise en question, à ma connaissance, depuis plus d'un siècle.

Un autre candidat possible au "remplissage" (éventuel) du vide est un "jardin proche du *Néôrion*" (κῆπος τὸν πρὸς τῷ Νεωρίῳ), appartenant à Apollon. Il apparaît dans un compte de 156/5 et était loué à 136 drachmes par an⁹¹.

Ce jardin, dont rien ne nous dit qu'il était fort étendu, se trouvait-il entre le Monument des Taureaux et le mur Est du péribole, ou à l'Est de celui-ci- donc hors du sanctuaire? C'est à cette dernière hypothèse que se rallie Ph. Bruneau⁹².

Ainsi un espace apparemment vide s'étendait devant la Stoa d'Antigone, du Monument des Progonoi à la section méridionale, conservée, du mur de péribole du *Néôrion*, vide que ne comblait, au Sud qu'un autel attribué par R. Vallois à Zeus Polieus et Sôter (Fig. 4, No 25), peut-être construit vers 280, donc avant les édifices dus à Antigone⁹³. Cette identification a été contestée par Bruneau et Ducat⁹⁴, qui estiment que cet autel, anonyme, ne peut être qu'"hellénistique". On ne peut toutefois contester que R. Vallois avait, en toute état de cause, raison d'assurer que Zeus Sôter était le patron des navigateurs et l'on verra que cette qualité n'est pas indifférente à l'égard de l'identification de l'autel.

Résumons: nous voici donc en présence d'un ensemble monumental typiquement hellénistique, visant à l'effet, constitué par un cadre (au Nord, la Stoa, à l'Est le mur du péribole, au Sud un autel, à l'Ouest le Monument des Taureaux) dont le centre est occupé par ... rien - si l'on veut bien oublier le carré de légumes du κῆπος et le très hypothétique "bois sacré". En revanche, nous voici, aussi, en présence d'un embarrassant espace libre de plus de cent mètres de long, large de 35 m environ à l'extrémité Nord du Monument des Taureaux (et de 18 m environ au Sud): il y a de quoi rendre perplexe quiconque cherche à comprendre le dessein d'Antigone et de ses architectes. (Figs 10 et 11).

Cette perplexité cesse complètement si l'on place dans cet immense espace vide l'ex-voto d'Antigone: il devient éclatant qu'il constituait le joyau dont les autres constructions qui l'entouraient, dues pour moitié seulement à Antigone, formaient l'écrin: à l'une des extrémités du navire faisaient face la Stoa d'Antigone, le Monument des Progonoi et une soixantaine de monuments votifs, à l'autre un autel dont il devient permis de croire, en raison de la présence du navire votif, qu'il était en effet dédié à une divinité protectrice de la navigation. En outre, l'"hyper-trière" d'Antigone Gonatas, déposée en strict parallèle avec la trière athénienne dédiée dans le Monument des Taureaux, s'affirmait comme sa soeur puînée par l'âge, mais bien plus grandiose encore (Fig. 12).

Il est évident qu'un navire dont les dimensions avaient frappé Moschion et, à sa suite, Athénée - cela à une époque où les souverains hellénistiques tentaient de se surpasser mutuellement à coups d'"hyper-galères" - n'aurait pu être abrité sous une structure de pierre: le navire devait être exposé en plein vent, peut-être sur une estrade, ou un châssis de bois⁹⁵. Il n'est donc pas étonnant que rien n'en ait subsisté. Il est plus curieux, sans doute que, mise à part la remarque de Pausanias, nous ne possédions aucune donnée épigraphique relative à un "monument" qui, par sa nature, dut requérir de fréquentes réparations, mais ce n'est pas, loin de là, le seul exemple du caractère lacunaire de l'épigraphie. Curieux aussi, du moins en apparence, que cet imposant ex-voto n'ait pas servi de point de référence topographique: pourquoi, en 156/5, alors qu'il existait vraisemblablement encore, un "jardin proche du Néôrion" et non "proche de la trière" - ou de l'ennère (cf. Pausanias)? Probablement parce que les jardins d'Apollon étaient localisés par rapport à des parties monumentales proprement dites - le *Néôrion* n'en était pas le moindre - et non à des ex-voto, même prestigieux.

Quel fut le sort du navire d'Antigone? Sauvé des tarets par sa mise au sec, les intempéries et, directement ou indirectement, les ravages exercés dans l'île en 88 et en 69, durent avoir raison de lui sans que rien n'en subsiste après deux siècles et c'est pourquoi il me paraît douteux que Pausanias, même s'il visita Délos, ce qui n'est pas du tout certain, ait pu voir le navire à l'époque de l'"abandon" de l'île sainte⁹⁶.

A défaut d'inscription relative au navire, il est possible que nous en possédions une image.

Les 78 graffiti de navires de Délos qu'il a été possible de conserver⁹⁷ sont tous, à l'exception d'un seul⁹⁸, des images qui, même si elles sont parfois dues à un trait maladroit, représentent des navires qui n'ont rien de fantastique⁹⁹. C'est pourquoi il est singulier qu'un graffiti tracé avec soin dans un stuc de la Maison du Dionysos, retrouvé en grande partie intact (Figs 13 à 15) n'ait pas suscité de commentaires, alors que son voisin immédiat, certainement dû à la même main et qui montre une trière, a connu la célébrité¹⁰⁰.

Une photo (retouchée) de ce graffiti fut publiée en 1922¹⁰¹ (Fig. 13), un relevé graphique en fut exécuté vers 1930 par le capitaine de frégate Carlini et publié par lui en 1934 (Fig. 14) et je pus encore le photographier, dans un état proche de celui de sa découverte, en 1963 (Fig. 15). Il est aujourd'hui bien mal en point. On y distingue essentiellement une coque vue par tribord, d'une longueur immense, si l'on prend pour échelle la taille des extrémités, soit une proue et une poupe de facture très classique. A la poupe, on remarque un épais barrot transversal,

qui servait de point d'appui aux deux gouvernails latéraux. Et l'on note, surtout, la présence de cinquante rames d'un seul bord. Le nom d'*hekatontore*, qui lui fut attribué par le Commandant Carlini¹⁰² est certainement impropre: le suffixe "-oros" désigne un navire dont les rames étaient actionnées par un seul rameur, le nombre des rames étant donné par le chiffre précédant ce suffixe: une triacontore était un navire à trente rameurs et à quinze rames de chaque bord. Or il est impossible de croire en l'existence d'un navire d'une telle longueur à cinquante bancs de nage occupés par deux rameurs, un de chaque côté, maniant sa propre rame: un tel "moteur humain" aurait été par rapport aux dimensions de la coque, dérisoire.

En revanche, une galère propulsée par des rames actionnées chacune par neuf hommes (cf. Pausanias!) est techniquement concevable¹⁰³. Certes, on peut être sceptique quand à l'existence de cinquante bancs de nage, occupés chacun par dix-huit hommes, sur une telle galère. En matière de bancs de nage, le maximum attesté par une source écrite me paraît avoir été celui de la galère à 36 bancs du corsaire turc Ucciali, amiral de Sélim II, en 1572¹⁰⁴. Y ajouter quatorze bancs (et quels bancs!) n'aurait pas été une mince affaire, mais on ne peut perdre de vue que le navire d'Antigone Gonatas, conçu spécialement pour défaire un formidable navire construit par Lysimaque, le *Leontophoros*¹⁰⁵, faisait partie d'une série d'"hyper-galères" gigantesques, construites au cours de la première moitié du 3e s., dont les caractéristiques techniques nous échappent, mais dont il faut bien admettre qu'elles furent efficaces - à l'exception, aux dires de Plutarque, de la *tessarakontère* de Ptolémée IV, victime de la démesure de son auteur¹⁰⁶.

C'est bien par sa taille, anormale, même pour l'époque, que le navire d'Antigone frappa Moschion, de même que le souvenir de son efficacité était encore vivant pour Pausanias.

Il convient ici de revenir sur la surprenante association d'idées de Pausanias, évoquant l'immense navire de Délos à propos du modeste "char nautique" des Panathénées, dont il ne nous livre qu'une seule caractéristique, plutôt négative: il peut être surpassé par un autre "navire" du même genre. Voilà une particularité qui n'est pas signalée, généralement, par les guides touristiques, mais qui peut s'expliquer ici si Pausanias avait eu vent d'un projet de remplacement du char proche de l'Aréopage par un autre engin en voie d'achèvement. Or Philostrate a vu, quelques années après Pausanias, un "navire" de la procession panathénaique qui comptait mille "rames" et se mouvait le long d'un rail¹⁰⁷. Si, comme on peut le supposer, Pausanias était au courant, par un cicerone local, de ce projet, l'association d'idées

devient explicable entre ce “mille-pattes” mécanique surtout remarquable, sinon unique au monde, par le nombre effarant de ses rames et un navire qui, lui aussi, était célèbre par un nombre différent, mais en fait tout aussi effarant, de rames.

Je conviens volontiers que le graffiti de la Maison du Dionysos ne permet pas de distinguer les *katastrômata* mentionnés par Pausanias¹⁰⁸ et que l'unique et gigantesque voile dont l'auteur du graffiti a muni son navire paraît peu réelle - surtout si l'on pense que le navire de Délos était un trois-mâts (le *triarmenos* d'Antigone, cité par Pollux (1,82)¹⁰⁹. Mais comme le graffiti est probablement de peu postérieur soit à la catastrophe de 88, soit à celle de 69, l'ex-voto se trouvait livré aux dommages des éléments et des hommes depuis au moins un siècle et demi: son gréement ne devait pas, depuis longtemps, avoir résisté, ni même, probablement, ses superstructures.

En résumé, les hypothèses suivantes sont proposées ici:

1. Consécration d'une *trière* par Athènes à Délos, probablement à l'emplacement du futur “Monument des Taureaux”, peu avant 342, à l'issue du litige tranché en sa faveur par Apollon Pythien. En attendant que soit construit l'édifice majestueux destiné à abriter l'ex-voto (qu'il était fort aisé de construire sur place), ses agrès étaient mis à l'abri dans l'Oikos des Naxiens, et comptabilisés.
2. En 330 ou peu de temps après, à un moment où la situation financière d'Athènes s'améliore sensiblement: début de la construction du *Néôrion*.
3. Interruption (ou, en tout cas, net ralentissement) des travaux après la défaite navale d'Athènes devant Amorgos.
4. Cessation probable des travaux en 314, date généralement admise pour l'Indépendance de Délos; la situation devait cependant être embarrassante pour les Déliens: consacrer des ressources, probablement maigres, à l'achèvement d'un monument à la domination athénienne dont ils venaient d'être affranchis n'était guère raisonnable, mais détruire un *agalma* déjà consacré à Apollon était sacrilège.
5. Il est vraisemblable que Démétrios Poliorcète, maître d'Athènes à partir de 307, fournit la solution: en achevant le *Néôrion*, à partir de 306, date de sa victoire devant Salamine de Chypre, il atteignait des fins multiples:
 - flatter Athènes, qui lui était stratégiquement nécessaire en raison de ses ports;
 - suivant une tradition remontant à Polycrate de Samos et qui voulait qu'une thalassocratie égéenne s'affirmât en honorant Délos¹¹⁰, il

soulageait les Déliens du fardeau que leur avaient légué les Athéniens tout en embellissant le Hiéron d'une manière éclatante;

célébrer sa gloire personnelle: à défaut de pouvoir, pour des raisons techniques, loger dans le *Néôrion* l'*heptère* victorieuse à Salamine, il réussit à y insérer un motif qui vaut signature, à tel point que le *Néôrion*, dont l'identité était inconnue au moment de sa découverte, fut, pendant des décennies, appelé "Monument des Taureaux".

Peut-être la visite de Démétrios en 301 à Délos fut-elle l'occasion de la consécration de l'édifice lui-même. Il faut noter ici que le *prodromos* du *Néôrion* contenait deux proues dorées, votives, dont l'une était ornée de la *stephané*, le diadème royal macédonien¹¹¹. Or Antigonos Monophtalmos avait élevé son fils, Démétrios, à la royauté après sa victoire de Salamine¹¹².

6. Antigone Gonatas, après sa victoire de Leucolla de Cos, décide de suivre l'exemple de son père, mais de manière plus complète et plus grandiose: il agrandit le sanctuaire tout entier, lui assignant ses limites définitives, en choisissant pour centre de ses constructions son navire amiral, l'ennère victorieuse, posée parallèlement à l'écrin offert par son père à l'ex-voto athénien: il réalisait ainsi la fusion de sa propre gloire avec la continuité des hommages navals rendus à Délos par les maîtres successifs de la mer Egée.

Aujourd'hui, il demeure, à Délos, ceci: un espace long d'une centaine de mètres, entre le Monument des Progonoi et l'autel (dit) de Zeus Polieus et Sôter, dont le vide total¹¹³ n'est qu'apparence: là gît l'ombre de l'un des plus fameux vaisseaux de tous les temps - et ce vide même suffit à témoigner de sa grandeur.

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NOTES

1. Tréheux (1987), pp. 178, 179. Le même auteur admettait encore en 1986 que l'identification faite par Tarn en 1910 du navire d'Antigone Gonatas était fondée sur "de bons arguments" (Tréheux (1986), p.303).
2. Ibid., p.179, n. 67.
3. Ibid. J. Tréheux est suivi sur ce point par G. Roux (1979), p. 271, n. 38, mais avec une importante nuance.
4. Basch, L., "The Isis of Ptolemy II Philadelphus", *The Mariner's Mirror*, 71, 1985, pp. 129-151 et Basch (1987), pp. 493-496.

5. Basch (1987), p. 228, Fig. 475; p. 347, Fig. 732.
6. L'expression est de J. Tréheux (1987), p. 179.
7. Ce n'est pas ici le lieu de préciser davantage la date de la composition et de la publication, controversée, de la Périégèse.
8. Tarn (1910); on trouvera de nombreuses références relatives à la date de la bataille de Cos in: Bruneau (1970), p. 554.
9. Du moins jusqu'à une date récente: depuis 1986, l'Ecole américaine fouille, à Samothrace, dans le Sanctuaire, un édifice - appelé provisoirement "Ship Monument" - qui a abrité un navire dédié en ex-voto. Il serait daté de la première moitié du 3^e s. av. J. - C. Les fouilleurs ont émis l'hypothèse d'un ex-voto d'Antigone Gonatas après la bataille de Cos, d'Andros ou une autre victoire navale (*Archaeological Reports of British School, Archaeology in Greece* 1986-87, p. 51 et 1987-88, pp. 62-63).
10. Roux (1981), p. 61.
11. Il en existe une autre, importante, au sujet des fonctions du *Néôrion*: était-il, en outre le Pythion mentionné par les inscriptions? Cette controverse est étrangère à notre sujet. Pour un état récent de la question: Gallet de Santerre (1982).
12. Couchoud et Svoronos (1921).
13. Ibid., p. 276.
14. Ibid., p. 285.
15. Tarn (1922).
16. Ibid., p. 474.
17. Ibid.
18. Il est juste d'ajouter que Couchoud et Svoronos avaient déjà évoqué l'idée d'un édifice plus ancien qui aurait aussi abrité un navire sacré (art. cité, p. 281).
19. Vallois (1944), pp. 35 et 39.
20. *Revue Archéologique*, 1952, II, pp. 79-83.
21. Vallois (1944), pp. 35 et 39.
22. Nom donné parfois au "local rectangulaire" le nom de *thalamos*: cf. Vallois (1944), p. 33 et n. 5.
23. Roux (1981), pp. 69-70.
24. Les "porte-rames" de la *trière* (*parexeiresia*) ne supportait qu'un seul rang de rames; à partir de l'époque où Démétrios Poliorcète domine la mer, une structure plus complexe, la "caisse de rames" (le nom grec est inconnu), qui supporte deux ou trois rangées de rames, lui succède. Cf.: L. Basch, "La "caisse de rames" hellénistique et le relief No 13533 du Musée de l'Acropole", *Cahiers d'Histoire*, 33, 1988 (Navires et commerces de la Méditerranée antique - Hommage à Jean Rougé), pp. 291-301.
25. Tréheux (1986), p. 306.
26. Tréheux (1987), pp. 179-180.
27. Ibid.
28. Ibid.
29. Ibid., p. 181.
30. Ibid.
31. Roux (1989), p. 272.
32. Ibid., p. 271.
33. Roux (1989), p. 271, n. 38.
34. Roux (1981), p. 69.
35. Couchoud et Svoronos (1921), p. 273.
36. D. J. Blackman (1968), p. 182.
37. Basch (1987), pp. 295, 296.
38. Basch (1987), p. 348.

LE "NAVIRE INVAINCU A NEUF RANGEES DE RAMEURS" DE PAUSANIAS (I, 29. 1)
ET LE "MONUMENT DES TAUREAUX", A DELOS

39. La trière "reconstituée" en 1987 par J. S. Morrison et J. Coates, en Grèce, est longue de 36m 80 (J. Coates, in: *An Athenian Trireme Reconstructed - The British sea trials of Olympias, 1987, British Archaeological Reports, International Series 486* (1989), p. 20).
40. La largeur adoptée pour la "trière reconstituée" dont il est question à la note précédente est de 5 m 45 (J. Coates, *ibid.*)
41. Vallois (1944), p. 39, n.1 (longueur et largeur); Bruneau et Ducat (1983), p. 138 (profondeur).
42. Bruneau et Ducat (1983), *ibid.*
43. *GOS*, p. 286; Casson (1971), p. 102 et p. 364.
44. Le chiffre de 492 trières, dans mon livre de 1987, p. 337, est évidemment une coquille.
45. Blackman (1968), p. 187.
46. On a même pu se demander si les vestiges trouvés à Munychie étaient bien ceux de neosoikoi: Blackman (1968), p. 181.
47. J. S. Morrison a démontré que le système de propulsion des tétrères athéniennes différait de celui des trières, puisque les rames des unes étaient différentes de celles des autres ("Notes on certain Greek nautical terms and on three passages in I. G. 2, 1632", *Classical Quarterly*, 41, 1947, pp. 132-135). J'ai dit ailleurs (Basch (1987), pp. 337-342) pourquoi les tétrères et les pentères, invention de Carthage, probablement peu après la destruction de Motya en 397, étaient des navires propulsés respectivement par des rames armées par quatre et cinq hommes, système que L. Casson (1971, p. 105) admet pour la quinquérème romaine de la première guerre punique (264-261).
48. Tréheux (1987), p. 179.
49. Coupry (1973), p. 148. il s'agit de I.D. 104-25.
50. - *σκεύη τριήρους* dans I.D. 104-29, ligne 13;
- *σκεύη τῆς τριήρους* dans I.D. 104-26, face B, ligne 16.
51. W.W. Tarn, *Antigonos Gonatas* (Oxford, 1913), p. 81, n. 36. Cf., aussi, W. Deonna, *Le mobilier délien (Exploration Archéologique de Délos, XVIII, 1938)*, p. 197, no 87.
52. Coupry (1973), p. 148.
53. Gallet de Santerre (1982), p. 225.
54. Tréheux (1986), p. 308.
55. voir ci-dessus n. 50.
56. Coupry (1973), p. 156.
57. Je saisis cette occasion pour dire à M. le professeur Llinas toute ma gratitude pour les réponses qu'il a bien voulu donner à mes nombreuses questions.
58. Rapports de Chr. Llinas in: BCH, 88, 1964, pp. 901-905 et BCH, 89, 992-996 (Chronique des fouilles).
59. Bruneau (1970), p. 556.
60. *Ibid.*, p. 557.
61. Marcadé (1951), p. 89.
62. Coupry (1973), p. 156.
63. C.N. Rados, *La bataille de Salamine* (Paris, 1915), p. 82.
64. Rados donne d'abord ses mesures en pieds (p. 82) et la valeur du pied à la p. 83. Si l'on adopte la valeur de 0 m 296 (pied attique solonien), on obtient une longueur de 44 m 40 et une largeur de 5 m 92.
65. J. Sears, "Oeniade. The ship sheds", *American Journal of Archaeology*, 8, 1904, p. 227.
66. Au maximum. Avec un déplacement de 40 tonnes, la largeur de la "trière reconstituée" de J. S. Morrison et J. Coates est, à la flottaison de 3m 62 (J. Coates, *op. cit.* (note 23), p. 20). La différence entre la largeur hors tout et la largeur à la flottaison s'explique par la présence des "porte-rames" (*parexeiresia*) qui débordent la coque.
67. Au 3e Symposium "Ship Construction in Antiquity" (Athènes, 1989), J.S. Morrison, dans une communication a cependant admis que la longueur de la trière pouvait excéder quelque peu 37 m.

68. Marcadé (1951), p. 89, n. 2.
69. Athènes n'a pas été totalement paralysée sur mer après la défaite d'Amorgos: voir: H. Hauben, "An Athenian naval victory in 321 B.C.", *Zeitschrift für Papyrologie und Epigraphik*, 13, 1974, pp. 61-64; mais ce n'était plus là qu'une grosse escarmouche: après 322, la marine de guerre d'Athènes, en tant que force dominante et organisée, a cessé d'exister.
70. J'entends par "construction" la mise en place effective des soubassements définitifs au moins. Le plan a pu être délimité sur place à une date antérieure.
71. Coupry (1973), p. 149.
72. Roux (1981), p. 71 et n. 58. Voir aussi les références citées par Gallet de Santerre (1982), p.221, n. 98.
73. Gallet de Santerre (1982), p.222.
74. Qu'il occupe en juin 307.
75. Marcadé (1951), p. 89, n. 1.
76. Diod. Sic., XX. 50.3.
77. Sur les *heptères*: Basch (1987), pp. 338-342.
78. J. Humbert, *La galère du XVIIe siècle* (Grenoble, 1986), p. 150.
79. Il est impensable que le navire ait été mouillé à demeure dans le port mal abrité de Délos: non seulement il aurait sérieusement gêné le trafic dans un espace déjà exigu, mais, surtout, en raison de sa taille qui donnait prise au vent, il aurait rapidement été jeté au rivage et détruit.
80. Au sujet de cette jonction, voulue: Vallois (1944), p. 37. Pour les fouilles: Holleaux (1908).
81. Ph. Bruneau et J. Ducat écrivent, dans les trois éditions de leur indispensable *Guide de Délos* que ce mur "date d'un agrandissement qui est contemporain de la construction du Monument des Taureaux" (3e édition, p. 141). Il doit s'agir ici d'un lapsus calami, d'autant plus que les auteurs ajoutent immédiatement:
"Le sanctuaire fut agrandi une seconde fois vers 250 au moment où fut édifié le Portique d'Antigone"; or le mur Est du péribole est précisément la matérialisation de ce second et ultime agrandissement.
82. Bruneau et Ducat (1983), p. 144.
83. Gallet de Santerre (1982), p. 219, n. 87.
84. Gallet de Santerre (1982), p. 219, n. 87.
85. Ibid.
86. Th. Homolle, "L'autel des Cornes à Délos", *BCH*, 1884, pp. 417-438; plan par H.P. Nènot: pl. XIX. Aussi: *Revue Archéologique*, 1880, pl. XV. Le *Néôrion* n'a jamais été complètement enfoui et figure déjà sur le plan de Délos par Stuart au XVIII^e s., qui, faute de fouilles, en fait plusieurs monuments distincts.
87. Nom donné, en raison de la décoration de ses métopes, au Portique d'Antigone, qui n'avait pas encore été identifié en 1904.
88. Holleaux (1904), p. 729.
89. En réalité: à l'Est.
90. Bizard (1907), p. 34.
91. Inscriptions de Délos no 1417, B, II, lignes 110-111.
92. Bruneau (1979), pp. 93 et 95.
93. Vallois (1944), p. 44.
94. Bruneau et Ducat (1983), pp. 140-141, qui attribuent à cet autel une date "hellénistique".
95. La question de son transport à cet endroit, compte tenu, notamment, des constructions existantes, est évidemment ardue, mais elle se pose quel que soit l'endroit de la consécration. On peut songer à un démontage suivi d'un remontage, mais il faut bien convenir que les techniques de construction navale antiques rendaient une telle opération fort difficile.
96. Sur l'"abandon" de Délos: Bruneau (1968). Pausanias a-t-il visité Délos? Ce qui permet d'en

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douter est qu'il écrit que Ménophane, général de Mithridate, détruisit Délos "jusqu'à ses fondations" (III, 23, 4) (il s'agit de l'invasion de 88 av. J-C.): si Pausanias a visité l'île au 2^e s. de notre ère, il n'aurait pu écrire une aussi évidente contrevérité. En revanche, il décrit avec un luxe de détails une antique statue de bois d'Aphrodite (un xoanon) qui se trouvait à Délos (IX, 40, 2), mais il n'est pas exclu qu'il utilise une source écrite ou orale.

97. Basch (1987), pp. 351, 373-380 et 498.
98. Basch (1987), p. 382 et Basch, "Graffites navals à Délos", *BCH, Supplément I*, 1973, Etudes déliennes, pp. 65-76.
99. D'une manière générale, il est tout à fait exceptionnel qu'un graffito de navire représente un navire imaginaire, ce qui peut être vérifié sur plusieurs centaines de graffiti navals, du Moyen Age au XVIII^e siècle, tant en France qu'en Grèce. La maladresse de certains auteurs de graffiti peut entraîner une déformation de certains aspects du navire, mais elle est alors involontaire et souvent facilement explicable.
100. On la retrouve, par exemple (mais "améliorée"!) dans l'ouvrage de J. de la Varenne, destiné au grand public (et d'ailleurs excellent), *La navigation sentimentale* (Paris, 1952), p. 59, fig 30.
101. J. Chamonard, *Le Quartier du Théâtre, I (Exploration archéologique de Délos VIII)*, 1922, p. 203, Fig. 286.
102. Carlini, "Les galères antiques", *Bulletin de l'Association technique, maritime et aéronautique*, 1934, p. 77. Blass, dans l'édition Teubner de Bacchylide, introduit l'épithète *ἐκατόντορον* pour le navire de Thésée, ce qui semble bien peu approprié. Pollux mentionne ce terme (I, 82) à une époque où le terme a pu désigner un navire mythique, équivalent à l'*hekatozugos* d'Homère (Iliade, 20, 247), qui doit être considéré comme une hyperbole: cf. Casson (1971), p. 46, n. 19).
103. Le navire d'Antigone fut conçu pour vaincre le Leontophoros construit par Lysimaque, un navire gigantesque propulsé par des rames actionnées par huit hommes. Dès lors, il est permis de supposer qu'Antigone ait voulu réaliser une galère à neuf hommes par rame. Etait-ce techniquement possible? Le capitaine Pantero Pantera, homme de mer, écrit dans son *Armata Navale* (Rome, 1614): "Le galeazze; che sono utilissime nelle impresi grandi; essendo corpi gravi, e tardi; non si deveno armare a meno d'otto huomini per remo, e de i migliori, che si habbiano" (p. 152). "A meno": neuf hommes est donc un effectif implicitement admis par ce technicien. Sur les rapports du Leontophoros et du navire d'Antigone (probablement nommée Isthmia): Basch (1987), pp. 345-347.
104. A. Jal, *Archéologie Navale* (Paris, 1840), I, p.386.
105. cf.note 75 ci - dessus.
106. sur ce navire: Casson (1971), pp. 108-112.
107. Philostrate, *Vit. Soph.*, 550.
108. Sur ce pluriel, cf. la note 4 ci / dessus.
109. Nous possédons une image d'un navire de guerre hellénistique à deux mâts (Basch, (1987), p. 346, Fig. 731) et celle d'un navire de commerce romain à trois mâts (Basch (1987), p.477, Fig. 1076).
110. Polycrate de Samos avait consacré Rhénée à Apollon Délien (Thucydide, I, 13) en la rattachant à Délos par une chaîne (Thucydide, III, 104).
111. Tréheux (1987), p. 172.
112. Plutarque, *Vie de Démétrios*, 18.1.
113. Je n'oublie pas que ce vide ne fut pas, tout au long de l'histoire de Délos, total: des maisons furent tardivement adossées au mur Est du péribole, à l'intérieur du *téménos*, et leurs restes furent détruits lors des fouilles. Etaient-elles byzantines (F. Durbach et A. Jardé, *BCH*, 29, 1905, p. 256, n.4) ou plus tardives (Bruneau (1968), p. 704)? Peu importe ici: il est évident qu'à l'époque byzantine plus rien ne subsistait du navire proche du mur.

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LEGENDES DES ILLUSTRATIONS

- Fig. 1. Le Néôrion (ou "Monument des Taureaux"), plan simplifié, d'après Bruneau et Ducat (1963).
 A. Le porche dorique (ou prodomos).
 B. La galerie centrale; en son centre, le bassin rectangulaire, entouré de "banquettes".
 C. Le "local rectangulaire" (parfois appelé *thalamos*), avec, en son centre, la base trapézoïdale faite de blocs de granit (cf. Fig. 2).
- Fig. 2. Le Néôrion vu du Nord. Au premier plan, la base trapézoïdale, au second plan la galerie centrale. Photo de l'auteur, juillet 1967.
- Fig. 3. "Essai de restitution provisoire du monument dit "des Taureaux", à Délos", d'après Couchoud et Svoronos (1921), p.283.
- Fig. 4. Le Hiéron vers 350. (schéma fondé sur la pl. I de: Bruneau et Ducat (1983)).

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- 6: "Oikos des Naxiens" (premier temple d'Apollon à Délos). 7e s.
 11. "Porinos naos". Fin du 6e s. (?).
 12. Temple des Athéniens. Vers 425-420.
 16 à 20: "Trésors". Le No 16 date du 6e s., les autres de la première moitié du 5e s.
 21. Edifice Δ. Première moitié du 6e s.
 22. Prytanée. Première moitié du 4e s. (?).
 23. Autels, du 6e et du 5e s. Ils ne faisaient pas partie du Hiéron.
 35. *Graphè*. Fin du 5e ou début du 4e s.
 36. Stoa des Naxiens. Fin du 6e s.
 39. "Monument à abside". Commencé au 5e s.
 42. Sanctuaire non identifié. Commencé au cours de la première moitié du 4e s.
 43. Monument non identifié. 6e siècle?
 44. "Monument aux hexagones". Vers 500.
 45. Portique. 4e s.
 46. Artémision. Remonte, quant à ses fondations, au 7e s.
 47. *Ekklesiastérion*. Début du 5e s. (dans son premier état).
 48. Edifice à cour péristyle (*hestiatorion*?). Milieu ou second quart du 5e s.
- Fig. 5. Le Hiéron vers 300. (schéma fondé sur la pl. I de: Bruneau et Ducat (1983)).
 24: Le *Néôrion*, ou "Monument des Taureaux", entouré de son mur de péribole. En S: section du mur représentée à la Fig. 6.
- Fig. 6. Section Nord du mur de Péribole du Néôrion (partie S du mur, sur la Fig. 5). Photographie prise au cours des fouilles de 1907. Document: Ecole française d'archéologie à Athènes.
- Fig. 7. Le Hiéron vers 225. (schéma fondé sur la pl. I de: Bruneau et Ducat (1983)).
 25: Autel dit de Zeus Polieus et Sôter.
 29: Portique d'Antigone Gonatas.
 31: Monument des Progonoi.
 32. *Théké* des Vierges hyperboréennes Opis et Argé X. Emplacement des vestiges d'un mur courbe de date inconnue (mais pré-classique). A, B, C: puits.
- Fig 8. Modèle de la région du Hiéron, vers 100 av. J.-C. A gauche, le grand quadrilatère représente l'Agora des Italiens, commencée vers 110. On distingue nettement l'emplacement central qu'occupait le *Néôrion*, de même que l'espace vide à l'Est de celui-ci. Modèle du Musée de Délos. Photo de l'auteur, avril 1980.
- Fig. 9. Le "bois sacré", d'après le plan restauré d'Henri - Paul Nénot (1882). D'après le catalogue de l'exposition "Paris-Rome-Athènes. Le voyage en Grèce des architectes français aux XIXe et XXe siècles" (Paris, 1982), p. 260.
- Fig 10. Vue, prise du Sud, de l'espace vide entre le Néôrion, à gauche, et le mur Est du péribole, à l'extrême droite. Au premier plan, mur d'enceinte de l'autel (dit) de Zeus Polieus et Sôter. Photo de l'auteur, avril 1980 (avec un objectif de 50 mm, correspondant à la vision normale).
- Fig. 11. Même vue que celle de la Fig. 10, mais avec un objectif de 28 mm, permettant d'inclure l'autel (dit) de Zeus Polieus et Sôter et le Néôrion tout entier. Photo de l'auteur, avril 1980.
- Fig. 12. Emplacement présumé (et approximatif) du navire dédié à Apollon Délien par Antigone Gonatas.
- Fig. 13. Graffito de la Maison du Dionysos: l'*hekatontore*. D'après: *Exploration archéologique de Délos*, VIII (1922), p. 203, Fig. 286.
- Fig. 14. Graffito de la "Maison du Dionysos: l'*hekatontore*. Relevé du Commandant Carlini, vers 1930.
- Fig. 15. Graffito de la Maison du Dionysos: l'*hekatontore*. Photo de l'auteur, juillet 1963.

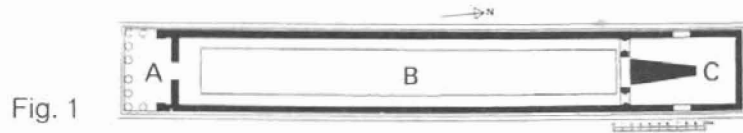


Fig. 2

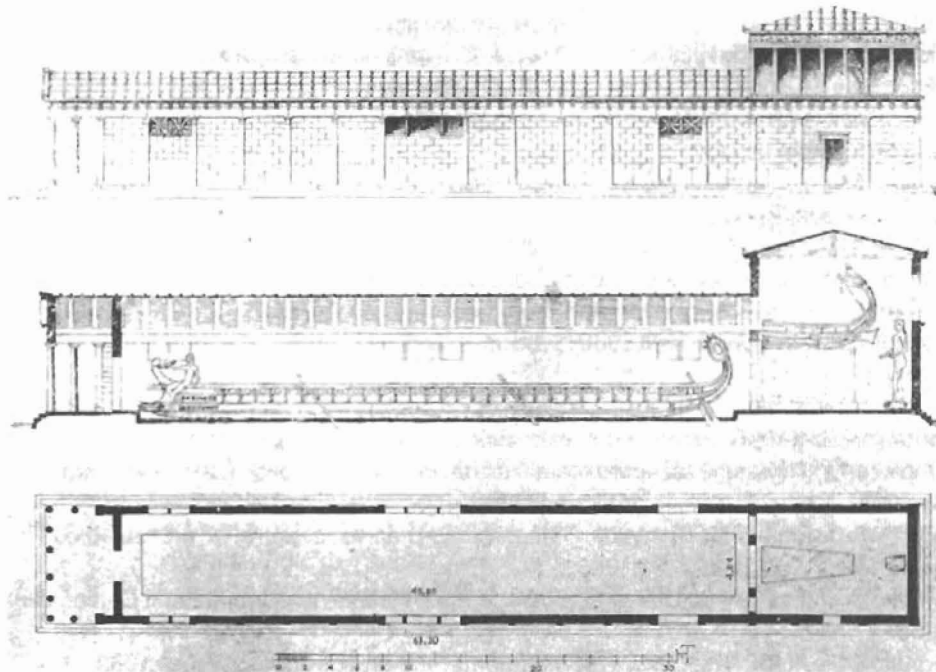


Fig. 3

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Fig. 4

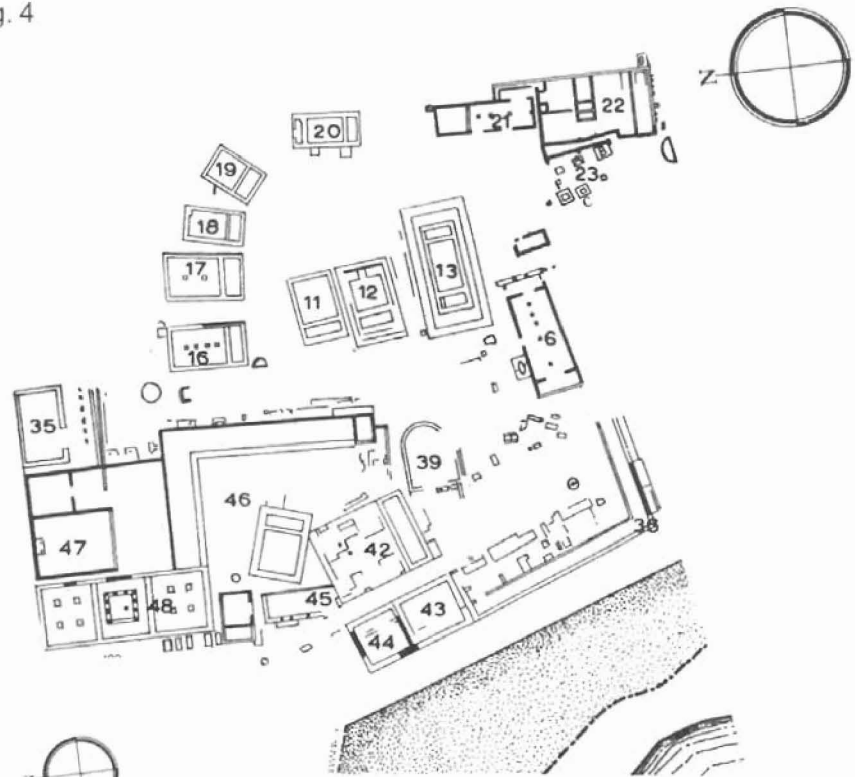


Fig. 5



Fig. 6



Fig. 7

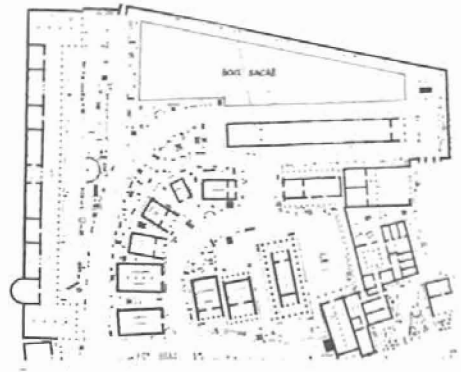


Fig. 9

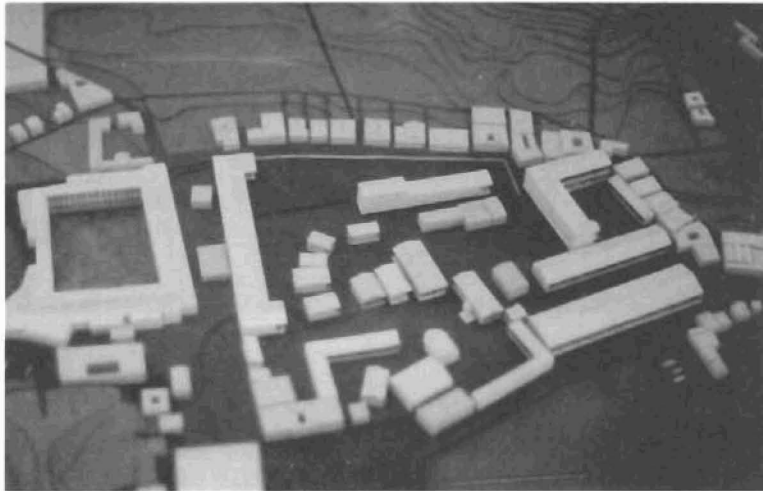


Fig. 8



Fig. 10

LE "NAVIRE INVAINCU A NEUF RANGEES DE RAMEURS" DE PAUSANIAS (I, 29. 1)
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Fig. 11

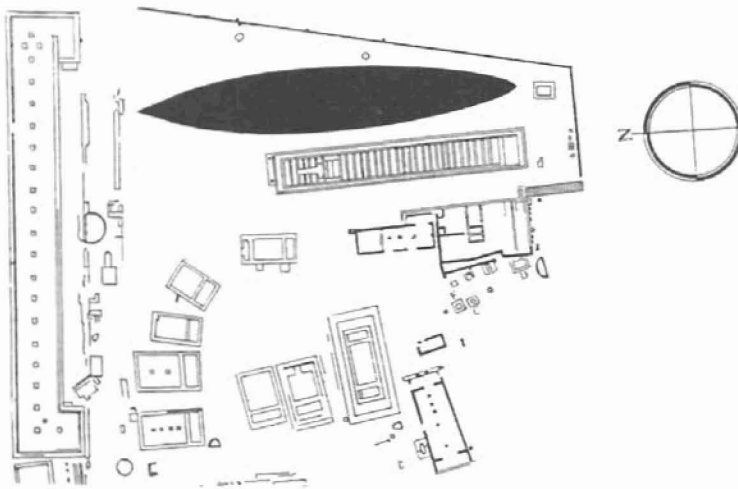


Fig. 12

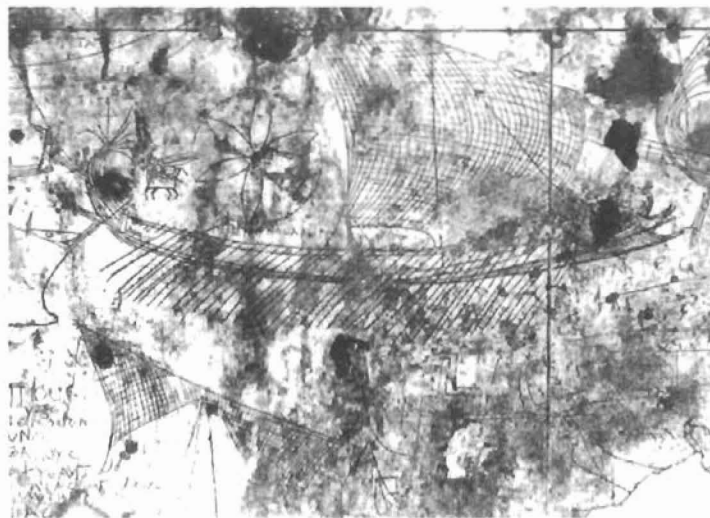


Fig. 13

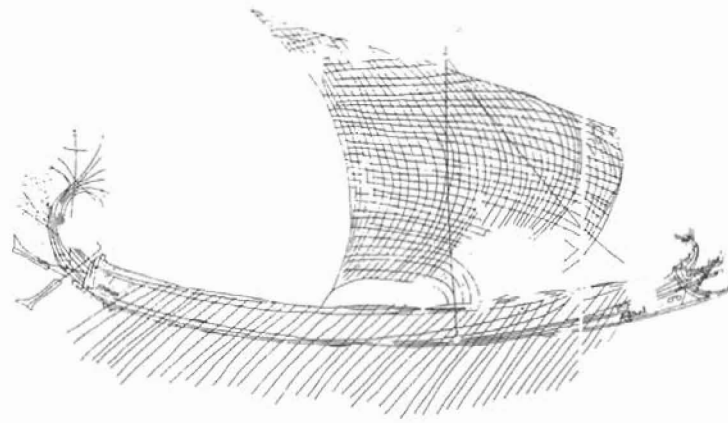


Fig. 14

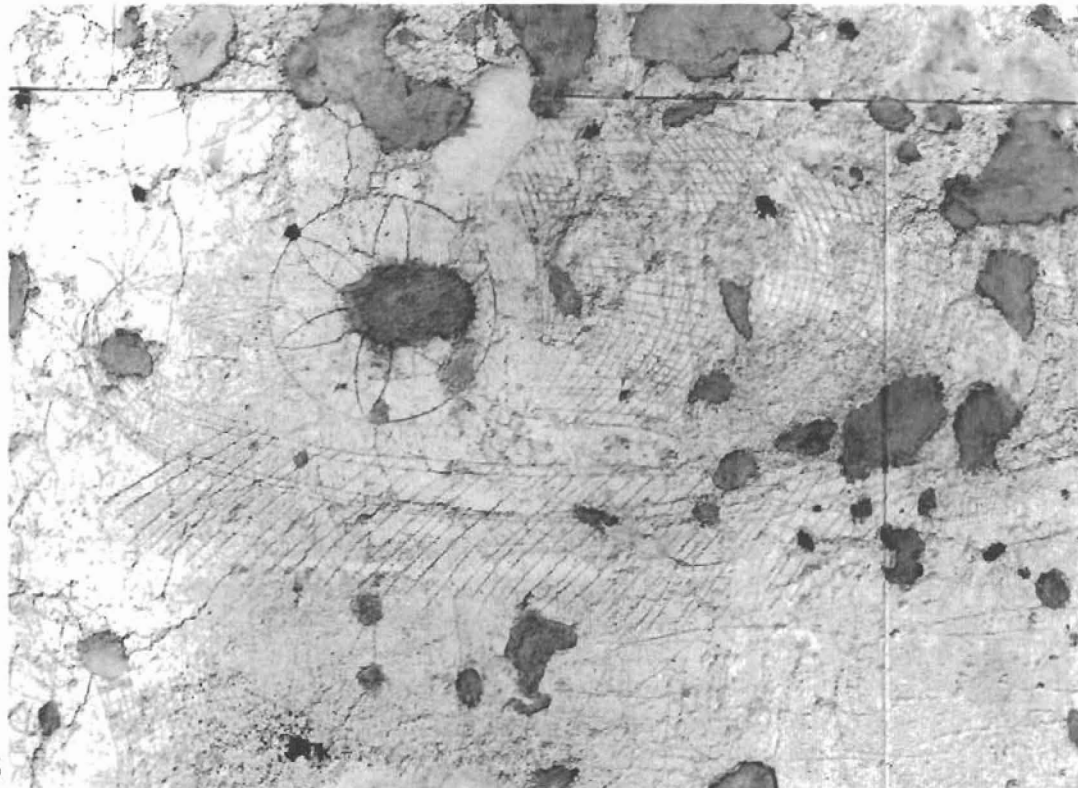


Fig. 15

SOME PROBLEMS OF SHIP OPERATION IN HARBOUR

In my contribution to the 1987 Symposium, I discussed the evidence for the use of timber on shipshed ramps, and the type of operations which could be carried out in the shipsheds. I start this paper by producing some additional evidence, from Carthage and from Kos.

The evidence from Carthage comes from a small supplementary excavation carried out on the *Ilôt de l'Amirauté* in 1980, on one of the ramps (13) on the west side of the island.¹ It was not a simple slipway like those previously found (e.g. 16)², but was divided into a series of small chambers or pits cut slightly below the general slope of the ground, separated by low walls and with their sides retained in place with mud bricks; to the excavator they looked as if they were secondary features cut into a regularly sloping ramp. Carbonised remains of two substantial squared timbers lay across the ramp at the divisions between the lower three pairs of pits, more widely spaced than the similar timbers found in the surface of Ramp 16. Hurst plausibly suggests that Ramp 13 was designed for repairs or maintenance of ships' hulls, with the keel resting on the central division, and working space being provided by the pits on either side; the cross timbers would have served, Hurst presumes, for the surface on which the keel itself, or a timber cradle carrying the hull, slid when a ship was moved. (Hurst does not mention the possibility of longitudinal runways laid on the sleepers; evidence of these was found on Ramp 16, but not on Ramp 13).

Thus we have more evidence that easier access was provided to the ship's bottom in at least some shipsheds.

The evidence from Kos comes from recent and so far unpublished excavations. A shipshed of the Hellenistic period has been discovered, which has well cut slots in opposed pairs on the inner side of stone courses running down well within the full width of the shipshed; in my estimate the sleeper length would have been under 3m in a total shipshed width of just under 6m. We look forward to more details from our Greek colleagues on this important find.³

There is thus no doubt about the use of horizontal timber sleepers on slips. The alternative explanation, that they were slots for timber shores, can be put aside; this is not to say, however, that shores were not used to support a slipped ship - Basch has recently plausibly so interpreted two frescoes from Pompeii which show timbers apparently projecting from the oar-box of a slipped warship.⁴

One feature of the shipshed remains at Rhodes, which I discussed at our last symposium, deserves more emphasis: there is clear evidence now of at least two widths of shipshed. The first is the "traditional" type, with a clear width of about 6m, which is rightly associated with the trireme (but also, we must assume, with the tetreres and penteres, since there is no clear evidence of alternative provision for them, e.g. at Piraeus). The second type can now be roughly defined, having a clear width of somewhat over 4m; further finds may call for further refinement. The narrower group of shipsheds at Rhodes have a clear width of 4.20-4.40m; those at Dor 3.80-4.50m; the possible remains at Phalasarua 4m; the possible remains at Antikirrha 4.20, 4.50, 4.70m (apparently widening seawards). These would have been for smaller warships such as hemioliae or possibly trihemioliae.⁵

Not all shipsheds will fall into these groups: for example the narrow ones for the two guard-ships at Sounion (2.60m wide).

One aspect of the use of timbers in slipping ships seems to have been overlooked: we do have the ancient Greek word for them - *φάλαγγες* or *φάλαγγια*. The word *φάλαγξ* more usually means a trunk or round piece of wood, but the word is used in two literary descriptions of the launching of the *Argo*, by Apollonius Rhodius (1375) and in the *Orphic Argonautica* (270). Apollonius Rhodius describes how the Argonauts dug a launching trench "deeper and deeper" down the beach, and in the trench laid "smoothed timbers" (*ἐν δ' ὀλκῶ ξεστὰς στρορέσαντο φάλαγγας*) and tilted the ship on to the first timbers⁶.

In the *Orphic Argonautica* the *Argo*, answering an Orphic call, "ran down so quickly that she scattered the close-set timbers (*θαμινὰς... φάλαγγας*) which lay under the keel; one sole stretched cable sufficed".⁷

The grammarian Pollux lists *phalanges* and *phalangia* among the equipment of the “ship-hauler” (*neolkos*),⁸ and there are other such references to *phalangia* in the lexicographers: normally translated “rollers”, though the timbers could of course be fixed skidways. That is certainly the case with their use in a dry dock, attested in a fragment of Callixenus’ *On Alexandria*. He describes a huge “forty” (reign of Ptolemy IV: late third century BC) which needed special arrangements for its launching - a cradle said to have been put together from the timbers of 50 *pentereis*, pulled into the water by a crowd. Then a Phoenician later had the idea of a dry dock into which the ship could be floated, for ease of launching and perhaps also for periodic maintenance. When the water had been pumped out “the ship sat securely on the above-mentioned *phalanges*”.⁹ The term *p(h)alangae* is used with the same meaning in Latin.¹⁰

I turn now to the subject of epigraphic evidence for harbour operations. It is admittedly sparse (with the obvious exception of the Athenian Naval Lists which still await a definitive study and publication), but what we have needs to be fully analysed and exploited.

A decree regulating harbour operations in second-century AD Ephesus has received little attention. This decree by the Roman governor of the province of Asia tried to control abuses in the harbour. Merchants importing marble must not unload it on to the quay, because its heavy weight imposed a heavy strain on the piers that supported the quay. Furthermore, importers of timber must not saw their timber on the quay, because the sawdust was threatening to choke the channel of the harbour (a problem already attested for Ephesus). A fine was prescribed for these offences, and offenders also had to appear before the governor “since his supreme majesty the emperor has a special concern for the efficiency of harbours”.¹¹

This last remark confirms the conclusions of Boyce’s persuasive study of harbour coinage of the second century AD on the degree of imperial concern for harbour development in the Eastern Empire.¹²

The text as a whole provides that rare shaft of light about harbour operations in detail, something which we badly need and which primary sources such as inscriptions can provide. The value of inscriptions is that in many cases they illustrate the typical and the routine rather than the untypical and the extraordinary, unlike most ancient ship descriptions in literary texts and probably also the ship monuments from Samothrace and Delos which are the subject of much present discussion.

Houston has argued that the lack of epigraphic reference to harbour operations or repair in the Roman period indicates a lack of harbours needing much maintenance or administrative involvement.¹³ I am not sure how valid is the *argumentum ex silentio*, and particularly not if it is projected back to the Classical and Hellenistic Period.

That harbour regulations were never a large body of material could perhaps be deduced from the fact that in the literary evidence for Rhodian sea law only one harbour regulation is preserved.¹⁴

I turn now to my main subject of discussion: the harbour regulation, on an inscription from Thasos, dating from the second half of the third century BC. The marble slab was discovered in 1930 in the Genovese fourteenth-century tower near the port, demolished in 1931, and was published by Launey in 1933. The inscription must have originally been displayed in the harbour area.¹⁵

Launey reported that the four sides of the stone are preserved; it was broken in two during extraction from the wall, causing the loss of a few letters in the first line. The inscribed side faced outwards when re-used in the tower and, being of friable local marble, suffered severe weathering. The text was thus extremely difficult to read, and Launey was unable to make a legible photo or squeeze. The beginning and end of the lines are difficult to define except by a slight apparent inset or cartouche, surrounded by a less polished border. Launey dated the text by the letter forms and published a majuscule text, republished in miniscule in the supplement to *Inscriptiones Graecae XII*¹⁶.

[ΠΛ]ΟΙΟΝ ΜΗ [Α]ΝΕΛΚΕΙΝ ΕΝ ΤΟΙΣ ΤΩΝ . . . ΡΓ . . . ΤΟΥ ΜΕΝ ΠΡΩΤΟΥ ΕΛΑ[CCW ΦΟΡ]-
 [ΤΟΝ ΑΓΟΝ ΤΡ]ΙΧΙ[Λ]ΙΩΝ ΤΑΛΑΝΤΩΝ, ΤΟΥ <ΔΕ> ΔΕΥΤΕΡΟ[Υ] ΕΛΑCCW ΑΓΟ[Ν] ΠΕΝΤΑ[Κ]ΙC-
 Χ[ΙΛΙΩΝ] ΤΑ[ΛΑΝΤΩ]Ν. ὍC Δ' ἌΝ ΠΑΡΑ ΤΑΥΤΑ ΑΝΕΙΡΥΧΙ, ΑΠΟΤΕΙCΑΤΩ ΠΕΝΤΕ [CΤΑ]-
 [ΤΗΡΑC] ΤΗΙ ΠΟΛΕΙ· ΠΡΗΞΑΝΤΩΝ ΔΕ <ΟΙ> ΕΠΙCΤΑΤΑΙ. ἌΝ ΔΕ ΤΙ ΑΜ[Φ][CΒ]ΗΤΗΤ[ΑΙ],
 5 [ΔΙΚΑCΑCΘΩΝ ΟΙ] ΑΠΟΛΟΓΟΙ ΠΑΡΑ ΔΙΚΑCΤΑΙC ΑΥΤΟΙC· ΤΗΝ ΔΕ ΚΑΤΑΔΙΚ[Η]Ν [ΠΑ]-
 [ΡΑΔΟΝΤΩΝ Τ]Ο[Ι]C ΕΠΙCΤΑΤΑΙC· ΟΙ ΔΕ ΕΚΠΡΗΞΑΝΤΩΝ. ἌΝ ΔΕ ΜΗ ΕΚΠΡΗΞΩC[Ι]Ν, ΑΥ]-
 [ΤΟΙ ΟΦΕΙΛΟΝΤΩ]Ν. ἌΝ ΔΕ ΟΙ ΑΠΟΛΟΓΟΙ ΜΗ ΔΙΚΑCΩΝΤΑΙ Η ΜΗ ΠΑΡΑΔΩCΙΝ ΤΟΙC
 [ΕΠΙCΤΑΤΑΙC, ΨΠ]ΟΔΙΚΟΙ ἔCΤΩCΑΝ ΤΟΙC ΕΙCΙ[ΟΨ]CΙΝ ΑΠΟΛΟΓΟΙC . . .¹⁷.
 [...¹⁸... ΤΟΙC ΕΠ]ΙCΤΑΤΑΙ[C] ΤΟΥC ΠΑΡΑ ΤΟ [Υ]Η[Φ]ΙCΜΑ ΑΝΕΛΚΟΝΤΑC ?¹⁹.
 10 [- - - - -²⁰ - - - - - ΤΩΙ] ΕΘΕΛΟΝΤΙ ΕΙ - - - - -

The text is of a decree, but simply publishes the regulation voted in the decree, without any traditional formulae. It was intended as a public notice and starts straightaway with the key words of the prohibition: “Do not haul out a merchant ship...”. Lines 1-3 give the full regulation; the rest of the inscription describes the penalty imposed on those contravening the regulation, and the obligations of various officials involved in exacting the penalty.

The regulation forbids the “hauling out” of merchant ships below a certain tonnage: for each of two places (parts of the port?) the minimum permitted tonnage is specified. The second numeral is clear: 5.000 talents (line 2/3); but the first numeral is not certain. Launey read “three thousand” but alternatives must be considered. All that can be read is]ισχι[λ]ίων.

The missing words in line 1/2 are fairly well defined by the sense required (and repeated in the second clause). We must restore a participle ἄγον agreeing with πλοῖον; the only doubt concerns the object of the participle: simply ἐλά[σσω] as a neuter accusative plural (sc. τάλαντα), or a noun in the accusative singular, such as φόρτον or γόμον, with ἐλά[σσω] in agreement? Launey preferred the latter, which leaves little space to restore any numeral longer than τρ]ισχι[λ]ίων. If we accept the former alternative, then, as Launey rightly pointed out, the numeral τετρακ]ισχι[λ]ίων would fill the space better. Launey acknowledged that epigraphically the restorations ἐξακ]ισ and ἐπτακ]ισ cannot be excluded, but felt that they fit the space less well; he was also unhappy about a reference to such high tonnages: “if we restore such a high numeral we should be banning the majority of ships from the shore of the port”. On this point let us reserve our position.

The main objection to τετρακ]ισ is that 4.000 in the first clause is too close to the (certain) numeral 5.000 in the second clause, providing too small a margin between the two categories of ships. This argument I find plausible, and it applies equally to ἐξακ]ισ, 6.000. But it does not prove the restoration τρ]ισ, 3.000, for there remain the alternatives ἐπτακ]ισ, 7.000 (we can hardly go higher, I think), or δ]ισ, 2.000 (which Launey finally admitted to be possible, but did not take seriously).

Therefore, if we accept that the margin between the two figures is likely to have been 2.000 or 3.000 talents rather than 1.000, then we are left with the alternatives 3.000 (as Launey), or 2.000 or 7.000 talents. I do not conclude that the restoration 3.000 is definitely wrong, but simply that it is not definitely right; and that it is unfortunate that the publication in *Inscriptiones Graecae* does not transmit (e.g. in a footnote) any of the points made in Launey’s discussion, but only his conclusion - which, admittedly, he expressed with confidence.

Thus my conclusion on the numeral has to be negative - that it is difficult to use as evidence of merchant ship size. This point was made against Casson by Hopkins in 1983, but Hopkins ignores the point that Casson adduced other evidence as well.¹⁷ Casson, a believer in large ships, had concluded (using the reading 3.000 in this inscription as one of the pieces of evidence): “the smallest craft the ancients reckoned suitable for overseas shipping was 70-80 tons burden”. What,

I wonder, is Casson's reaction to the possibility of the reading 2.000 (some 52 tons burden)?

There are some other points in the inscription which deserve discussion. First, we have evidence that merchant ships were hauled ashore, within a port.¹⁸ The technical term is used: ἀνέλκειν (II. 1,9) and the alternative ἀνειρύειν (I.3, a poetic and Ionic form of ἀνερύειν). No more precision is given. Were the ships slipped in shipsheds? - something we have thought unlikely because of the beam; or on open slips? - if so, they were special ones; or simply on an open beach? It should make one cautious in assuming that the shoreline of commercial harbours was entirely lined with quays; though of course the evidence of this inscription from Thasos can strictly only be applied to Thasos.

The very fact that the ships could be hauled out is, perhaps, an argument against a high numeral in the first clause, even if we assume that winches were used and that they were dealing with unladen weight. What sort of net tonnage were they dealing with? I compare Coates' estimate of a trireme's weight at slipping of 25 tons.

Secondly, the regulation specifies the minimum size of ship which it was permitted to haul out within two parts of the port. Why was a minimum size of ship specified? Casson, accepting the reading "3.000", argued: "the clear implication is that the 80-tonner was a small ship - the smallest that the harbour authorities cared to use the facilities". In response to this Houston has commented that "the very issue of a decree limiting the inner harbour to large vessels, however, also shows that there were in fact many smaller ships, so many that they caused congestion, and that it was thought necessary to exclude them from the inner, protected harbour. Had there been no smaller ships, there would have been no need for any such regulation"; and he adds: "Perhaps it was thought that the smaller ships could more readily make do with the beach outside the protected inner harbour: the smaller the boat, the more easily it could be beached and drawn out to a position of safety". Houston seems to have overlooked that the regulation allows larger ships to be beached within the harbour; perhaps the difference was between slips (inside) and open beach (outside).¹⁹

Launey argued that in a period of known insecurity at sea (he refers to the pirates' attack on Samothrace between 288 and 281 BC)²⁰ the "closed port" of Thasos offered a welcome refuge, that "perhaps one did not want the shoreline of the port to be encumbered with too small ships", and that "this measure was taken in favour of more valuable ships"; "small ships could of course remain afloat

in the reserved areas and there was plenty of space in the "open port". Launey argued that we have here evidence of the value of *ellimēnia* as income for a harbour city such as Thasos.

One must note that the regulation limits the hauling out of ships within specified parts of the port; Launey is right that it does not forbid the mooring of smaller ships. *Ellimēnia* could no doubt be charged for mooring a ship, but less, one assumes, than for hauling it out; quay space for unloading cargoes does not seem to be involved.

Thirdly, what are the two areas specified? The key to the answer lies in the first line, which is damaged; Launey was not able to restore with confidence. Pouilloux provided the solution, reading ἐν τὸς τῶν [ὄ]ρων, and referring to the *horoi* of ports such as Piraeus.²¹

Thus the regulation forbade the hauling out

1. of ships of less than (???) talents burden within the first *horos*;
2. of ships of less than 5.000 talents burden within the second *horos*.

What precisely is proposed? What are the first and second *horoi*? I can only argue as an outsider, and look for a response from those working on the ports of Thasos.²² My assumption is that either the first *horos* is the entrance mark to an outer harbour, and the second *horos* is the entrance mark to an inner harbour; or the *horoi* are outer and inner marks within a single harbour. Though I have no proof, I assume it to be logical that "first" and "second" count from seawards.

If this is so, can we reach any firmer conclusion about the first numeral? At first sight one would expect the regulation to have encouraged larger vessels into the first (outer) harbour and medium-sized vessels into the second (inner) harbour, taking into account, for example, shallower depths there; in this case one has an argument for a larger numeral in the first clause, e. g. 7.000 talents. But perhaps Launey was right after all, that the Thasians were anxious to offer the best facilities to the richest cargoes, and encouraging the larger vessels into the inner harbour, or innermost parts of the harbour (even if, to be precise, the text deals with beaching rather than unloading). Modern practice would indicate the latter alternative.²³ Let us hope that the new work on the ports of Thasos will throw new light on this interesting document.

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NOTES

1. H. Hurst, *Lancaster in Italy and North Africa*, University of Lancaster 1981, 15-19, esp. 16-17; cf. Hurst, "The Carthage Models", *Popular Archaeology*, May 1983, 24-27. I am grateful to Henry Hurst for these references. See also *CEDAC Carthage Bulletin*, 4, 1981, 24. My 1987 paper: *Tropis* 2, 1990, 35-52.
2. H. Hurst, "Excavations at Carthage: fourth interim report", *Antiquaries Journal* 59.1, 1979, 24.
3. I am grateful to Dr. I. Papachristodoulou, Ephor of the Dodecanese, for giving me permission to visit the excavation site, and to his staff for arranging the visit.
4. L. Basch, *Cahiers d'Histoire*, 33.3-4, 1988, 295 fig. 8 (Naples Museum, No 8606). With the ship clearly on a slip the timbers can hardly be oars: cf. Basch, *Mariner's Mirror*, 65.4, 1979, 292-4 & figs 4-5 (No 8604), quoting earlier references.
5. Dor: A. Raban & E. Linder, *JNA* 7.3, 1978, 243; the slipways here are 30m in length, which may be taken as indicative of the length of the narrower group - not, however, at Rhodes where they were alongside a wider, and therefore longer group. Phalasarua: E. Hadjidaki, *AJA* 92, 1988, 477. Antikirra: unpublished remains, visited by the Symposium participants in 1987. For smaller warships see L. Casson, *Ships and Seamanship in the Ancient World*, Princeton 1971, 123-35.b
6. Mooney translated lines 371-7 as follows: "And quickly they hollowed out a trench in breadth as wide as the space the vessel encompassed, and extending in front of the prow into the sea itself as far as she was likely to run when pulled down by their hands. And the further they went, the deeper they kept digging down below the level of the keel, and in that furrow they laid smooth rollers, and on to the first of these rollers they tilted the vessel that she might glide down smoothly over them". The translation "rollers" conveys a slightly misleading impression.
7. *Argonautica* 270-1, with the convincing emendation *ταθεισης* of F. Vian (*Les Argonautiques orphiques*, Budé 1987): it was enough to tauten one cable to set Argo in motion. Note here the use of cables in launching (as well as for hauling out): compare Horace, *Odes* 1.4.2 "trahuntque siccas machinae carinas".
8. Pollux X 149: the other items are *holkoi* and *ouroi*, terms which deserve further analysis. Other references: Liddell-Scott-Jones s.v. Φαλάγγιον III.
9. Callixenus *Peri Alexandreias* I (in Athenaeus V 204 c-d). See J.P. Oleson, *Greek and Roman Mechanical Water-lifting Devices: The History of a Technology*, Toronto 1984, 33; he suggests that one purpose was to allow access to the under part of the ship as it rested on the skids. Cf. J.G. Landels, *Engineering in the Ancient World*, London 1978, 163, who rightly argues against the traditional interpretation of the account, as referring to a slipway for construction and launching; N.A.F. Smith, "Roman Canals", *Transactions of the Newcomen Society*, 49, 1978, 83; Casson, *op. cit.* (n.5) 108-9, n.48.
10. Nonius Marcellus, 163.20ff.: "Phalangae dicuntur fustes teretes qui navibus subiciuntur quum attrahuntur ad pelagus vel quum ad litora subducuntur". *Phalangarii* were stevedores who carried e.g. amphorae slung on poles: J. Rougé discusses the evidence, *Recherches sur l'organisation du commerce maritime en Méditerranée sous l'empire romain*, Paris 1966, 180ff.
11. First published by J. Keil, *Ost. Jahreshfte* 44, 1959, 142-7. The reference to timber attracted the attention of R. Meiggs in his masterly work, *Trees and Timber in the Ancient Mediterranean World*, 1982, 358 & n.120. (with inexact reference). See now *Die Inschriften von Ephesos*, I (1979) no. 23.
12. A.A. Boyce, "The Harbour of Pompeiopolis: a study on Roman Imperial ports and dated coins", *AJA* 62, 1958, 67-78.

SOME PROBLEMS OF SHIP OPERATION IN HARBOUR

13. G.W. Houston, "Ports in Perspective: Some Comparative Materials on Roman Merchant Ships and Ports", *AJA*, 92, 1988, 563.
14. Quoted in Cicero, *De Inventione*, II 32, 98: "lex apud Rhodios est, ut, si qua rostrata in portu navis deprehensa sit, publicetur". I have heard rumours of an inscription found in Samothrace referring to ships and shipsheds, but know no details.
15. M. Launey, "Inscriptions de Thasos", *BCH*, 57, 1933, 394-410.
16. *IG XII Suppl.* 348. The line length (ca. 55 letters) is established by a legal formula in lines 6-7.
17. K. Hopkins, "Models, Ships and Staples", in *Trade and Famine in Classical Antiquity*, ed. P. Garnsey & C.R. Whitaker, *Cambridge Philol. Soc. Suppl.* Vol. 8, 1983, 84-109, esp. 99-100 & n. 34; Casson, op. cit. (n.5) 171 & n.23; 183. Casson had of course noted that "3.000" is a restoration, but found Launey's defence of it "completely convincing" ("The size of ancient merchant ships", *Studi A. Calderini e R. Paribeni*, 1956, 1234 & n. 12). He adds, however, that the only alternative would be 4.000, which we have seen is not correct; nor is his reference to the inscription as containing "a series of harbour regulations".
18. Cf. my 1987 discussion (*Tropis* 2, 1990, 45). If it was standard practice to haul merchant ships ashore in the winter months, this has not been recognised hitherto. A rabbinical source (D. Sperber, *Nautica Talmudica*, Leiden 1986, 77-80) apparently refers to slipping a merchant ship with cargo; cf. *ibid.* 80-82 for a possible reference to a launching windlass.
19. Houston, op. cit. (n. 13) 559 & n. 32.
20. *IG XII* 8.150.
21. J. Pouilloux, *Recherches sur l'histoire et les cultes de Thasos*, I (1954) 394, n. 5, noting that Launey had been deceived into reading $\acute{\epsilon}\nu\ \tau\omicron\iota\acute{\iota}\varsigma$ by a vertical scratch on the stone; Piraeus *horoi*: *IG I* (2) 889-96.
22. See e.g. A. Archontidou-Argyri, A. Simossi & J.-Y. Empereur, "The underwater excavation at the ancient port of Thasos, Greece", *JNA*, 18.1, 1989, 51-59.
23. Participants in the discussion stressed the modern practice of preventing small craft from cluttering up the best quays of a harbour.

On the use of the talent as a universal measure see H.T. Wallinga, "Nautika I. The unit of capacity for ancient ships", *Mnemosyne* 17 (1964) 1-40, esp. 11-12. He generally follows Casson, and is non-committal on the purpose of the two areas; he quotes Prof. Forbes as suggesting depth as a factor.

On the dangers of square brackets see E. Badian, "History from 'Square brackets'," *ZPE* 79 (1989) 59-70.

**SARDINIAN, VILLANOVIAN AND ETRUSCAN CRAFTS
BETWEEN THE X AND THE VIII CENTURIES BC
FROM BRONZE AND CLAY MODELS.**

Archaic figurative documents show very clearly that drawing techniques did not develop in parallel with building techniques, they had a wide delay which was solved only occasionally in Hellenistic time. Archaic figures, at least for the examples found in Italy, show a mix of traditional elements, realistic and up to date details, overemphasized ornamental aspects, such as animals or parts of them. The result is that on the figure of a boat or of a ship there is the superimposition of different aims, among which the realism of technical details became less important as far as the artist wanted to put more art in his work to achieve a graphical synthesis in terms of geometric fitness to other subjects or to the shape of the object. The following aims can be summarized as follows. According to late Villanovian, orientalizing, Corinthian and early Etruscan styles, the ship could have been given a zoomorphic appearance, as shown by the Padula amber or by the Cerveteri vase at the Louvre or some Corinthian figures, where ships were idealized as fishes, sea monsters or birds. Another aspect is the purpose of these figures as *emblémata* in painting, in modelling lamps or ex votos in shape of boats, in engraving Heracles lying on the raft, or in reproducing Egyptian boats (as in Palestrina gold dish). As we can see in Pythecussae (Ischia) vase, technical features may well be deduced, but as a remembrance which is similar to the appearance of cars in road signals; a good instance is the comparison of no-overtaking signals of 1940-50 with the present ones: we cannot say that they are not realistic, but we are far from a good description of cars. The delay of drawing vs building techniques is clear also from the fragmentation of figures. Something similar can be observed in many Minoan, Mycenaean and Geometric figures and this appears to be bound certainly not to lack of drawing ability, but to the mind of the painter or of the sculptor. A good instance of this mind is shown by the figures of men in Minoan, Mycenaean and Geometric art; they are parts put together, not coordinated bodies; similarly the literary procedure for describing a human body was a list of its parts and only later, after the VI Century BC the comprehensive word *soma* was used.

Similarly the description of boats is by single parts, not necessarily coordinated among them. The prow may be well described, but then only one or two benches or cross beams are indicated, to show the type of ship, but not to tell us how many these benches were (Fig. 4C). Therefore, with this background, the analysis of our anchaic models first of all lets us take the superimpositions (e.g. animals or their parts not part of the ship) away, then concentrate on the details. If the quality of the model allows, the details can be more or less coordinated, to build the possible appearance of the original boat, otherwise we discuss only the details.

Being the models tri-dimensional objects, there are some better chances to come to technical conclusions, because even if the sculptor interpreted the ship as described earlier, he could not overlook completely the aspects of a basic description. Generally it is difficult to find big distortions in the shape of posts, in the angles and slopes of surfaces and details; flat bottomed crafts can be well distinguished from round hulls, even if these latter have been made a little flat to let the model stand.

Sardinian bronze models belong to a period between the X and the VII centuries BC, with some later specimen; a lot of them has been found in Sardinia and in Etruria and the studies made so far did not cover the analysis of nautical aspects. They can be divided into two categories: flat bottomed and round hulled boats. Flat bottomed models appear to have been made more realistically and their features can be better coordinated. Structural details, such as posts, wales, bindings and sewings in many cases are well identified, although general proportions or the proportions of parts among each other are not respected. There is the tendency to build too short, broad and tall hulls, and too large animal heads, when present. By taking these distortions into account and selecting the most indicative examples we can identify smaller and larger flat bottomed crafts.

Small crafts (Fig. 1), well described by Tula (Sassari), Lula (Nuoro), and Oliena (Nuoro) bronze models, appear to have been built around the flat bottom with the addition of posts. These can be straight or slightly curved, to follow the similar shape of the sides. Connection between the bottom and the sides is strengthened by a thicker strake, which was sewn to the shell by sewings which went also in the outer surface of the strake. The upper wale was sewn in a similar way, while the other boards of the shell could have been sewn by *sparta* which did not go to the outer surface of the shell, as in the Etruscan wrecks of Bon Porté and of Giglio. There is little doubt about these *sparta*: Oliena model (Fig. 1 B) shows clearly the sewings of the wales, while no trace is indicated on the rest of the surface of the hull, moreover the Tula model shows how the ends were connected. The

end parts of the shell, of the upper whale and of the topgallant bulwarks were bound by the system A in Fig. 1, while the *akrostolion*, the post and the end parts of the other structures were bound by the system B which followed. There are no indications about inside structures, but it is obvious that there were bottom frames and ribs, not necessarily connected, and the posts. As far as proportions are concerned, they depend on the size of the original boat, but the general knowledge of flat bottomed crafts and the connections among single parts (bottom, sides and their slope) lets us propose those given conjecturally in Fig. 1 A. The shape of the topgallant bulwarks astern, which is common to other Sardinian models, is made in order to give room and a leaning point to the steering device.

Larger Sardinian flat bottomed crafts (Fig. 2) are well described, among the others, by the Costa Nighedda (Oliena, Nuoro), Is Caniles (Padria, Sassari) and the "Noha's Ark" found in the Tomba del Duce in Vetulonia, bronze models. It appears that the increased size of the boat made it necessary to put an intermediate whale for increasing sturdiness of the hull and as a fender. The interest of this double system of whales lies in the fact that, later, Hellenistic and Roman ships were built ideally in "slices", i.e. the shell was growing around a basic single part, with the addition of other "slices" as far as the hull was larger. The references for the shape of the "slices" were the whales or fixed boards of the shell at their boundaries. The presence of the two series of whales in these Sardinian ships appears to be with the same purpose and confirms the nature of similar hints in Geometric figures, thus bringing back to at least the VIII c. BC a procedure which in the past was documented only from the Vth c. BC onwards (tomb of Vele Caicna; Bologna). In some specimen of this type of ship the posts do not protrude outside the planking surfaces (figs 2 A & C): they are just only internal supports for the end parts of the planking of the shell. Its boards join at the prow edge with no scarf at the post and sewings can have been very simple. The type of lashings at the end (Fig. 2 C) indicates that they enclosed the ends of the whales, of the shell, of the internal post and the base of the *akrostolion*: a heavy sculpture of a deer's head. All these elements indicate that the sculpture was fixed to the post by means of a simple scarf and the fact that the post did not protrude was helping tightness of bindings around the end part of the shell. In addition to the lashings, the heavy *akrostolion* was fastened by two side stays (Fig. 2 C) or by a prop (Figs 7 and 8).

In addition to these details we can induce that the hull was open, probably with partial decks at the ends of the larger specimen, but nothing is indicated about the presence of the mast (which almost obviously should have been present at least in the larger crafts) nor about rowing/paddling. Measures can only be

conjectured, while proportions can be reasonably proposed; small crafts could have been from 10 to 15 metres long, larger crafts about 20 to 25, however these assumptions are highly conjectural.

Some clay and bronze models as lamps or ex votos coming mainly from Cerveteri and Vulci represent a symmetrical flat bottomed craft. They are from the X to the VII centuries BC; a little later (VI-V c.) some buccheri represent the same type of boat, in an idealized and heavily decorated way (Boston, Haifa), while a similar shape was given to some clay models of the VIII cent. found in Sasso di Furbara (Cerveteri, Fig. 3C). The original boat had a flat bottom, slightly curved sides, similar ends with posts and protruding points. These points are present in round boats according to the models from Selciatello (Tarquinia, IX century, Fig. 6), and Sardinian models from Sini collection (Nuoro, Fig. 7B) or from Sa Sedda é Sos Carros (Oliena, Nuoro, Fig. 8); with a recent name we could call these points *bittalò*, like those of the traditional *speronare* of Naples, Catania or Malta. In addition to the structural simplicity of this solution which helps easy connections of the end parts of the whales, these *bittalò* could have been used also as a holding tool for lifting the boat when taking it ashore. The information we have about this type of boat is sufficient to give us further details. Bottom frames and ribs were certainly present, stringers were fixed against the ribs to support the beams for partial decks and the benches for the rowers or the paddlers. The hull was painted in stripes of bright colours, as shown by lines and cross markings on two lamps; similar ornamental patterns were present in Cypriot models of XI-XII centuries BC and in subsequent Etruscan frescoes (Tarquinia, VI cent.). We cannot go further with assumptions: mast and sails, number or rowers or paddlers, number of benches, steering devices ... we can only assume a hypothetical length of about 12-15 metres.

The presence of the above flat bottomed crafts along the Tyrrhenian shores can be connected to the preference given to lagoons or mouths of rivers as landing places. In fact many *nuraghi* in Sardinia are near still existing or ancient coastal lagoons. Moreover the distribution of Etruscan centers and the ways of penetration inland confirm the importance of rivers and lagoons: Aleria in Corsica, the mouth lagoons and the courses of the Volturno, Garigliano, Tiber, Fiora, the Lake Prile, the Ombrone and Arno are the framework into which the positions of centres like Capua, Rome, Orvieto, Todi, Perugia, Roselle, Vulci, Ansedonia, Florence and Arezzo fit well with inland navigation. A similar aspect can be found in the later Etruscan centres in Northern Italy which were bound to inland navigation: Ravenna, Spina, Adria, La Bologna, Mantova (Bagnolo S. Vito), the course of the Panàro (named Scultenna, an Etruscan name).

But these flat bottomed crafts did not appear suddenly on these coast lagoons or river mouths around the X century BC. They were certainly the result of the evolution from rafts to flat bottomed plank boats, which, at an undetermined step of our nautical history took place on our rivers and internal lakes. This step could have been occurred in the neolithic or eneolithic periods, according to the technical stage of these periods and to the relevant needs for transport, but it is clear that seagoing flat bottomed crafts, like those discussed above, were adaptations and developments of boats used on the internal courses of rivers and lakes, or on coastal marshes and lagoons for limited local usage (fishing, short transport of materials, hunting, ferrying).

Round hulled models are a little more difficult to interpret, because, if flat bottomed models have a certain realism (or their features are easier to correlate), with an involvement of whom is conscious to represent part of a reality into which he is much bound, and probably proud, round hulls were easier to be distorted, or oversimplified, according to the artistic background of the sculptor.

Villanovian clay models show a variety of types. A vase from Bisenzio of the VIII century BC has a lively figure of a boat with three rowers (Fig. 4A), with a deer in the background. The boat is very simply drawn: a round hull, something protruding at prow, which appears to be the simplification of an animal head with an open mouth, with teeth or beard or similar. This type of boat is obviously connected to some Villanovian clay models (Fig. 4B), like those of Tarquinia (one is in Haifa Nautical Museum). The representation is very schematic, but basic features and a size larger than that of the Bisenzio boat may be drawn as proposed in the sketch of Fig. 4. A similar type of craft is described also by some Sardinian bronze models: an ex voto found in Corinth (Fig. 4C) is very detailed, while a large series of simplified models appears to refer to the same type. The model from Corinth shows one bench, partial decks, keel and posts and the central keelson; the hull has a beautiful hydrodynamic shape. As far as the size is concerned, the Bisenzio painting shows three oarsmen with six oars; the Corinth model shows only one bench. By keeping in mind the function of these models and figures as *emblemata* and the fragmentation of the figures, it is most possible that the benches for the rowers were many more: I proposed six to give the measure of the problem. However, as hinted earlier, Bisenzio boat was smaller than that described by the models, the originals of which should have had more than six rowing benches. This type of boat, although represented very simply, confirm a kind of common nautical traditions along the shores of the Tyrrhenian sea, both on the Etruscan and on the Sardinian side. The Bisenzio vase confirms that Villanovian models were not imitations of Sardinian figures, or vice versa. Connections with Eastern

Mediterranean refer to the ornamental patterns of the *akrostolion*: we have at Bisenzio a simplified head which could be compared to the head of a vase of the VII c. BC. at the British Museum or to a similar animal head of a bronze cauldron found in the Bernardini tomb in Palestrina (VII century BC), a specimen of the orientaling style. The duck's head belongs to the widely discussed, and not yet solved, problem of derivation from the civilization of the "fields of urns" of central Europe; this detail went down to the Mediterranean during early iron age, as shown, among the others, by some bronzes of Macedonia (Tsansitsa, Museum of Thessaloniki, Fig. 4E), by the well known *akrostolia* of the ships of the Peoples of the Sea of Medinet Habou (Fig. 5,II,B) and of the ship painted on the Skyros vase, which is almost contemporary to Medinat Habou relief (XII century BC).

Other Villanovian models from Tarquinia area, always between the X and the IX centuries BC refer to larger crafts, real seagoing ships. One type has symmetrical hull, with birds heads as *akrostolia* at the top of high posts. Posts may have been slightly curved (Fig. 5 I and II) or straight and in one case (Tarquinia Museum, Fig. 5 II) the keel protrudes at both ends. The hulls of these models generally have been flattened to let the model stand, but the shape of the posts and the curve of the sides indicate that the original hull had a keel. The model of Fig. 5,II has a series of holes for oars and for the mast, which originally were of wood. These types of ships are not new in the Mediterranean. Curved symmetrical ends with high posts similar to these are represented in a vase from Phaestos (Stratigraphic Museum, Fig. 5,II), in a clay model from Hagia Triada at Heraklion Museum (reconstruction proposed can be corrected to symmetric posts), in a small clay model from Mycenae at Athens National Museum or in one of the graffiti in Tarxien (Malta, Fig. 5,I). Comparable straight posts with protruding keels are present, among the others, in Medinet Habou relief and in a clay model in Athens National Museum (Fig. 5,II). The implications of the ships of the Peoples of the Sea to Thyrrhenian seafaring can be hinted also by the possible identification of the Mycenaean, Etruscans and Sardinians among them. The shape of the model of Fig. 5 II leave little doubts about the technical links with the above comparisons, although the more recent age of the Villanovian models may also indicate a certain delay of technical developments of Thyrrhenian shipbuilding or the repetition of a shape used in earlier times.

Among the Villanovian models published by Montelius one show a very schematic hull, nicely round, with a cutwater at prow and an animal head as *akrostolion*. This cutwater reminds very closely that of the clay model of Palaikastro (Fig. 5, III) and similar solutions will be used in later times to improve handiness

of the hulls under sail; the Aristonothos vase from Cerveteri (VII century BC) is a good example of such later cutwaters (Fig. 5, III), thus indicating that this technical detail was actually used in the Thyrrhenian in Villanovian times.

To end with seagoing ships of Villanovian culture, there is a nice clay model from Selciatello (Tarquinia, Fig. 6) of the IX century BC. It represents a round hull, well shaped, with a thin prow ending at its highest part with a *bittalò*, like that of the flat bottomed boats discussed before. The stern is high and shaped to give the hull a good hydrodynamic behaviour; this is improved by a cutwater which has a hole, probably for a suspension thread, but it may have been the reproduction of a hole actually driven in the cutwater, to bind the ship with ropes when hoisting it ashore. The presence of such cutwaters in Mediterranean shipbuilding is confirmed by Aegean models and Minoan gems: the bronze model from Crete at the Cincinnati Museum is the best comparison. It can be induced that such cutwaters were connected to steering with a single side rudder. The same function of contrasting lateral displacement was played in some similar way by the shape of the stern of one of the Punic (or Roman) galleys found in Mozia (Marsala); similar devices are present in recent traditions in the *gaita* of Missolongi lagoons or in Northern American or Indonesian canoes. The high stern of this Villanovian ship has a short fence, which most probably surrounded the rised or partial part of the deck where the helmsman was sitting. All these elements indicate that this was a sailing ship, a well developed one, as some details will be found in later Attic figures and the shape of the hull appears to have been accurately studied.

This is what can be derived, with a reasonable confidence and technical realism, from Villanovian clay models. As discussed earlier, they are schematic, but technical details have not been overlooked, mainly if we compare the above models with other Villanovian ship-like objects: perfume burners, lamps or an uncommon bronze found in Bologna. In these cases ships were not the scope of the figures: they just fit, ideally, into the shape of the objects, with a lot of idealization. Also some later Etruscan figures represent ships in such an idealized manner, like in the perfume burner of Artimino (VI century) or a bucchero boat at the Nautical Museum in Haifa: they are graphical devices, but useless nautical documents.

Sardinian bronze models describe also seagoing ships with round hulls, which can be classified as small and large crafts. From the little details given by these simplified figures, the structure of the hull was similar to that of the flat bottomed crafts, i.e. sewing with *sparta* and lashing the *akrostolion* to the stempost; the presence of a keel and of posts, at least internally, is indicated by the model

of Corinth (Fig. 4) and upper wale and partial decks at the ends were common to all these ships. A model from Sini (Nuoro) collection (Fig. 7) shows external bindings around three sections of the hull: bindings were fixed to protruding cross beams at midship and in correspondence of the partial decks at both ends of the ship. Both large and small ships have generally a stempost oblique with respect to the keel, but some cases are also of stemposts and *akrostolia* perpendicular to the keel. These ships had a mast with a forestay and different fittings for securing it. The type of sail and of rigging can be deduced from earlier documents (Phaestos, Skyros, Medinet Habou, etc.), i.e. a rectangular sail (wider than high) was fastened to a yard, which was suspended by two braces and the sail had two sheets and a series of brails. Sardinian models show the top of the mast with elaborated ornamental details: rings, spheres, birds, horns, etc; hints to a karchesion with a superimposed ornamental sculpture could be guessed, but not proven. Small round ships had a support for the steering device, which was cut in the stern upper edge, like in the small flat bottomed boats (Fig. 7). The suspension systems and the simplification of the lower part of the mast in the models of small ships appear to indicate that the mast could have been bound to a trestle (Fig. 7), like that appearing in some Geometric figures. This structure has interesting implications with the general structure of the hull and with rigging. The impression is that the use of such trestles was dictated by a certain weakness of the hull, in line with early lashing and sewing technique. Moreover this trestle could have been used to support a tent and to bind the ends of ties and brails. A possible indication of the size of these small round ships can be drawn by the Golo wreck, which was about 13 metres long. The shape of this boat, although much more recent, is closely comparable to that of Sardinian small round ships of early Iron Age, while the structure, made of bound ribs, and the half deck, appear to belong to a more developed stage of technics.

Larger seagoing Sardinian ships are identified by a rail and a couple of shrouds at each side of the mast. A bronze model at the Archeological Museum in Florence and a fragment from Sa Sedda é Sos Carros (Oliena, Nuoro, Fig. 8) indicate the presence of arches inside the rails, which are not part of the suspension system of the model as a lamp, but describe a feature of the original ship. They appear to have been part of a light structure, possibly to support a tent or a cabin covering the open part of the hull enclosed by the rails.

The shape of these oared and sailing Sardinian ships follow an archaic pattern comparable to that of Minoan ships and in our case the Homeric epithets *koronis* or *eise* appear as appropriate. The shape of crescent will be found in Etruscan

figures and in Golo wreck. Figures like a graffito from Veio (VI century), the reliefs of urns from Volterra or a similar clay model at the British Museum (IV century) show the superimposition of a light ram to a crescent shaped hull. These rams are similar to that of the III c. found off the coasts of North Africa and now at the Fitzwilliam Museum in Cambridge. These developments of the crescent shape are still to be studied in detail: it is sufficient here to have hinted at the problem, as a comparison to the old shape of Sardinian ships.

In comparison to the fairly archaic appearance of Sardinian ships of early Iron Age, ships used at that time around Tarquinia area appear to have been sturdier and more nautical. In other words they were, even if with some delay, in line with the development of Eastern Mediterranean shipbuilding. The sturdier lines of these Pontine ships, when compared to their Aegean relatives, remind, not as a coincidence, that in XVI century Pontine galleys had taller hulls than the Levantine, due to the conditions of the sea and this compelled to use wider sails. The number of different types betokens a lively nautical activity and in one case (Selciatello) the study of the shape of the hull is particularly accurate. Subsequent Etruscan documents appear to be interested to a more limited range of types, but this appears to be only the effect of artistic preference: the development of a multiplicity of crafts certainly continued and, later, Roman art came back to describe different types.

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ILLUSTRATIONS

- Fig. 1 Small flat bottomed Sardinian boats:
- A from the bronze models of Tula (SS) and Lula (NU), Lilliu n. 316, 325; the details show the different bindings of the ends of the sides (A) and of the bow tip (B).
 - B model from Oliena (Lilliu n. 323), conjectural section with sewings.

- Fig.2 Large flat bottomed Sardinian crafts:
 A model from Oliena, Costa Niggheda (NU), inv. 59612 Sopr. Arch. SS.
 B bow of the model from Is Caniles, Padria (SS), S. E. XLII, 1974, pp 547-548, f. CIII a; f, n.7.
 C Conjectural proportions of the original of A.
 D The Noha's Ark, Vetulonia, Tomba del Duce, with conjectural details of the original structure (M. Bonino, 1985, f.2).
- Fig.3 Etruscan coast boat:
 A Lamp from Vulci (VII cent. B.C.), Mus. Etrusco Vaticano, Inv. 15329.
 B Conjectural reconstruction of the type of craft.
 C Terracotta from Sasso di Furbara cemetery (Cerveteri), X c. BC (M. Cristofani, 1985 1.8:11).
- Fig.4 A Painting of a vase from Bisenzio (M. Cristofani, 1985, 2.10.5).
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 C Sardinian bronze model from Corinth (Basch, 1987, 496.3).
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 E Animal heads: from Palestrina (VIII c.) and from Tsamitsa Iron Age (Macedonia, Thessaloniki Museum).
 F Conjectural reconstruction of the boat type.
- Fig.5 A Villanovian double ended clay model (Basch, 1987, 841).
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 II A Villanovian clay model (Basch, 1987, 843).
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 D Conjectural reconstruction of the ship type.
 III A Villanovian clay model with cutwater (Basch, 1987, 846).
 B Detail from the clay model from Phylacopi (Basch, 1987, 296).
 C Detail from the Aristonotos vase, with the indication of the extension of the cutwater (M. Cristofani, 1983, cover and f. 15).
- Fig.6 Clay model from Selciatello site (Tarquinia) (M. Cristofani, 1983, f. 7) and graphical interpretation of the lines.
- Fig.7 Small round Sardinian ships:
 A Conjectural reconstructions from Lilliu n. 281, 283, 294.
 B External bindings of a model of Sini collection (M. Bonino, 1985, f.3,D).
 C Suspension systems of models n.282, 289, 293 (Lilliu), possibly indicating trastles for the masts.
 D Geometric figure with trestle for the mast (Basch, 1987, 401).
- Fig.8 Large round Sardinian ships:
 A Models from Bultèi and Sa Sedda é Sos carros (M. Bonino, 1985, Fig. 1,3).
 B Conjectural reconstruction from A (Bultèi).
 C Perpendicular stempost from A (Sa Sedda é Sos Carros).
 D Large ship with a tent laid among the mast and the arches (model in the Arch. Mus. of Florence, Lilliu 295 and above A).

ABSTRACTS - ΠΕΡΙΛΗΨΕΙΣ

IMBARCAZIONI SARDE, VILLANOVIANE ED ETRUSCHE DAL X ALL'VIII SEC. AC DA MODELLI DI BRONZO E DI TERRACOTTA

Una serie numerosa di modelli di bronzo e di terracotta documenta in modo schematico, ma riconducibile a caratteristiche tecniche precise, alcuni tipi d'imbarcazioni. Vi sono barche a fondo piatto, sia in Sardegna che in Etruria, costruite con la tecnica delle cuciture ed in relazione con la scelta delle foci dei fiumi e delle lagune quali approdi e vie di penetrazione all'interno.

Gli scafi a fondo tondo mostrano, per il Villanoviano, una molteplicità collegata a tipi mediterranei più antichi e forme ben sviluppate ed anche locali.

I tipi sardi tondi appaiono stilizzati, con poche varianti, tuttavia i particolari: cuciture, cinte, attrezzature, mostrano caratteri tipici del Tirreno, oltre che il substrato mediterraneo.

SARDINIAN, VILLANOVIAN AND ETRUSCAN CRAFTS BETWEEN THE X AND THE VIII C.BC FROM BRONZE AND CLAY MODELS

A large series of bronze and clay models shows in a schematic way, but with some exact technical details, a number of types of crafts. There are flat bottomed crafts, both in Sardinia and in Etruria, which were sewn and connected to the choice of mouths of rivers and lagoons as landing places and for penetration inland.

Round Villanovian crafts show a multiplicity bound to older Mediterranean types and well developed and local shapes.

Sardinian round ships are simplified models, with little variations, however their details (sewings, wales, fittings, rigging) show a Mediterranean basis and some typical Thyrrhenian features.

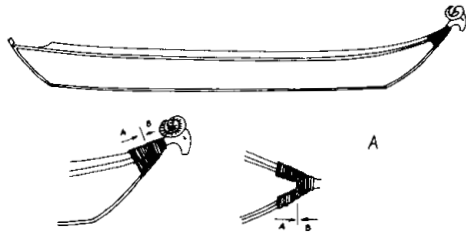


Fig. 1

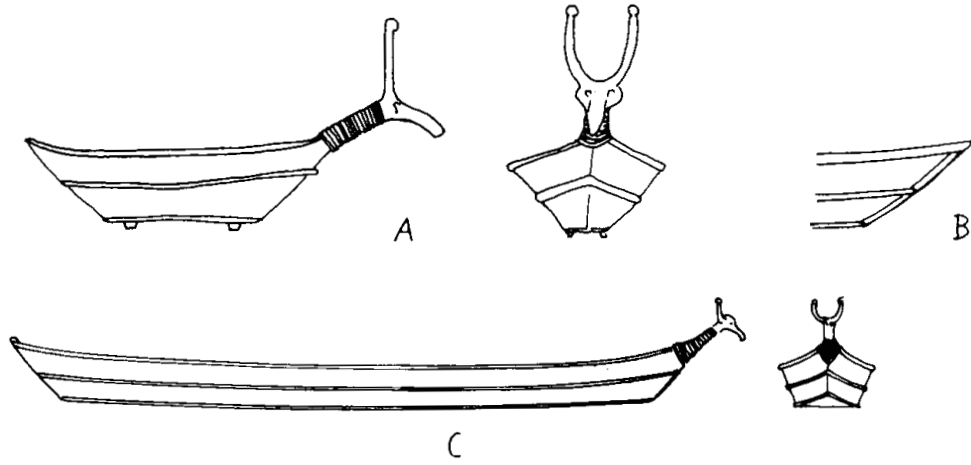
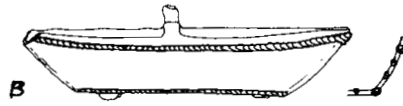
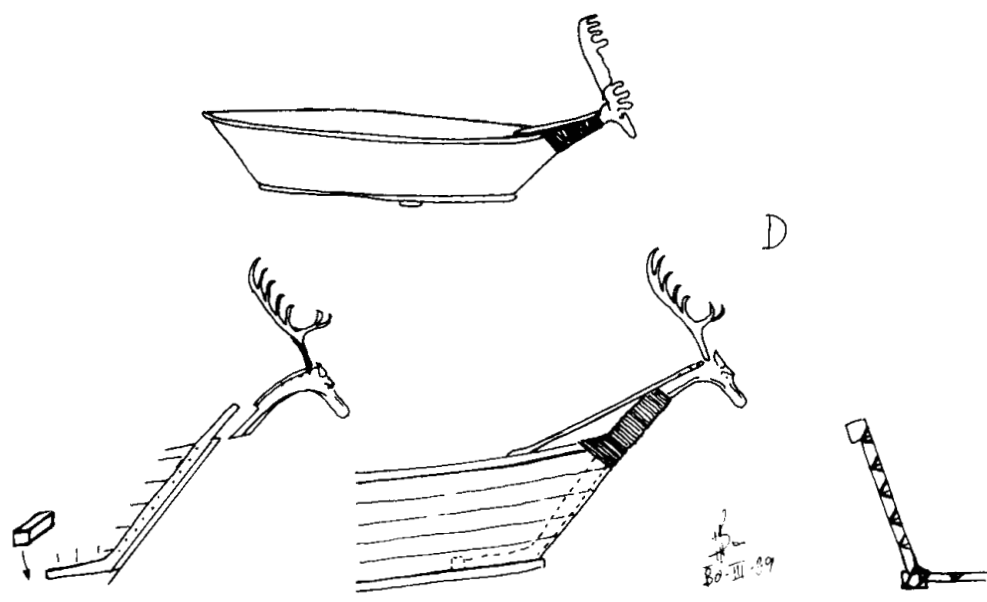


Fig. 2



SARDINIAN, VILLANOVIAN AND ETRUSCAN CRAFTS BETWEEN THE X AND THE VIII CENTURIES BC FROM BRONZE AND CLAY MODELS.

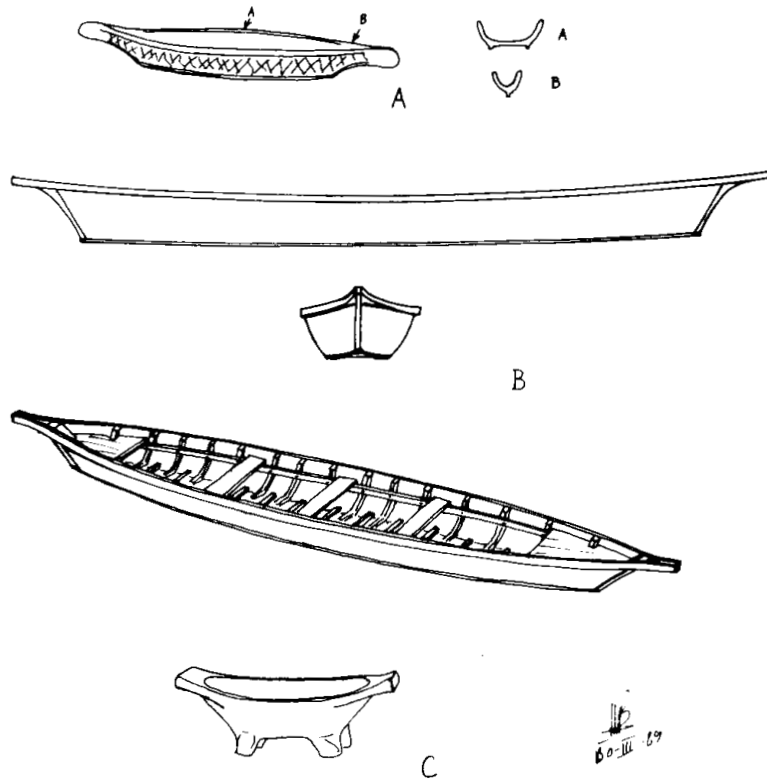


Fig. 3

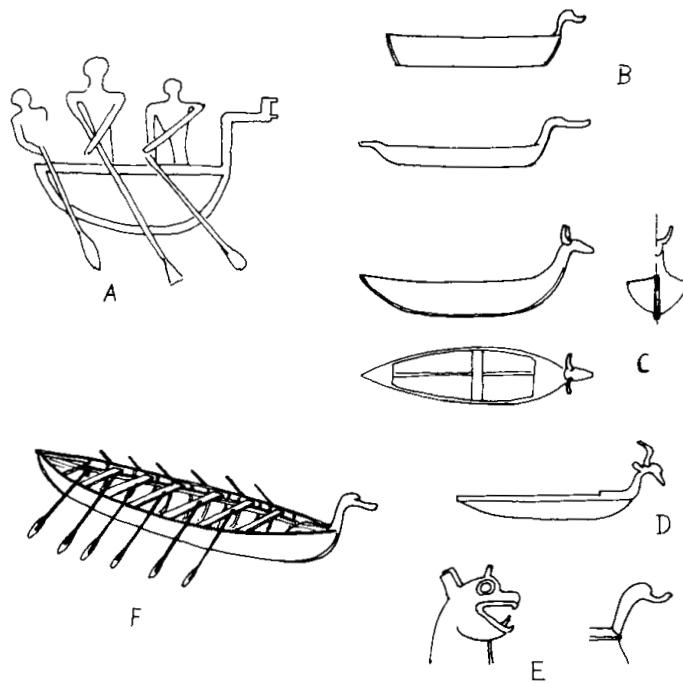


Fig. 4

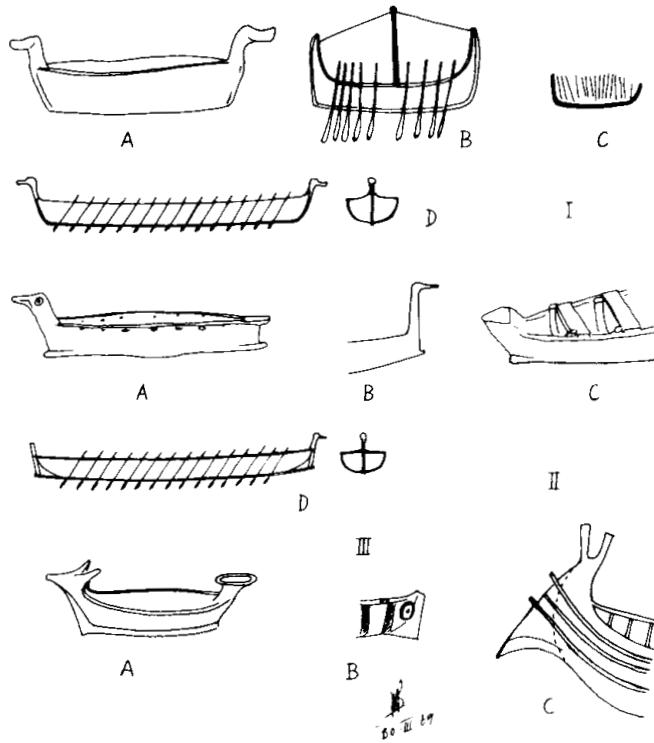


Fig. 5

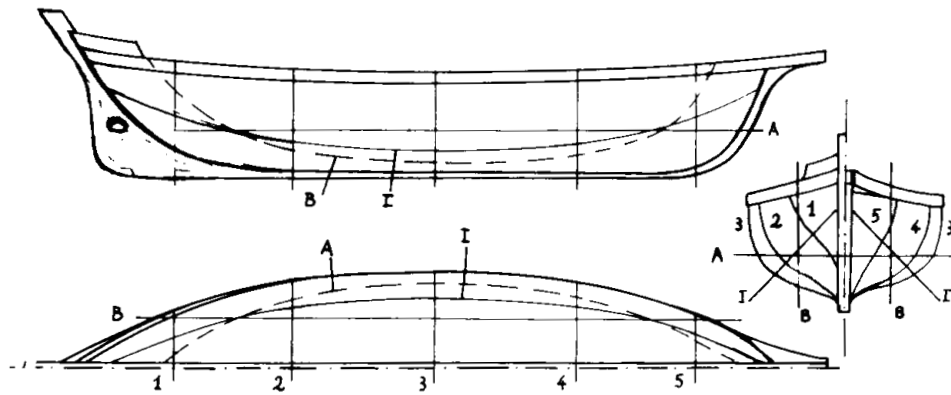


Fig. 6

SARDINIAN, VILLANOVIAN AND ETRUSCAN CRAFTS BETWEEN THE X AND THE VIII CENTURIES BC FROM BRONZE AND CLAY MODELS.

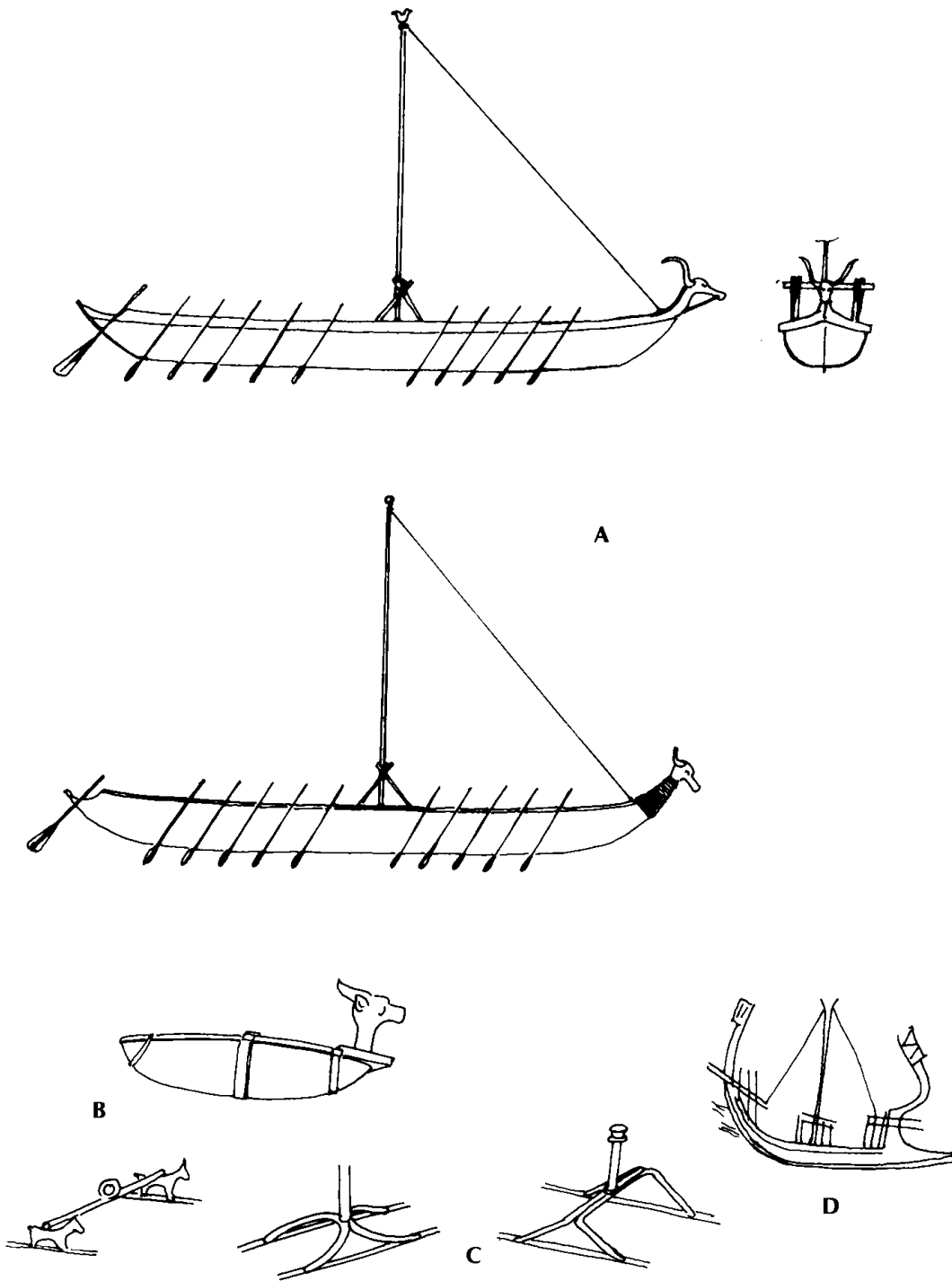


Fig. 7

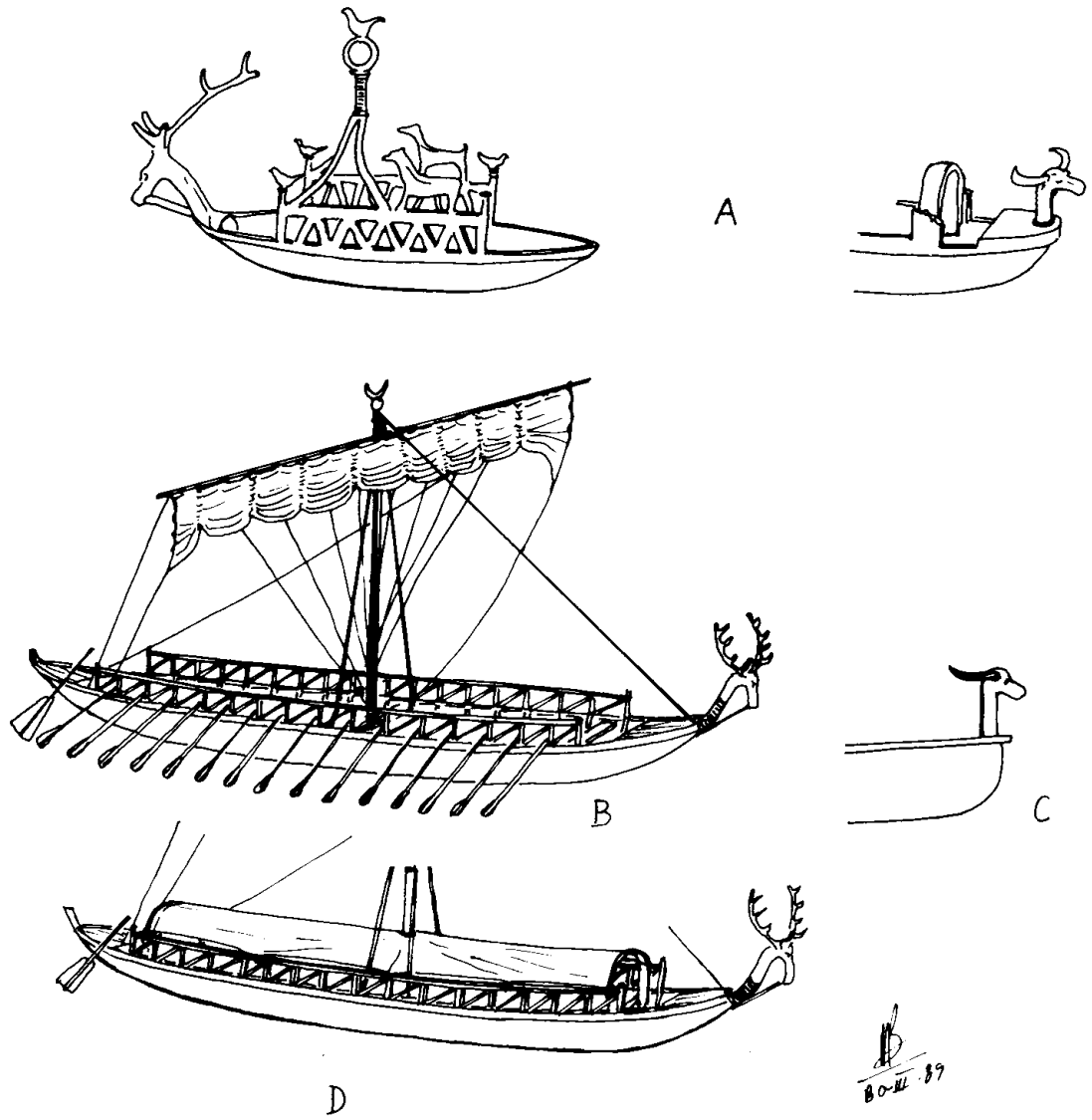


Fig. 8

THE CARPENTER'S CALIPERS FROM THE PRE-CLASSICAL WRECK AT CAMPESE BAY, ISLAND OF GIGLIO, NORTHERN ITALY (c. 600 BC)

The pre-Classical wreck off the Island of Giglio in the Tuscan Archipelago, was found in 1961 by Mr. Reg Vallintine. The remains of the vessel, which can be dated to c. 600 BC (or soon after), were situated in 45 to 55m of water at the base of an off-shore reef known as *Secca i Pignocchi* in Campese Bay on the north west side of the island. Excavation of the site was carried out between 1982 and 1986 by Oxford University MARE in strict collaboration with the Superintendency of Archaeology for Tuscany, under the direction of the present writer (Bound & Vallintine, 1983; Bound, 1983; 1985A; 1985B; 1985C; 1986; 1990A; 1990B; 1991).

The fine wares from the wreck consisted of aryballoi (Figs 1-3), craters, oinochoe and skyphoi from Corinth, mugs and aryballoi from Sparta (Fig. 4), Ionian bowls, bucchero kantharoi and an aryballos from Etruria (Fig. 5). The amphorae were of Etruscan, Samian, East Greek and Phoenician-Punic origin. Three intact Greek lamps were excavated, two of which were charred at their beaks thus indicating shipboard use (Fig. 6). The metal finds included fishing weights, ship's fittings, arrowheads, lead and copper ingots, and an ornate Greek helmet which was found in 1961 and is now in Germany (Figs. 7-9). The ship was also carrying iron bars, small nuggets of copper (*aes rude*) and amber, all of which we interpret as currency. The organic remains include gaming bones, a wooden writing plaque, an elaborately carved wooden lid, a fragment of inlaid furniture, and a series of musical pipes (*auloi*). A number of the Etruscan amphorae were full of olives, while others contained pine pitch. A section of the keel (Fig. 10) and its associated planking was also recovered; these showed that the vessel was of laced, or sewn, construction.

The calipers: find spot

One of the most remarkable artefacts to have come from the wreck was a pair of carpenter's calipers; to our knowledge the only ones to have survived from antiquity. We cannot be certain whether these were part of the cargo, or belonged to the ship; the latter seems more likely.

The wreck was located in 1982 when a metal detector signalled a metallic presence of considerable size beneath the sand. This turned out to be a large amorphous concretion from which protruded the handle of an Etruscan amphora. Because the concretion itself had little appeal, and because it was firmly adhering to a boulder, it was decided that, for the time being, it could safely be left in situ. During the final days of the 1985 season, the concretion was freed from the boulder using a car jack and then raised to the surface with the aid of air-filled lifting bags.

Directly underneath the concretion a small assemblage of interlocking pieces of worked wood was found. Because of its close resemblance to modern calipers, identification was not difficult. If these did indeed belong to the ship then it is possible that the overlaying concretion represented the remains of a tool bag.

State of preservation

Only the heads survived. The beam, or shaft, was broken off where it emerged from the sliding, or mobile, head. This was unfortunate, for it is likely that the beam would have been calibrated, and could have given us information on the unit of measure. In figures 11, 12 and 13 the draughtsman has recreated the remainder of the beam to give an impression of the intact tool.

Measurements

Ht. of heads 94 mm. Width of fixed head at ends 10mm. Width of fixed head at centre 22 mm. Width of mobile head at ends 12 mm. Width of mobile head at centre 24 mm. Thickness of heads 13 mm. Section of shaft 15x6 mm. Surviving length of locking pin 49 mm. Section of pin 11x5 mm.

The fixed head

The beam passes right through the fixed head so that the end of the shaft is flush with the outside edge of the head. The head is fixed permanently to the beam with four wooden pins (Figs 13 & 14).

The sliding or mobile head and braking mechanism

The function of the sliding head is to move up and down the beam so that the object to be measured can be accommodated between the jaws. The beam passes through the centre of the sliding head. For the purpose of freezing the

head in position while the measurement is being taken, a wooden braking pin is passed through an oblong cutting in the head. This second cutting is perpendicular to the beam. In figures 15 to 19 it can be seen that the upper cutting which takes the locking pin, slightly overlaps the cutting through which the beam passes. In this way, when the braking device is removed, one millimeter of the upper side of the beam is visible as a slight lip in the bottom of the upper cutting.

The purpose of this lip is to provide a surface which can rub against the braking pin and freeze the sliding head by means of friction. At first glance the braking pin appears to be oblong in form, but this is deceptive, for the pin, in fact, is slightly wedge shaped (Figs 20 & 21). If it were a perfectly symmetrical oblong, then, through repeated use, it might become slightly worn, so that its efficacy as a restraining and halting mechanism would be impaired. Being slightly wedge shaped ensures that there will always be an adequate surface area in contact with the top of the beam.

The tool would have been held by the shaft, just behind the sliding head. The sliding head's braking capability would have been activated by the application of pressure from the thumb on the broad end of the pin. Since the diminution of the pin is slight the braking mechanism would have been fairly sensitive and would have responded to only slight pressure. The head would be remobilized by the simple means of applying a little pressure with the forefinger on the narrow end of the pin.

Retaining stud

One feature of the sliding head was, at first, a puzzle. Just beneath the cutting for the beam on the rear side of the head, was a little rounded niche. The explanation for this came from looking at one of our calipers in the draughting office. On the side at the end of the shaft was a metal retaining stud to stop the sliding head from slipping off the end of the shaft. The ancient calipers would clearly have required a similar device, and so the tool maker put a stud at the end of the beam (Fig. 22). Such a placement on the side for the ancient artificer, would have been too conspicuous, so instead he put it on the underside of the beam. The problem now was one of aesthetics, for when the jaws were fully open there would have been about a centimeter of the beam protruding from the back of the sliding head. Although this, does not in any way, offend modern taste it must have been displeasing to the ancient tool maker. He therefore notched the back of the sliding head in such a way that when the jaws were wide open the retaining stud was absorbed into it, so that the back of the head would have been flush with the back of the beam (Fig. 23). In this way, when the jaws were at maximum extension, the tool would have had a balanced symmetrical profile. Attention to such detail reveals the tool maker's pride and sense of craftsmanship.

Metal pointers or pins

At the bottom of each head was a metal pin. With the possible exception of the retaining stud, this was the only metal to have been used in the tool. The pins, which were either copper or bronze, have not survived, but we know them to have been there from the holes that were used to contain them and the greenish copper staining and salts that were surrounding the holes.

Similar pointers can be found on the heads of some modern calipers. They are used for taking precise measurements where the jaws are ineffective (such as the interior rim diameter of a pot). In carpentry, they are also used for scoring measurements on to wood.

The holes to take the pins were drilled, and thus were round in section. This presented a problem for the tool maker for if the posts of the pins were also rounded, then, no doubt, it would not be long before they began to turn in the holes and slowly work their way free.

To prevent this the posts of the pins were carefully beaten so that they were square in section. They were then inserted into the bore holes with little wooden shims on each side, four per hole. These were flat where they abutted the sides of the post, and were rounded on the sides in contact with the surrounding wood. Five of the shims survived. To inhibit slippage it is likely that glue was used with the shims.

The locking mechanism

A complex instrument of this nature would have been expensive. It was also a delicate tool which would need to be stored properly when not in use. The snipe-nose ends of the heads, and the precision fitting of the sliding head over the beam, would have been a particular cause for concern in the constantly moving environment of a ship at sea. To overcome these worries the heads would need to be locked together so that they would buttress each other and prevent any loose movement that might cause the tool to damage itself.

We have described how the top of the beam was not flush with the bottom of the upper cutting. One millimeter of the top edge of the beam passed through the upper cutting so as to provide a surface against which the braking pin could rub. This lip had a secondary function as part of the tool's locking mechanism. That part of the shaft which was aligned with the cutting for the pin when the jaws were closed, was notched (Fig. 24). In this position, when the pin was inserted, it passed between the edges of the notch, thus preventing any movement of the sliding head until the pin had been removed or partially withdrawn. So simple; yet so effective.

The calipers, it is worth noting, were found in the locked position.

The modern appearance of the calipers might tempt one to query whether they could be of later date and of an extraneous origin. This is impossible because of the sealed context from which they came directly beneath a large concretion deep in the sand. If this were not enough, there is proof of an even more categorical nature. Along one side of the locking/braking pin, and down either side of the sliding heads, are the fugitive remains of several letters in Archaic Greek script.

Acknowledgements

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(MARE).

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- Fig. 3 Heraldically positioned sphinxes on a Corinthian aryballos from the Giglio ship.
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THE CARPENTER'S CALIPERS FROM THE PRE-CLASSICAL WRECK AT
CAMPESE BAY, ISLAND OF GIGLIO, NORTHERN ITALY (c. 600 BC)

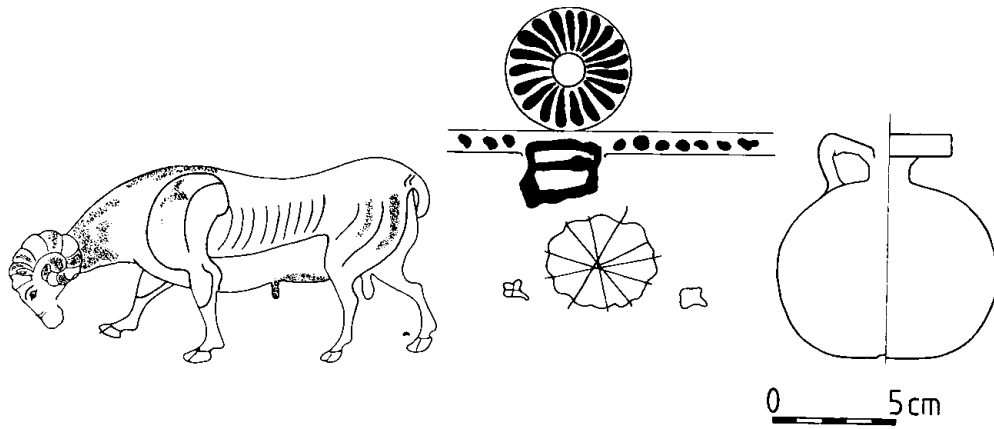


Fig. 1

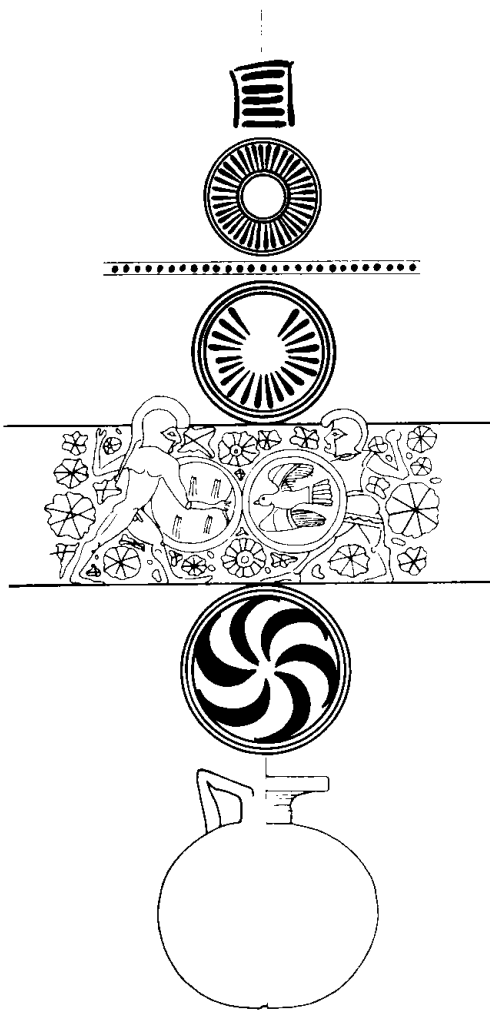


Fig. 2

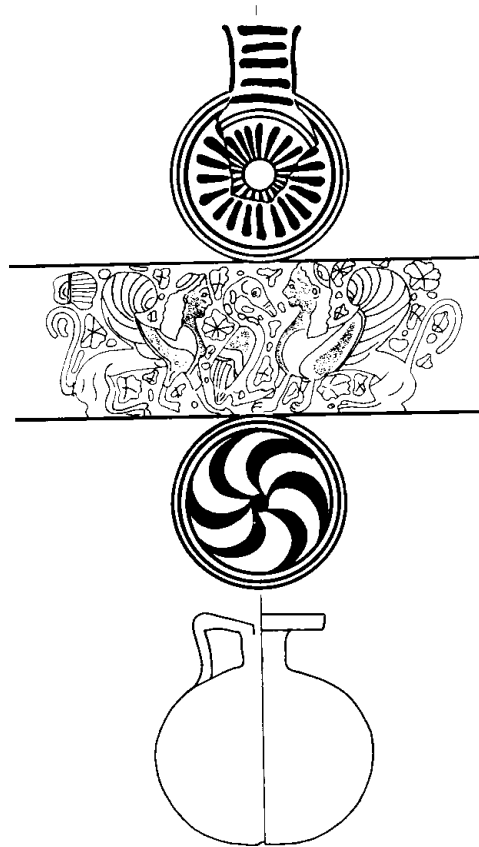


Fig. 3



Fig. 4

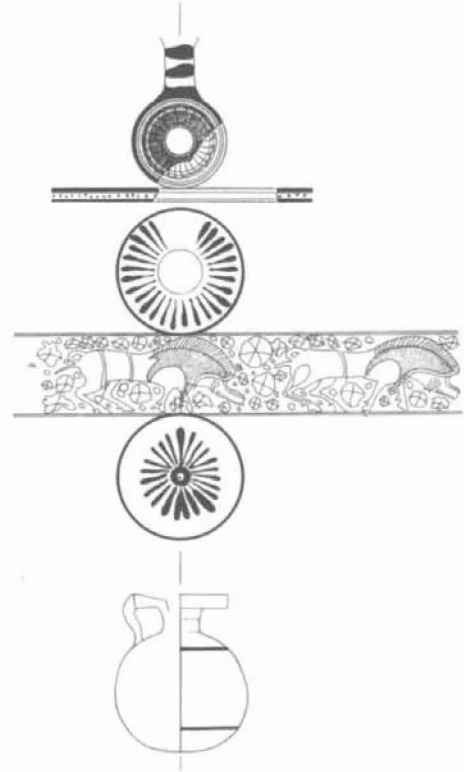


Fig. 5



Fig. 6

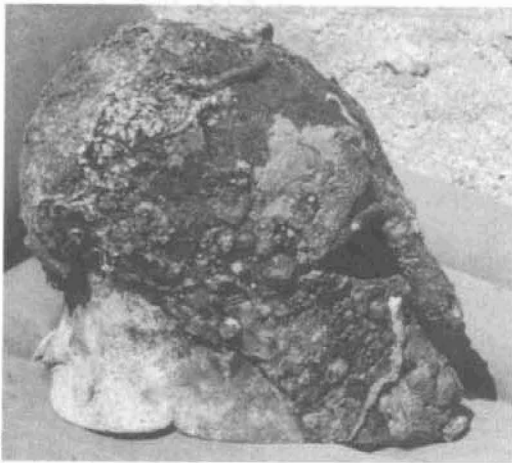


Fig. 7

THE CARPENTER'S CALIPERS FROM THE PRE-CLASSICAL WRECK AT
CAMPESE BAY, ISLAND OF GIGLIO, NORTHERN ITALY (c. 600 BC)



Fig. 8

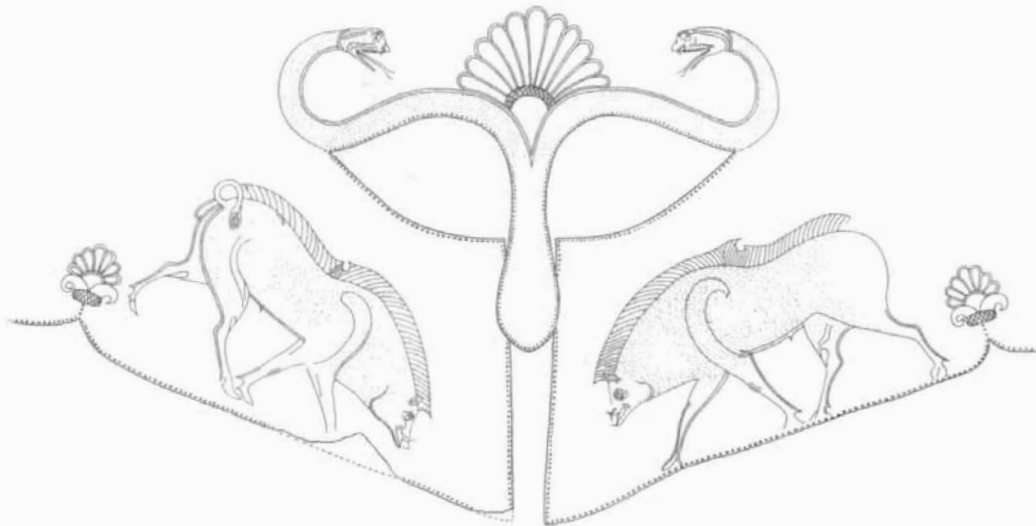


Fig. 9

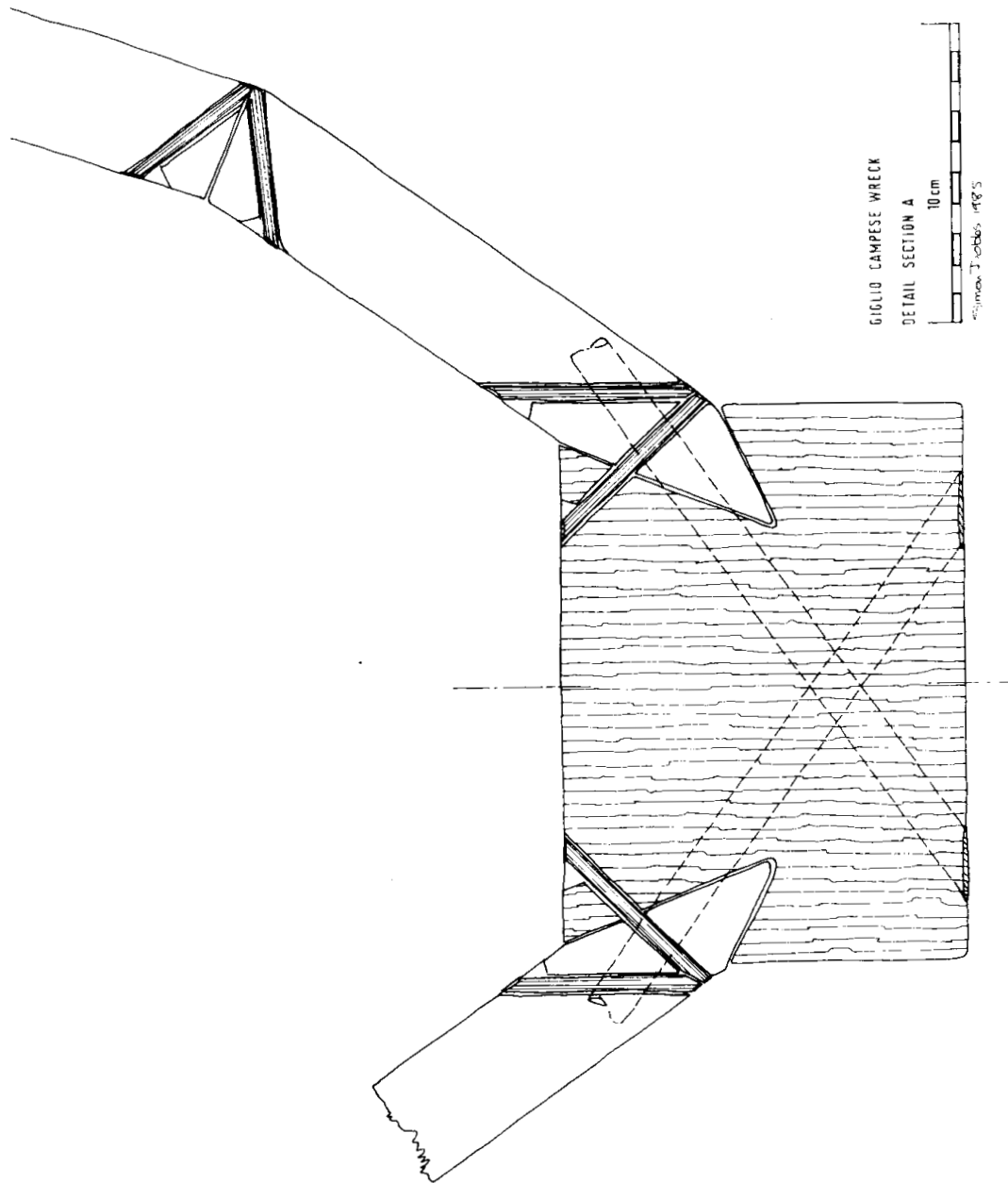


Fig. 10

THE CARPENTER'S CALIPERS FROM THE PRE-CLASSICAL WRECK AT
CAMPESE BAY, ISLAND OF GIGLIO, NORTHERN ITALY (c. 600 BC)

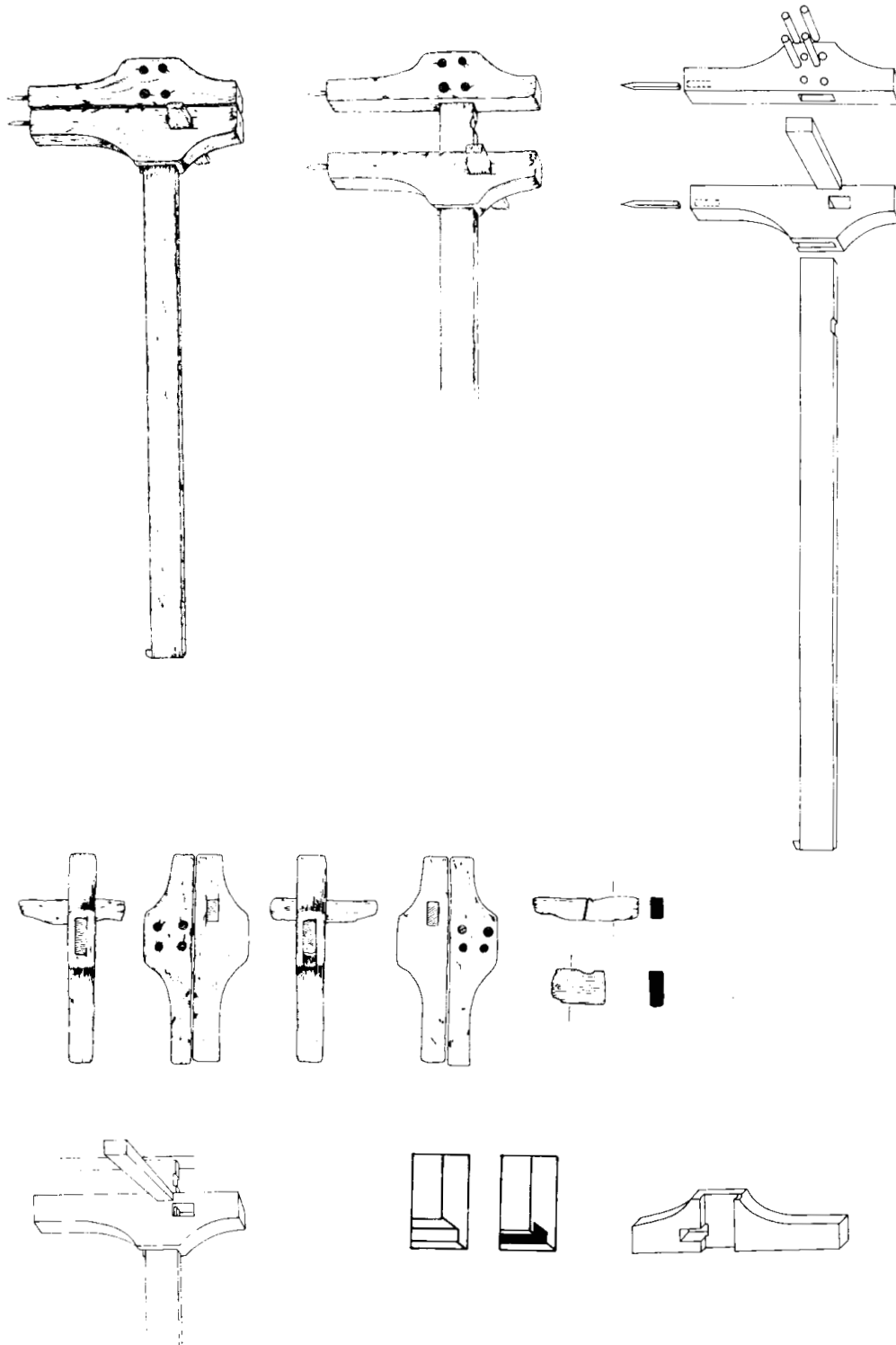
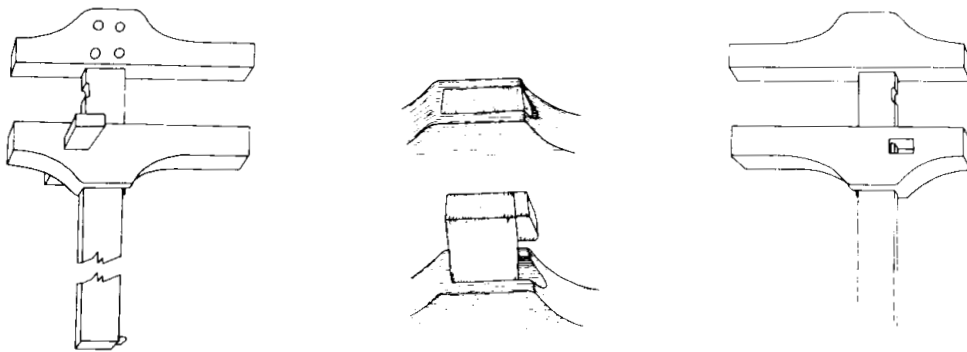
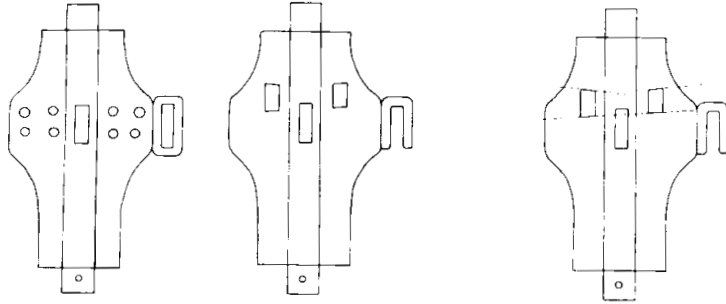
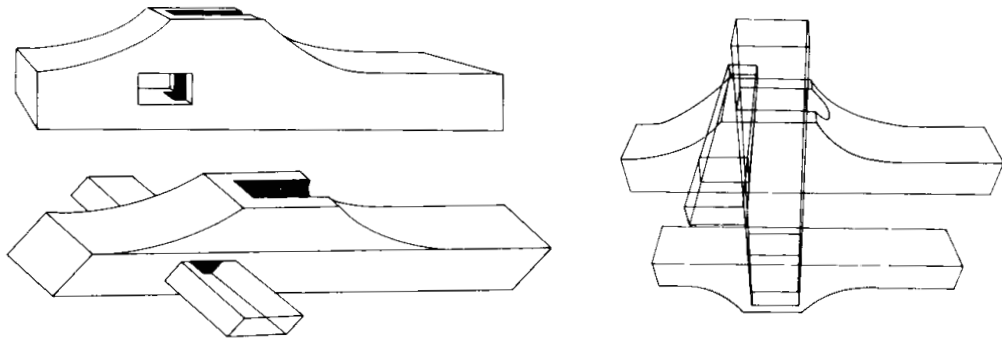


Fig. 11-17



: 18-22

**BYZANTINE DROMON AND ARAB ṢĤĪNĪ:
THE DEVELOPMENT OF THE AVERAGE BYZANTINE AND ARAB WARSHIPS AND
THE PROBLEM OF THE NUMBER AND FUNCTION OF THE OARSMEN**

It is a commonplace that little has been accomplished in the study of Byzantine and Arab warships. Much of the relevant material lies still buried in unpublished Greek and Arabic manuscripts. Underwater archaeology, which has yielded valuable clues relating to Byzantine and Arab merchant ships, has yet to reveal anything important concerning Byzantine and Arab warships. Arab and Byzantine crude graffiti and pictorial evidence, because of their limited nature, shed little additional light.

The aim of this paper is, first, to offer a cursory account of the origin and development of the average Byzantine warship, most commonly known as a *dromon*, and then to examine the question of the number and function of oars and oarsmen in the Byzantine *dromon* of about the tenth century AD and in the Arab *ṣĥīnī*. These appellations seem to be interchangeable, at least by the tenth century, with the terms *pamphylos* and *chelandon* in Greek (H. Ahrweiler, 1966, 45) and *ghuarāb* and *shalandī* in Arabic (D. Nakhili, 1979, 78-85).

The word *dromon* appears at least as early as the sixth century AD (Procopios, Bell. Vand. I.11.15-16). Meanwhile the term *trieres* used in Ancient Greek as a general term corresponding to *dromon* for the average Greek warship continued to appear in late Byzantine sources, but as a bookish imitation deprived of its actual meaning. (See G. Makris, 1988, *passim*.)

Dromons acquired great importance in Justinian's expeditions. The sixth-century Byzantine historian Procopios reports that Justinian's general Belisarios in his expedition against the Vandals for the reconquest of North Africa, in which the author himself participated, made use of 92 *cataphract dromons* and 500 transport ships. The Byzantine *dromon* of Belisarios' fleet was very small. This is usually considered as a sign of weakness, i.e. the Byzantines' lack of proper technology. In reality, this type of ship was especially constructed to suit long voyages. The Byzantine *dromons* had to be small to sail to the inhospitable ports of North Africa.

There is no doubt that the conquest of North Africa by the Vandals in 406 AD and the creation of their maritime empire weakened the western part of the Byzantine Empire, but, as correctly pointed out by F. Meijer, Constantinople in the fifth century continued to build warships successfully, in the tradition initiated by Constantine the Great. (Meijer, 1986, 234). If we believe Zosimos (5th c. AD), the construction of the longer triremes was abandoned since 323 AD and instead the triaconters, 30-oared vessels, were built (Zosimos, 2.23.3). Whether Belisarios' warships were constructed smaller specifically to meet the needs of sailing to

North Africa and along the African coast, or whether the change merely reflected the fifth-century tradition reported by Zosimos, is a matter of conjecture. Perhaps it was a combination of the two.

For Belisarios' long voyage and the run along the coast of North Africa with few suitable ports, a scorching sun overhead and huge quantities of water needed to quench the men's thirst, a small number of dromons accompanied by a huge fleet of merchant ships was called for. This explains why there were only 92 warships in contrast to 500 merchant ships, as reported by Procopios (op.cit.).

It is worth comparing Belisarios' trip to North Africa with a similar venture by Scipio. Scipio, in his effort to conquer Carthage, sailed from the port of Lilybaeum in Western Sicily with 400 transport ships escorted by only 40 warships. Before his departure from Lilybaeum he mustered the navigators and captains of all the ships and made sure that they had put on board adequate quantities of water for the crew and animals: *quaesivit Scipio si aquam hominibus iumentisque in totidem dies quot frumentum imposuissent* (Livy, XXIX, xxv. 8).

In contrast, Belisarios' supply of water was spoiled, except for some in glass containers buried in cool sand by Belisarios' wife. It must be mentioned here that in the wreck found in the little port of Mazzameni (at the southeastern tip of Sicily), dated a little after Belisarios' expedition, a large water storage capacity was found (F. van Doornick, 1972, 136).

Both Scipio and Belisarios took great precautions to land undetected. Scipio pretended to land elsewhere but actually disembarked at Utica, since no specially constructed landing ships existed at that time; they were not invented until much later (Christides, 1988, 319 ff.). Belisarios moved cautiously and made a great effort to avoid being sighted by the Vandals. The enormous difficulties of landing without specially constructed vessels are vividly described in a hagiographical text, *The Martyrium of Arethas*, reporting events of the sixth century. A huge force of Yemeni infantry and cavalry waited in a trap on the Yemen seashore where the Ethiopian fleet was to land. After 600 Ethiopians had died from thirst and hunger while they waited in indecision, the Ethiopians decided to use a ruse to land safely. Leaving their ships anchored offshore, they boarded small boats (*καράβια*) and proceeded to the land, where the enemy was waiting for them. They disembarked in the shallow waters, keeping the small boats in front of them as a protective wall, and thus managed to land safely (*Martyrium Sancti Arethas et Sociorum, Acta Sanctorum, October 24, 755*).

Concerning the number and size of Belisarios' ships, Procopios reports that the 92 dromons were manned by 2000 men who were simultaneously oarsmen and fighters, which means that there were about 22 men in each ship.

Procopios states explicitly that the fighting men in each ship were also oarsmen *δισχίλιοι ἔπλεον αὐτερέται πάντες*. The term *αὐτερέται* was taken, according to Procopios' common practice, from Thucydides (see, for example,

Thucydides III. 18. 3-4). Needless to say, any crew that had the duty of rowing and fighting would have performed a herculean task on such a long voyage. One, wonders, therefore, whether Belisarios' crews were actually *αὔτερέται* or whether this is simply another bookish but misleading imitation of Thucydides' style by Procopios. We should not forget that these crewmen had to handle the sails too.

There is no concrete information about the type of sails of these dromons. Casson has convincingly argued that most probably they were equipped with lateen sails (Casson, 1982, 25).

I believe that the most important element to be found in Procopios' narrative concerning the Byzantines' sixth-century *dromon* - which has hitherto passed unnoticed - is that the Byzantines relied mainly on the standard naval tactic of the ancient Greeks, i.e. the use of the ram (*ἐμβολισμός*). This is clearly shown in a naval battle which took place between the Goths and the Byzantines at Sinigalia, near Ancona, in 551. Procopios expressly states that the Byzantines used the ram: *κατὰ μόνας ἐμβάλλειν* (Procopios, op. cit., VIII.23.31). This is the last notable instance of the use of the ram in a naval battle.

The ram, the typical main weapon of ancient warships, was recently studied thoroughly on the basis of a recent discovery in a bay near Athlit, twelve miles south of Haifa (Fig. 1). The Athlit ram, a mass of bronze weighing 465 kg., is 2.26 m long, has a maximum width of 76 centimeters and a maximum height of 96 cm (L. Casson and J.R. Steffy, 1991, 11).

In a short but succinct and comprehensive article by Casson in this book, "The Evolution in Shape of the Ancient Ram", the author makes a controversial statement (Casson, 1991, 69): "A galley had still to have a ram, but even before Trajan's time it had become nothing more than a symbol". As correctly pointed out by L. Basch, this is an oversimplification (Basch, 1991, 438). Procopios' evidence offers definitive proof of the last notable use of the ram in the middle of the sixth century.

Thus the Byzantine *dromon* of this early period functioned on completely different military principles, which had little in common with the *dromon par excellence* of the ninth and tenth centuries.

In the following centuries, speed, the most important characteristic of the early *dromon*, is sacrificed for the sake of heavy equipment. The loss of speed and the need for additional power led an unknown Byzantine author to suggest the construction of a vessel powered by oxen driving two great side paddles (Fig. 2).

We cannot trace the development of the Byzantine *dromon* from Procopios' time (middle of the sixth century) to the eighth and ninth centuries, when it was stabilized.

I believe that the battle of *Dhāt aş Şawānī* in 655-56 AD was a turning point. The Greek and Arabic sources state explicitly that neither the Greeks nor the Arabs used the ram.

At least a century after Belisarios' expedition, at the time of the naval engagement of *Dhāt aṣ Ṣawānī*, a new type of *dromon* emerges, a slow-moving ship equipped with catapults and manned by heavily-armed marines. Speed, from which the *dromon* took its name (from *δραμεῖν* = to run, to move quickly), was lost for ever. This naval engagement, which sometimes is considered a proof of the newly acquired Arab seamanship, was in reality a conspicuous example of naval incompetence of both sides. Both the Arab and Byzantine fleets spent the whole night before the battle praying unceasingly. No attention was paid by any of the sides to take profit of the dawn winds, so important in such naval engagements. The Byzantines made no attempt to break the ropes with which the Arabs tied their vessels with their own and thus abandoned any effort to use their nautical expertise against an unexperienced enemy. In any case the speed played no part any more in naval engagements and the ram is conspicuously absent. (For the equipment of the ships involved in this naval engagement and the naval tactics employed there, see Christides, 1985. For a secondary use of the ram by both Byzantine and Arab ships for delivering blows and holing the enemy ships, see A. Abdelfatah, 1912, 366).

It was this heavy type of warship that the Arabs used as a model to start building their own warships after the conquest of Egypt, completed in 645, and these were the vessels they used in their first raids against the Byzantine islands.

Information about the development of Byzantine and Arab warships from the middle of the seventh century to the ninth and tenth centuries, the peak of their activities, is sadly deficient. By the tenth century the average Byzantine *dromon* and its Arab equivalent, the *shīnī*, both look like floating fortresses - an expression which often appears in Arabic poetry - strongly resembling each other. This is hardly surprising, since there are numerous documented cases of both sides capturing each other's warships with their crews. Moreover, the Byzantines' main manual of naval warfare, Leo VI's *Naumachica*, was translated into Arabic (Christides, 1982, 1993).

On the evidence of both Arab and Byzantine sources, it appears that stone-throwing catapults and large siphons mounted in the bows and smaller ones amidships and aft were the salient characteristics of the warships of the time. (The standard work on the Byzantine *dromon* is still R.H. Dolley's article on "The Warships of the Later Roman Empire", 1948, 47-53. Likewise, his article concerning naval tactics is still of value, although certain statements can no longer be accepted (1953). For other relevant problems see Christides, 1982, 1984, 1989, 1991, 1993 and J. Lirola Delgado, 1992.)

In spite of some progress in the study of Arab and Byzantine warships certain problems have remained unanswered, such as the various names used for Arab vessels by the Byzantine authors, the exact function of the Arab and Byzantine fire-throwing warships and, most important of all, the number of oars and the

function of oarsmen in both Byzantine and Arab warships.

The big warships were sometimes accompanied by smaller vessels; these auxiliary craft appear frequently escorting Greek and Roman merchant ships, under the names *káραβος*, etc. Such ships would naturally be needed to escort the now big and slow-moving Byzantine *dromons*. In the Arabic sources one such type of vessel is called *shākhṭūr*. This Arabic type of ship also appears in the Byzantine sources that mention Arab ships. Thus, Theoph. Cont. reports that a squadron of Arab ships from Crete included *κουμβαρίων ἄχρι εἴκοσι, ἑπτὰ γαλέας καὶ τινὰς σατούρας...* (Theoph. Cont., Bonn ed., p. 196). (H. Antoniadis-Bibicou's statement, 1966, 168 "nous savons très peu de chose des σατούραι" is inaccurate).

The typical *shākhṭūr* is of small size and carries one mast in the middle:

الشخّور - والشخّورة - سفينة صغيرة بصارٍ واحدٍ
في الوسط .

(s.v. in the dictionary *Muhīt al-Muhīt*). Arab illustrations of merchant ships show small vessels escorting them, while a small escort vessel without a mast appears in the picture of an Arab warship (Fig. 3). The Arabic sources report that the *shākhṭūr* was one type in a vast group of smaller escort vessels, including the *qārib* (Greek *káραβος*, also an escort ship), *barkah*, etc.

The term *barkah* corresponds to the *barce de canteria*, escort ships of Western Europe. (For an example of a small vessel of this kind with its sail hoisted, see the interesting depiction on a mediaeval Muslim bowl imitating Western models in J.H. Pryor, 1990, 100, pl. 1,2).

In addition to this type of accompanying ship called *shākhṭūr*, with the same name is labelled a river ship on the river Nile or other rivers (Nakhili, 1979, 74 ff.).

The Byzantine authors frequently call the Arab warships *κουμπάρια*, a word not used by the Arabs themselves, perhaps a misspelling of the Arab word *marākib kubār* (big ships), although it does appear in the Geniza document (Christides, 1982, 62). Perhaps the appearance of the word *kubār* in the Geniza documents solely, should be related to the etymology expounded by Antoniadis-Bibicou (1966, 168).

To return to the type of the Byzantine *dromon* and Arab *ṣhīnī*, while abundant evidence in the Byzantine and Arabic sources and illustrations convincingly prove that the average warships were three-masted (Dolley, 1948, 51; Christides, 1993), the problem of the position and number of oars and oarsmen in Arab and Byzantine warships is complex and difficult to solve. According to Leo VI's *Naumachica*, there were the following arrangements for the two main types of *dromon* (ed.

Dain, 1943, 1,7-8):

Ἐκαστος δὲ τῶν δρομώνων εὐμήκης ἔστω καὶ συμμετρους ἔχων τὰς λεγομένας δύο, τὴν τε ἄνω καὶ τὴν κάτω.

Ἐκάστη δὲ ἔχέτω ζυγούς τὸ ἐλάχιστον κε' ἐν οἷς οἱ κωπηλάται καταστήσονται ὡς εἶναι ζυγούς τοὺς ἅπαντας κάτω μὲν κε', ἄνω δὲ ὁμοίως κε', ὁμοῦ ν'. Καθ' ἓνα δὲ αὐτῶν δύο καθεζέσθωσαν οἱ κωπηλατοῦντες, εἷς μὲν δεξιά, εἷς δὲ ἀριστερά, ὡς εἶναι τοὺς κωπηλάτας ὁμοῦ καὶ τοὺς αὐτοὺς καὶ στρατιώτας τοὺς τε ἄνω καὶ τοὺς κάτω ἄνδρας ρ'.

According to this text the first type of a two banked *dromon* carried a crew of one hundred, divided in four units of 25 oarsmen each placed two on the upper level ($2 \times 25 = 50$) and two on the lower level ($2 \times 25 = 50$).

More complicate and controversial is the calculation of the number of oarsmen in the second type of *dromon* mentioned in another passage of Leo VI's *Naumachica* (ed. Dain, 1,9):

Καὶ ἕτεροι δὲ δρόμωνες κατασκευαζέσθωσάν σοι τούτων μείζονες, ἀπὸ διακοσίων χωροῦντες ἀνδρῶν ἢ πλεον τούτων ἢ ἔλαττον κατὰ τὴν χρεῖαν τὴν δέουσαν ἐπὶ καιροῦ κατὰ τῶν ἐναντίων· ὧν οἱ μὲν ν' εἰς τὴν κάτω ἐλασίαν ὑπουργήσουσιν, οἱ δὲ ρ' καὶ ν' ἄνω ἐστῶτες ἅπαντες ἐνοπλοισμαχέσονται τοῖς πολεμίσις.

According to this passage 50 oarsmen were placed on the lower level and 150 oarsmen, who were simultaneously fighters, were placed on the upper level. I believe that there were three units in which 25 oarsmen ($3 \times 25 = 75$) and the rest were kept in reserve, taking task in turns. (This view is expressed by C. Torr, 1895, 16 ff.; repeated by L. Casson, 1973, 149, n. 3 and M. Reddé, 1986, 120 ff.; for a different view see R. Dolley, 1948, 48).

No literary evidence reports that more than one oarsman was put in each oar - a practice which started much later, in the fourteenth century - and in none of the numerous illustrations of ships in Skylitzes' manuscript we notice any depiction of such practice.

As regards the Arab *ḡhīnī*, we face again the same problems concerning the number of oars and oarsmen and their function. Paradoxically, these problems have not been discussed in any modern work. Thus, while there are scattered references to the subject in the work of Nakhili (1979), and H. Ziyat (1949), the simple questions how many banks of oars and oarsmen there were in the Arab warships and how many oarsmen sat on each bench have not been asked.

To start with the first question, the Arabic sources clearly differentiate between the soldiers (*jund*, *muqātīla*) and the sailors (*malāhūn*, *nawāta*) and report that - in contrast to the Byzantine warships - there is a clear demarcation between these two categories. This practice is rooted in the original strict differentiation between the two categories, dated to the middle of the seventh century, when the *jund* received better pay and better bread than the *malāhūn* (Christides, 1984, 54-55).

The Arab average warships were definitely two-banked. The artistic evidence is too poor to illuminate this point, since there are only sketchy Arabic manuscript illuminations and vague paintings on ceramics. (See, for example Figs. 3-4). In contrast, many Byzantine illuminations depict clearly two-banked Byzantine vessels (Fig. 5). Nevertheless, the literary evidence in the Arabic sources shows persuasively that the average Arab warships - *ṣhīnī*, *shelandī*, *ghurāb* - were two banked.

Ibn al-Mamātī explicitly states that the *muqātila* fought on higher level while the oarsmen rowed below them. Concerning the number of oars and oarsmen, Ibn al-Mamātī, who is the most reliable of the writers on seafaring, states in the above mentioned passage (ed. A.S. Attiya, 1934, 340):

الشين ... فإنه يجدف بعائة وأربعين مجدافاً ، وفيه
المقاتلة و الجداعون . الشلندي فإنه مركب مستقف
تقاتل الغزاة على ظهره .

“The *ṣhīnī* sailed with 140 oars and on it there are the fighters (marines),” and speaking about the *shelandī*, “the *shelandī* is a decked warship carrying the fighters on it and the oarsmen row under it.”

While Ibn al-Mamātī’s reference is the most concrete evidence of the number of oars in an average Arab warship, it leaves open the problem of how many oarsmen there were to each of the 140 oars and the exact position of both oars and oarsmen.

If we accept the theory that one person manned one car, then the average Arab *ṣhīnī* must have been longer than the Byzantine average *dromon* estimated by Dolley at 130 feet (Dolley, 1948, 48). Most probably there were two rows of oarsmen below the fighters.

It was in the lower area that the wounded were placed along with the doctors. Physicians are reported in the Arabic sources on every average warship (Christides, 1984, 143). The presence of physicians are also reported in the Greek and Latin sources and while there are no such references in the Byzantine sources, there is no doubt that physicians must have existed in their warships (Christides, 1992, 38).

It is noteworthy that in a Spanish source, written in later time, ca. 1500, it is suggested that: “wounded men must be sent below, for they are in the way and intimidate the others” (F. Foerster Laures, 1987, 26).

The number of marines in each average *dromon* and *ṣhīnī* varied in accordance with the distance they had to sail and the mission they undertook. Numerous scattered references collected by Nakhili suggest a figure of about 50 marines (*jund* or *muqātilah* in each Arab *ṣhīnī* or Byzantine *shelandī* (= *dromon*) (Nakhili, 1979, 80). The same number of 50 marines appears in a passage of the tenth-century Arab author *Ibn Ḥayyān* (P. Chalmers, 1979, 366-67). (See other relevant passages reporting the average number of 70 marines in Christides, 1982, 85 ff.)

In general by the tenth century the average Arab and Byzantine three-masted and oared warships must have looked very similar and been indistinguishable from a distance. This was natural since, as the Arabic and Byzantine sources reveal, whole ships were often captured by both sides with their crews from early in the ninth century, following the revolt of Thomas the Slav (821-823 AD). This revolt opened the way to the conquest of Crete and Sicily by the Arabs and was the catalyst for the rapid improvement of the construction and efficiency of Arab warships. (The interdisciplinary study of historical events and naval technology is a must for the understanding of both history and seafaring, otherwise any research remains futile; see, for example, A.N. Stratos' work (1980) and Treadgold's monolithic approach based solely on literary evidence (1988). Both are conspicuously lacking in even a rudimentary knowledge of naval technology). Treadgold does not seem to understand either the importance of the Byzantine navy in general or the disastrous impact of Thomas' revolt on it, which opened the way to the conquest of Crete and Sicily. (See H. Kopstein, 1991).

On close examination of the Arab *ṣhīnī* and the Byzantine *dromon*, of course, the flags and banners would make their identity obvious. In addition to the flags which appear in Figs. 3, 4 and 5, see also Fig. 6 where there is also a clear depiction of the *ξυλόκαστρον* placed in the middle of the ship.

Concerning the painting of ships, according to an Arab poet, the Arab ships were painted black and their sails were white (Nakhili, 1979).

وكانت عدة مراكبه أربعين مركباً ،
عشرين حراقات ،
فيمها النفط والآلات البحرية ،
وعشرين ميلا الرجال
المقاتلة ، وكان عدد ركابه من الجند ألف رجل ،
و من البحرين ألفين .

فأناخ بها مائة مركب من الثلدية ،
يحمل كل مركب
مابين الخمسين رجلاً إلى مائة .

Reddé believes that the Roman tradition of painting the ship's side blue must have continued for purposes of camouflage (M. Reddé, 1986, 27). In Byzantine ships such camouflage would have been needed only for scout smaller bank dromons.

Finally, it should be noted that after the ninth century the part played by oarsmen on long-distance trips was strictly limited in both Arab and Byzantine warships, because of their enormous weight. This explains why the Byzantine admiral Adrianos' fleet, sent on a mission to Sicily, was immobilized in the port of Gerax in Laconia because of adverse weather. Skylitzes explicitly mentions that Adrianos refused to use oars to cope with the calmness of the sea: *μη βουλομένου κατὰ τὰς νηνεμίας εἰρησία χρῆσθαι* (ed. Thurn, p. 159).

The effectiveness, of Arab and Byzantine oarsmen - both free citizens and selected after trials - was greatly reduced by the extreme heaviness of their vessels in contrast to their counterparts in the ancient triremes. (On the performance of the latter, see V. Gabrielsen, 1991, 180, and A.F. Tilley and V.H. Fenwick, 1973, 96-99.)

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A new article comparing Ibn al Manqali's work with Leo VIth, by the same author will appear in the next issue of Byzantinoslavica.

ILLUSTRATIONS

- Fig. 1 The Athlit Ram. Courtesy of S. Arenson.
- Fig. 2 Imaginary Byzantine ship propelled by the power of oxen. F. Meijer, 1986, Fig. 14.8.
- Fig. 3 Arab shīnī. S. Maher, 1967, Fig. 48.
- Fig. 4 Arab Warship. D. Nicolle, 1989, Fig. 29a.
- Fig. 5 Byzantine dromon. Illumination (ca. 1200 AD). R. C. Anderson, 1962, Fig. 11.
- Fig. 6 Chelandia on a medal of Doge Pietro Candiano of Venice of 931 AD. Pryor, 1992, Fig. 7.

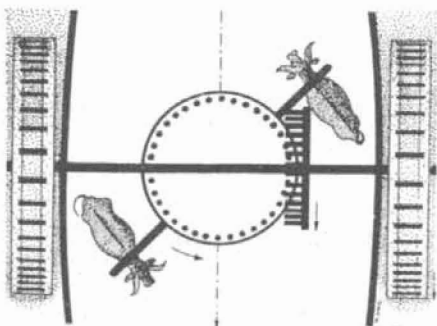


Fig. 2

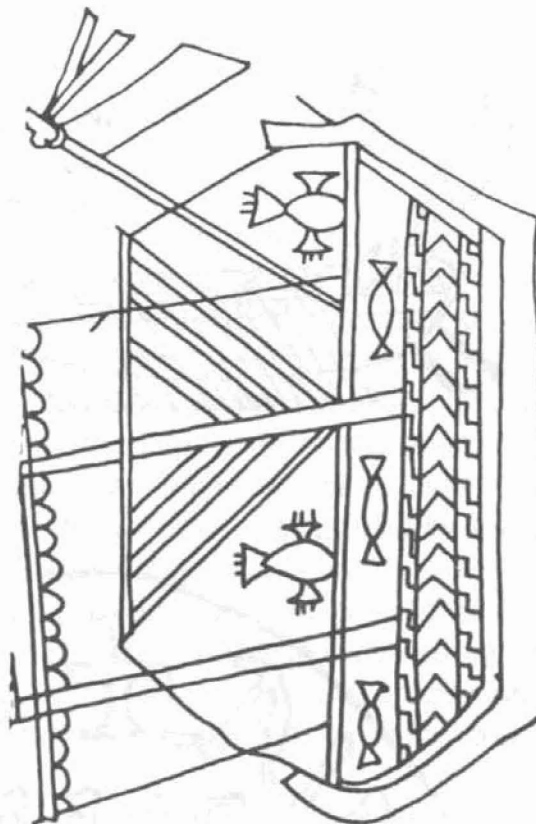


Fig. 4



Fig. 1

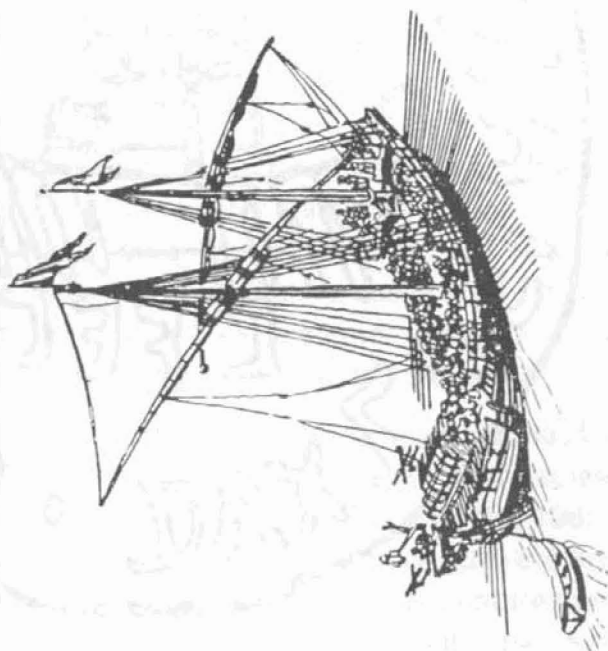


Fig. 3

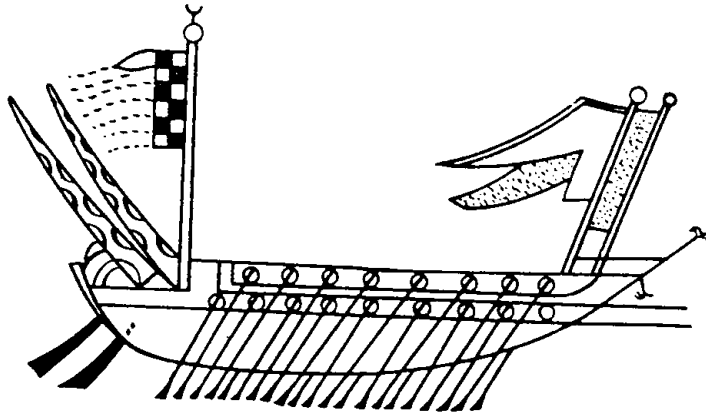


Fig. 5

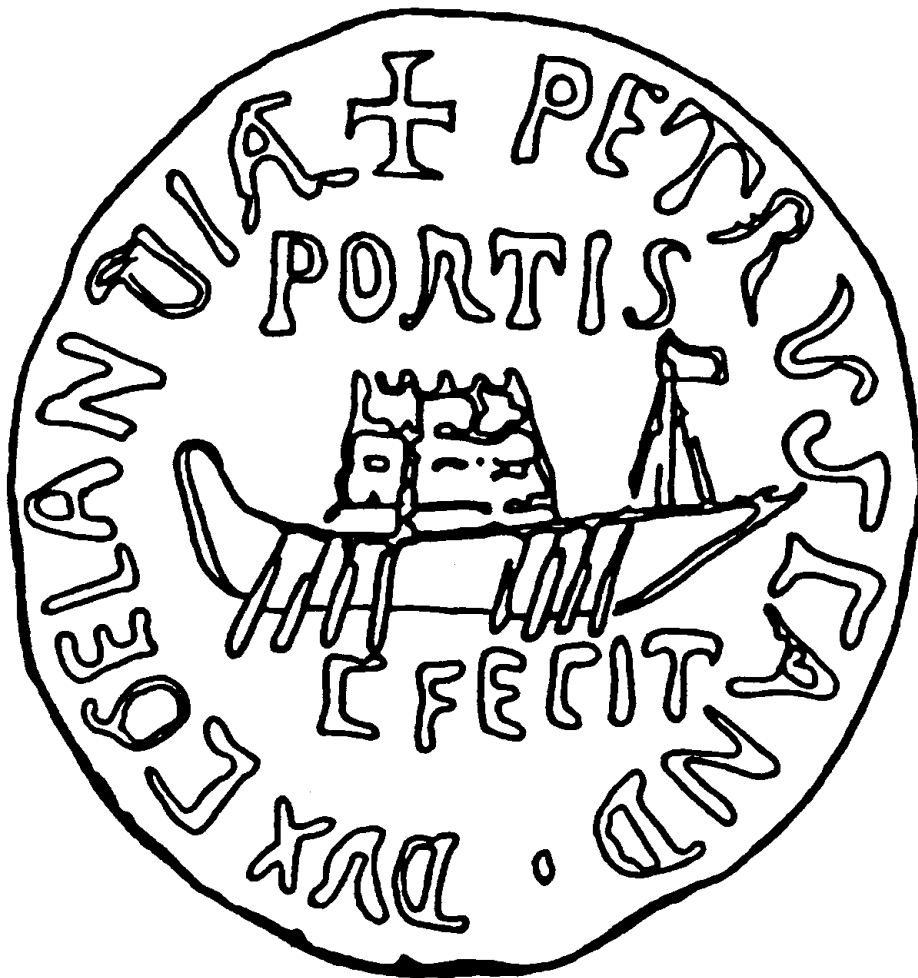


Fig. 6

LE MAT DU NAVIRE: REALITE ET IMAGINAIRE EN GRECE ANCIENNE

Grâce aux recherches consacrées à la construction des navires antiques pendant les dernières années on a pu élargir notre connaissance en ce qui concerne la technique de fabrication. Grâce aussi à une étude systématique des sources, on a également accès à des détails dispersés mais concordants qui ouvrent des vastes perspectives d'analyse et d'interprétation des données sociales relatives à la navigation. Ainsi, pour rappeler les choses essentielles, on sait que le mât fait son apparition dans l'histoire du bateau avant même que cette histoire ne nous soit révélée par des témoignages écrits ou figurés. Les premières voiles qu'on peut reconnaître avec certitude sur les représentations des navires sont celles que l'on aperçoit sur des dessins des bateaux égyptiens qui datent à peu près de 3100 av.J-C.; mais il reste toujours possible qu'en Mésopotamie les marins se soient servi du mât déjà avant 3400 av.J-C.¹ Il convient, donc, de préciser que lorsque le mât entre dans l'histoire nautique hellénique, il est déjà le fruit d'une technique prouvée et élaborée.

Déjà dans l'épopée homérique sont précisés les termes qui désignent les principaux éléments du gréement d'un navire. L'*histos* (le mât), l'*histion* (la voile), la *mésodmé* (poutre transversale où s'emboîte le mât), l'*histopède* (la douille au pied du mât), l'*histodoke* (le support du mât lorsqu'on l'abaissait), les *protonoi* (les étais), l'*épitonos* (le galhauban), l'*épikrion* (la vergue). On sait par Homère que la voile était levée à l'aide de cargues, qui servaient aussi à réduire ou augmenter sa surface en fonction de la puissance du vent.² Lorsque le vent tombait, la voile pouvait être amenée au creux du navire.³ Pour fixer le mât dans l'*histopède* on le levait de l'*histodoke* au moyen des étais. Lorsqu'on ne voulait pas s'en servir on le maintenait couché vers la poupe. Mais il se pouvait aussi que le mât reste fixé dans l'*histopède* sans pour autant porter la voile. C'est, justement, ce qui se passe à bord au moment où le navire d'Ulysse s'approche de l'île des Sirènes.⁴

Pour pouvoir écouter le chant des Sirènes, Ulysse doit être lié, pieds et mains, contre le mât de son navire. Sa position exacte est soigneusement précisée à plusieurs reprises dans le texte (12, 50-51, 160-163, 178-179, 193-196): il reste fixé contre l'*histos*, debout au pied du mât. A travers tout ce qui a été écrit sur l'épisode des Sirènes, on s'étonne de voir qu'en réalité on s'est très peu demandé pourquoi Ulysse devait être attaché debout contre le mât et pas dans

une autre position ou contre une autre partie du navire, puisque le texte décourage toute tentative de penser qu'il pourrait jamais voir les Sirènes; elles sont, de toute façon, les êtres les plus invisibles de l'Odyssée.

Quelques siècles après Homère, les commentateurs anciens voyaient dans cette position d'Ulysse l'attitude du savant qui, seul parmi les hommes, peut raisonner et résister aux tentations mortelles.⁵ Une autre explication est, bien sûr, la différence qui sépare *a priori* et surtout aux moments critiques du voyage, le roi de ses compagnons; cette différence serait ici manifestée aussi sur un plan visuel. Déjà le privilège d'écouter le chant des Sirènes souligne cette distance qui doit être rappelée. Cependant, la distance la plus importante à rappeler est celle qui sépare la vie de la mort. Car la mort, dans son aspect le plus séduisant, avec le savoir absolu et conclusif qu'elle entraîne, est l'enjeu de cette promesse musicale des Sirènes. Et un homme debout, c'est surtout un homme qui vit. Dans toutes les sociétés, dans tous les systèmes rituels, dans toutes les formes de vie collective qu'on puisse étudier, on devient témoin d'ordalies, initiatiques ou autres, dont le but est toujours de prouver qu'un individu est capable de faire face aux difficultés qui le menacent. On sait que l'épreuve d'une ordalie consiste souvent à attacher quelqu'un contre un pieu ou un arbre et à lui y faire subir le danger auquel il devra survivre.⁶ La position d'Ulysse sur le navire à côté des autres aspects sémantiques dont elle peut être chargée, reflète aussi cette idée de l'épreuve qu'on subit attaché. Mais cette fois c'est le mât qui se substitue au pieu d'attachement en devenant en quelque sorte un arbre de la mer, ce cette mer qui, à elle seule, suffit souvent à représenter l'espace d'une ordalie.⁷

Les liens qui attachent Ulysse au mât de son navire ne font pas seulement allusion aux étais qui retiennent la voile mais aussi aux liens insinués par le nom même des Sirènes. Car, en faisant un rapprochement probablement parétymologique, les anciens Grecs voyaient déjà un rapport entre le mot *seiren* et le mot *seira* (lien, corde).⁸

L'image d'Ulysse attaché au mât de son navire, comme si les deux n'en faisaient qu'un, fait, je crois, partie d'une conception plus vaste qu'on arrive à dévoiler lorsqu'on se souvient de l'usage propre auquel la cire est destinée à bord: il s'agit surtout de couvrir les fissures du bois, protéger les planches de l'eau salée. Ainsi, la ruse d'Ulysse qui bouche les oreilles de ses compagnons avec de la cire et se fait, quant à lui, attacher contre le mât ne consiste, au fond, qu'à assimiler l'équipage au bateau même, à identifier le capitaine au mât et les rameurs au corps du navire en leur assurant cette même protection qui empêche l'eau de pénétrer dans la coque et la mort de pénétrer dans l'âme des navigateurs.

Or, si le mât sert déjà à assurer la survie du commandant c'est que souvent, dans l'imaginaire collectif de l'antiquité, il s'identifie à lui. Dans une époque assez éloignée d'Homère, Artémidore écrivait encore que lorsqu'on rêve d'un navire "le mât du navire indique le commandant, la proue le timonier, ... les agrès les matelots"⁹. La comparaison du mât avec le corps humain est reflétée aussi dans les noms des parties de l'histos; Asclépiade de Myrléa, cité par Athénée, en conserve les principaux termes: talon (*pterna*) pour la partie basse du mât, cou (*trachélos*) pour la partie du milieu, torse (*thôrakion*) pour la partie rectangulaire du *carchésion* (=poste du vigie).¹⁰

C'est peut-être le moment de rappeler que, dans l'Odyssée, Ulysse s'accroche encore une fois au mât de son navire. La plus terrible des tempêtes homériques se déchaîne en mer quand le bateau d'Ulysse quitte l'île de Thrinakia où les compagnons ont impieusement tué les vaches sacrées d'Hélios. C'est le départ final, le dernier voyage du dernier vaisseau, la course la plus courte.¹¹ Le mât emplanté (pour la dernière fois, v.402) dans l'*histopède* n'est plus soutenu par les étais rompus (v.409); il tombe vers l'arrière et frappe la tête du gouverneur qui en meurt. Ainsi, par la rupture du mât, la mort s'empare du navire foudroyé¹² et la mer "disloque sa membrure" (421). Jusqu'ici l'*histos*, fidèle à son étymologie, restait, tout comme Ulysse, debout sur le bateau;¹³ ici commence l'aventure du mât flottant. Mais sur ce mât qui flotte contre la quille, l'un des contre-étais, un cuir de boeuf, reste encore attaché. Ulysse y voit le moyen de lier ensemble mât et quille; puis, fixé pour la deuxième fois sur son mât, il se laisse porter par le vent. C'est la partie du voyage que les auditeurs apprennent de la bouche d'Ulysse lui-même. En une seule nuit Ulysse raconte aux Phéaciens ses aventures maritimes depuis son départ de Troie. Grâce à une des inventions structurales de l'Odyssée, le temps réel des aventures vécues est réduit au temps raccourci de ce récit nocturne. Cette durée paraît, tout au moins, suffisante pour illustrer le passage du danger vécu collectivement au danger expérimenté individuellement, de la métis agressive à la métis défensive, de l'acquisition des richesses à la perte des biens, de la mer dominée à la mer dominante. C'est dans cette même perspective que l'on voit Ulysse se croiser, dans son nostos, à pratiquement toutes les étapes temporelles, sociales et techniques de la navigation. Partant à la tête d'une flotte dominante, il perd successivement les bateaux qui l'accompagnent, il perd par la suite son propre vaisseau, pour être enfin emmené aux temps reculés précédant la navigation, à l'époque où l'on traversait l'eau assis sur un tronc. Lorsque ce tronc incontrôlable, voire ce mât brisé, va de nouveau ramener Ulysse au gouffre de Charybde, la seule chance de survie sera de quitter la mer, de s'accrocher, comme une chauve-souris, aux rameaux du figuier au-dessus de la grotte, en

sautant du bois flottant vers le bois enraciné, de l'espace maritime vers l'espace terrestre, en interposant entre les deux l'espace vital, l'espace humain. Quand le mât et la quille sortent de nouveau du gouffre, Ulysse plonge dans la mer et remonte dessus; mais cette fois, il ne se laisse plus porter par le vent: come pour évoquer une idée et une pratique plus avancées, il essaie de diriger sa course en ramant des deux mains. Après avoir passé neuf jours dans la mer, il atteint enfin le littoral d'Ogygie, l'île de la nymphe Calypso¹⁴, ou une autre vie l'attend.

Le mât et la voile étant constamment présents dans la vie quotidienne de nombreuses cités grecques, il n'est étonnant qu'ils aient influencé aussi la vie culturelle en Grèce ancienne. Ils ne sont pas seulement décrits ou évoqués par les peintres ou par les poètes lorsqu'il s'agit d'un récit maritime, mais ils inspirent aussi souvent des métaphores qui désignent la poésie elle-même: ce n'est plus la poésie qui parle du mât, c'est le mât qui parle de la poésie. Cela ne pouvait, évidemment, arriver que dans une époque où les bateaux grecs ont déjà acquis un haut degré technique de construction et une importante assurance, parfois même une fierté, d'avoir dompté de longs parcours maritimes. C'est le passage du VI^e au Ve siècle av. J-C. Les bateaux de cette époque n'hésitent plus. Dans sa Ve Néméenne, composée probablement vers 489 av. J-C., Pindare incite le poète qui est en lui de ne pas hésiter de chanter mais de "hisser la voile": "si tu viens pour chanter Thémistios n'hésite plus: donne de la voix, hisse la voile jusqu'à la vergue de hune".¹⁵ Le mât est équipé d'une hune (*karchésion*), le chant poétique respire d'un souffle qui gonfle la voile du navire et neuf ans seulement séparent les bateaux grecs du combat naval victorieux de Salamine. Ces métaphores nautiques sont destinées à célébrer la victoire d'un jeune athlète d'Egine, d'une île qui a toujours su justifier sa grande réputation en matière de navigation. Mais ces métaphores ne sont pas, pour autant, les seules à s'inspirer du mât et de la voile dans la poésie de Pindare. Ainsi, la "voile emplie du vent" (*histion anemoen*) évoque, dans la première Pythique, la générosité qui doit être, pour un chef d'état comme Hiéron, une des vertues politiques exigées. Cette générosité va de pair avec la justice qui est comparé, dans le même poème, au gouvernail du navire.¹⁶ Les cités grecques sont déjà en pleine expansion. L'image du navire se veut très proche de la réalité de la polis qui devient, pendant cette période, le coeur de l'évolution historique. Le changement des voiles (*histion metabolai*) dans la IV^e Pythique de Pindare, se veut significatif des changements d'ordre politique qui doivent se passer dans la cité. Les temps qui changent, exprimés, dans cette métaphore, par l'idée du vent qui tombe, donnent lieu aux modifications propres aux circonstances actuelles de la cité.¹⁷ C'est le moyen dont dispose Pindare pour intervenir auprès d'Arcésilas, roi de Cyrène, en faveur d'un exilé politique qui, d'après lui, doit retrouver sa place dans la ville.

La voile, le vent, le changement et le navire. La ville et le bateau se mirent l'un dans l'autre. Parfois même ils ne font qu'un. Alcée l'a dit carrément: la ville c'est le bateau. Et le bateau, dans le plus célèbre des poèmes d'Alcée, navigue dans la tempête.¹⁸ "Je suis dérouté par la mêlée des vents la vague qui roule vient tantôt d'ici et tantôt de là; nous cependant, au milieu des flots nous sommes emportés avec notre noir vaisseau, ballotés violemment par la grande tempête; l'eau, dans la sentine, couvre le pied du mât toute la voile est déchirée;-elle pend en grands lambeaux; et les câbles cèdent." (Puech-Reinach). Le désordre des vents qui soufflent de tous les côtés est appelé *stasis* pour désigner directement le désordre dans la cité, les vagues roulent dans des sens opposés comme des partis politiques et le pied du mât (*histopeda*) est couvert d'eau. La menace du naufrage est accentuée par l'image de la voile abîmée. Dans cette description des plus terrifiantes, quant à un bateau, que nous a léguée la poésie antique on doit toutefois, souligner quelques points intéressants. Contrairement au naufrage d'Ulysse, le risque ici ne prévient pas d'une brisure éventuelle du mât. Le danger représenté par l'eau qui couvre le pied du mât est, en réalité, l'inondation du vaisseau. Le bateau, voire l'espace politique, risque de couler entier sans être cassé. Excepté la voile déchirée, les autres parties du navire restent étrangement intactes malgré les vents violents. Il est certain qu'entre Homère et Alcée la construction des bateaux se veut déjà plus solide. Mais ce n'est pas cela qui préoccupe Alcée; c'est la conscience politique qui compte. Ce n'est plus le mât qui symbolise le commandant, ce n'est plus l'individu qui est visé, c'est la cité dans son intégralité qui est impliquée, c'est un corps collectif qui meurt. Dans la poésie d'Alcée ce "corps" collectif vit en mer, dans les bateaux, et en ville, dans les banquets. Et, c'est, justement, le dieu de ces banquets, le dieu Dionysos, qui a construit le mât le plus original qu'on n'ait jamais pu implanter ou, tout court, planter dans un navire. Sur une coupe d'Exékias (V^e siècle av.J-C.)¹⁹ on voit Dionysos dans une position qui renvoie aux habitudes du banquet plutôt qu'à celles du marin, naviguer seul, dans un bateau. Le bateau est en forme de poisson, et porte un mât qui aboutit à une hune. La voile est emplie par le vent. Au milieu du bateau, comme si elle était enracinée à côté du mât, une énorme vigne surgit. Elle occupe tout l'espace au-dessus du bateau, comme un vrai parasol. Sept grappes prouvent la fertilité de cette vigne qui s'accorde très bien avec le caractère fécond de Dionysos appelé souvent, on le sait, Endendros, Dendrites, Problastos, Auxites et, aussi, Pélagios. Le nombre des grappes correspond aux sept dauphins qui occupent l'espace maritime autour du vaisseau. L'impression devrait évidemment être encore plus forte lorsque la coupe était remplie d'une liquide plus ou moins transparente. Mais Dionysos était souvent représenté en bateau, même à terre.

Ceci est, peut être, un souvenir de l'arrivée du dieu par voie maritime. Dans ces représentations Dionysos était porté sur un bateau roulant.²⁰ Il va de soi que la peinture d'Exékias a été mise en rapport avec l'histoire racontée dans le premier des trois hymnes homériques à Dionysos selon laquelle le jeune dieu a été enlevé au bord de la mer par des pirates tyrrhéniens qui espéraient l'échanger contre une rançon intéressante²¹. Mais une fois au large, des choses prodigieuses se passent; Tout d'abord, le vaisseau se remplit de vin. Puis, une vigne se déploie de chaque côte jusqu'en haut de la voile, dont on voit pendre de nombreuses grappes et un lierre chargé de fleurs s'enroule autour du mât. Le dieu se transforme en lion et un ours apparaît dans le bateau. Le lion dévore le capitaine et les pirates sautent dans la mer et deviennent des dauphins. Grâce est accordée au pilote.²² Dans la version d'Apollodore (III.V.3) Dionysos transforme le mât et les rames en serpents. Ceci est intéressant en ce que le mât affecte, cette fois, la forme d'un être vivant; c'est encore un bateau qui vit mais d'une vie qui évoque la terre dans son aspect le plus chthonien: le serpent. Au fond, il n'y a rien d'étonnant de voir Dionysos de faire d'une vigne, c'est à dire d'une plante qui lui est si chère, le mât d'un navire. Mais le dieu est aussi en relation étroite avec un autre arbre qui fournit aux constructeurs des navires le bois lié par excellence aux mâts: c'est le pin.²³ Plutarque précise²⁴ que le pin est l'arbre sacré de Dionysos aussi bien que de Poséidon parce que ces dieux sont tous les deux "maîtres du principe humide et fécond" (*τῆς ὑγρᾶς καὶ γονίμου κύριοι δοκοῦσιν ἀρχῆς εἶναι*), parce que les pins poussent souvent près de la mer et parce qu'ils aiment, tout comme la mer, le vent (*φιλήνεμος*). Mais surtout, le pin, le pin parasol et le sapin sont nécessaires à la construction des bateaux (*ἀλλὰ διὰ τὰς ναυπηγίας μάλιστα*) pour leur bois, la poix et la résine de l'enduit. En ce qui concerne la vigne, le pin s'y associe, entre autres, parce que les régions pinifères donnent un vin plus doux et parce que la résine est souvent ajoutée au vin.

Mais ce n'est pas seulement les arbres vivants qui se substituent au mât, c'est aussi le mât qui, séparé du bateau, est dressé sur la terre pour se substituer à un arbre, là où les arbres ne poussent pas. Ainsi, dans les jeux funéraires en l'honneur de Patrocle décrits par Homère,²⁵ on assiste à un tir à l'arc sur une cible originale: une colombe attachée par la patte au bout d'un mât d'un navire. Ce mât n'est plus sur un bateau. Achille le dresse sur le sable. Le premier archer, Teucros, atteint seulement la corde; le deuxième, Mérion, transperce avec sa fleche la colombe qui vole. L'oiseau, juste avant de tomber mort sur le sable, va se poser d'abord sur le mât, le seul objet entre l'air et la terre, aussi entre la vie et la mort.

L'arbre et le mât sont, naturellement, associés à la vie dans l'imaginaire

hellénique: sur la terre l'arbre est, le plus souvent, la preuve même de la vie; dans la mer, le mât, l'arbre maritime, porte en lui la même valeur. Et c'est encore des arbres que se préoccupe Ulysse dans l'île de Calypso où nous l'avons déjà vu. Il y est resté durant sept ans. Mais on sait qu'il est reparti. Pour cela, il a construit un radeau, une *σχεδίη*. Mais la naissance de cette *σχεδίη*, comme d'ailleurs, toute deuxième naissance, porte en elle le souvenir du vécu et du savoir précédant, le souvenir de quelqu'un comme Ulysse qui a navigué sur un vrai bateau. C'est aussi pour cela que, comme le montre L. Casson ("Ships.." p.p. 217-219), ce radeau ressemble si bien à un navire. Il est intéressant de constater que Calypso emmène Ulysse au bout de l'île pour lui fournir le bois nécessaire à la construction du vaisseau. Il y trouve du bois "séché depuis longtemps et léger à souhait"; aune, peuplier et sapin. C'est de ce bois qu'Ulysse construit son vaisseau dans lequel il dresse un gaillard pour planter un mât. (Hom. Od. 5,252-254). Ce mât, on le sait, sera cassé en deux et le bateau sera encore anéanti par Poséidon. Ulysse devra nager pour arriver à l'île des Phéaciens qui vont l'aider à regagner Ithaque. Mais avant que la *schédie* soit détruite on a le temps d'observer un détail. C'est que la voile du radeau est tissée par Calypso. (Hom. Od. 5,62,258-260). On se souvient maintenant qu'on la voit souvent devant son métier. Ici, plus qu'ailleurs, il sera nécessaire de se rappeler du champ sémantique très large du mot *ιστός*. Car, si le retour d'Ulysse est directement associé au mât de son navire, il y a, dans l'Odyssée, un autre *ιστός* auquel son sort est également lié: c'est l'*ιστός* métier à tisser. Plus on entre dans l'imaginaire inspiré du mât, plus on se rend compte que des analogies constantes se présentent entre les deux: le mât, comme le métier, est le support d'une toile; le mât et le métier sont les domaines où excellent par définition la capacité et l'ingéniosité de l'homme et de la femme respectivement; le mât pour le commandant, le métier pour la maîtresse de maison sont les objets où se concentrent leurs occupations et leurs préoccupations majeures. Linguistiquement et sémantiquement apparentés, le mât et le métier sont souvent placés au même registre, dans les catégories de la pensée grecque ancienne. La plus haute partie du mât (au-dessus du *carchésion*) s'appelle *ήλακάτη*.²⁶ Dionysos punit les filles du Minyas qui ne lui rendaient pas hommage exactement comme il punit les pirates tyrrhéniens: il fait jaillir une vigne de leur métier à tisser. Artémidore précise que "si quelqu'un en mer voit (=en songe) un métier à tisser, qu'il estime qu'il voit le mât du navire. Quoi que se soit, donc, qui arrive au métier, la même chose arrivera aussi au mât."²⁷ Rappelons que le métier n'est pas seulement l'instrument avec lequel on fabrique une toile; souvent, dans la pensée hellénique, il évoque aussi le tissage d'une ruse (*δόλος*). Ruse d'une femme habituellement, puisque ce sont les femmes qui s'occupent du tissage. Mais,

justement, l'*histos*, le mât d'Ulysse, l'emmène souvent vers une femme. Une femme qui tisse. Circée. Calypso. Et, bien entendu, Pénélope.²⁸ Il ya toujours un fil, un lien, une corde qui attache Ulysse à son sort. Le fil du temps tisse le *nostos*, le retour. Ce retour aura lieu au moment où Pénélope vient de finir son *histos*, sa toile elle-même raconte comment elle s'est mise à ce tissage (19.137-156). Elle tisse pendant la journée et la nuit elle défait son ouvrage. C'est l'*histos* dont la toile s'étend le jour et se défait la nuit, tout comme l'"histos" d'Ulysse sur lequel la voile se dresse le jour et se cargue la nuit.

C'est, donc, ce mot seul avec ses deux significations qui se repondent et qui se croisent, ce mot du voyage et du tissage, du *pontos* et de l'*oikos*, de l'homme et de la femme, qui constitue ainsi un des éléments thématiques majeurs de l'Odyssée. Et c'est par ce thème de l'*histos*, à la fois mât et métier, fil conducteur et fil du temps dans ce poème, que l'on achève ce bref voyage dans la réalité et l'imaginaire liés au mât du navire en Grèce ancienne. A travers son histoire, le mât a su réaliser ce que l'homme n'a jamais pu faire: rester debout sur les flots.

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NOTES

1. Ce sont les hypothèses retenues par L. CASSON aussi dans "Les marins de l'antiquité", (tr. fr. Paris, 1959, p. 12) que dans "Ships and Seamanship in the Ancient World" (Princeton, 1971, pp. 5-29 rééd en 1990) avec une différenciation pour la datation des documents égyptiens: 2 900av.J.C. en 1959 et 3 100av.J.C. en 1971, les deux dates restant, de toute façon, approximatives. Les bateaux égyptiens en question sont représentés sur les rochers ou sur les vases trouvés au Sud de l'Egypte. L'existence d'une voile dans les bateaux mésopotamiens de 3 400av.J.C. paraît surtout probable à cause d'une mortaise susceptible de recevoir un mât dans un modèle de bateau en argile qui date de cette époque (fouilles d'Eridu).
2. Rappelons que jusqu'au sixième siècle les vaisseaux grecs étaient équipés d'une seule voile carrée. L'expression *histia* signifie toujours cette voile unique en désignant, peut-être, les toiles cousues ensemble dont elle était composée; cf Il.I.480-482 *οἱ δ' ἰστὸν στήσαντι ἀνά θ' ἰστία λευκά πέτασσαν/ ἐν δ' ἄνεμος πρήσεν μέσον ἰστίον, ἀμφὶ δε κύμα/στεῖρη πορφύρεον μέγαλ' ἴαχε νηὸς ἰούσης. "Μέσον ἰστίον"* indique que la puissance du vent s'exerce à la partie centrale de la toile. C'est au croisement du 6e et 5e siècle que les documents semblent indiquer l'apparition d'une deuxième voile qui jouait, en tout cas, un rôle secondaire. Voir L.Casson, "Ships..", p.70.
3. p.ex.Hom.Od.12,169-170.

4. Hom.Od.12.165-200
- Ἦ τοι ἐγὼ τὰ ἕκαστα λέγων ἐτάροισι πίφαισκον· 165
 τόφρα δὲ καρπαλίμως ἐξίκετο νηῦς εὐεργῆς
 νῆσον Σειρήνοισιν· ἔπειγε γὰρ οὖρος ἀπήμων.
 αὐτίκ' ἔπειτ' ἄνεμος μὲν ἐπαύσατο ἢ
 δὲ γαλήνη
 ἐπλετο νημεμίη, κοίμησε δὲ κύματα δαίμων.
 ἀνστάντες δ' ἔταροι νεὸς ἰστία μηρύσαντο, 170
 καὶ τὰ μὲν ἐν νηὶ γλαφυρῇ βάλον, οἱ δ' ἐπ' ἔρετμά
 ἐζόμενοι λεύκαινον ὕδωρ ξεστῆς ἐλάτησιν.
 αὐτὰρ ἐγὼ κηροῖο μέγαν τροχὸν ὀξείῃ χαλκῶ
 τυτθὰ διατμήξας χερσὶ στιβαρῆσι πίεζον.
 αἶψα δ' αἰνέτο κηρός, ἐπεὶ κέλετο μεγάλη ἴς 175
 Ἥελίου τ' αὐγῇ Ὑπεριονίδαο ἄνακτος·
 ἐξεῖς δ' ἐτάροισιν ἐπ' οὔατα πᾶσιν ἄλειψα.
 οἱ δ' ἐν νηὶ μ' ἔδησαν ὁμοῦ χειράς τε πόδας τε
 ὀρθὸν ἐν ἰστοπέδῃ, ἐκ δ' αὐτοῦ πείρατ' ἀνήπτον·
 αὐτοὶ δ' ἐζόμενοι πολίην ἄλα τύπτον ἐρετμοῖς. 180
 ἀλλ' ὅτε τόσσον ἀπῆν ὅσσον τε γέγωνε βοήσας,
 ῥίμφα διώκοντες, τὰς δ' οὐ λάθην ὠκύαλος νηῦς
 ἐγγύθεν ὀρνυμένη, λιγυρὴν δ' ἐντυνον αἰοιδῆν·
 "Δεῦρ' ἄγ' ἰών, πολύαιν' Ὀδυσσεῦ, μέγα κῦδος Ἀχαιῶν,
 νῆα κατὰστησον, ἵνα νωιτέρην ὄπ' ἀκούσης. 185
 οὐ γὰρ πῶ τις τῆδε, παρήλασε νηὶ μελαίνῃ,
 πρὶν γ' ἡμέων μελίγηρυν ἀπὸ στομάτων ὄπ' ἀκούσαι,
 ἀλλ' ὅ γε τερψάμενος νεῖται καὶ πλείονα εἰδώς.
 ἴδμεν γὰρ τοι πάνθ' σ' ἐνὶ Τροίῃ εὐρείῃ
 Ἀργεῖοι Τρῶές τε θεῶν ἰότητι μόγησαν· 190
 ἴδμεν δ' ὅσσα γένηται ἐπὶ χθονὶ πουλυβοτείρῃ."
 Ἦς φάσαν ἰεῖσαι ὅπα κάλλιμον· αὐτὰρ ἐμὸν κῆρ
 ἦθελ' ἀκουέμεναι, λῦσαι τ' ἐκέλευον ἐταίρους,
 ὄφρυσιν νευστάζων· οἱ δὲ προπεσόντες ἔρεσσον.
 αὐτίκα δ' ἀνστάντες Περιμήδης Εὐρύλοχός τε 195
 πλείοσι μ' ἐν δεσμοῖσι δέον μᾶλλον τε πίεζον.
 αὐτὰρ ἐπεὶ δὴ τὰς γε παρήλασαν, οὐδ' ἔτ' ἔπειτα
 φθόγγον Σειρήνων ἠκούομεν οὐδέ τ' αἰοιδῆν,
 αἶψ' ἀπὸ κηρὸν ἔλοντο ἐμοὶ ἐρήρηρες ἐταῖροι,
 ὄν σφιν ἐπ' ὤσιν ἄλειψ', ἐμέ τ' ἐκ δεσμῶν ἀνέλυσαν. 200

Le mât reste dressé pendant le calme non "presumably" comme le pense L. Casson ("Ships.." p.47 n.32) mais certainement et expressément, car, quelques vers plus haut (160-164) les compagnons d'Ulysse sont avisés qu'ils devront bientôt lier Ulysse debout sur l'emplanture du mât d'après les conseils de Circé. C'est, d'ailleurs, une des raisons pour lesquelles ils ne sont informés que peu avant le danger qu'ils vont encourir. Ainsi, le récit est, aussitôt, suivi des réactions qui en constituent la suite immédiate. Le même schéma sera reproduit plus tard lors du passage du détroit de Charybde Ulysse avisera ses compagnons une fois en route en leur épargnant le temps d'une hésitation craintive; c'est, d'ailleurs, pour la même raison qu'il ne leur révèle pas la présence de Scylla.

5. Voir le commentaire d'Eustathe sur l'Odyssee (1708, 1709).
6. Une des interdictions qui seraient imposées à Ulysse par rapport aux Sirènes pourrait être aussi, à mon avis, le silence qu'il doit observer pendant l'épreuve; les Sirènes s'adressent à lui de façon très personnelle et les compagnons d'Ulysse ont les oreilles bouchées pour ne pas

entendre non seulement les Sirènes mais Ulysse lui-même. On n'a jamais su comment ils ont été convaincus que le moment était venu pour détacher Ulysse puisque sur ce plan ils ne devaient pas lui obéir; ceci prête aussi à penser que l'idée de la cire serait une des innovations du poète sur un mythe connu.

7. A travers l'Odyssée, les aventures d'Ulysse sont, en quelque sorte, des épreuves qui touchent à l'idée de l'ordalie. De toutes ces aventures, les Sirènes sont, à mon avis, uniques en ce qu'elles arrivent à mobiliser cette volonté intérieure qui mène le héros vers la mort. Sur l'idée de l'ordalie en général voir GLOTZ, "L'ordalie en Grèce primitive". Sur l'aspect initiatique de certains rites des cités grecques et en particulier de l'"éphébie" athénienne, voir P. VIDAL-NAQUET, "Le chasseur noir", Paris, 1983, pp. 125-207.
8. Le nom a été rapproché aussi des mots "Seirios" et "Zeirene" de façon peu convaincante. Voir P. CHANTRAINE, Dict. Etym. (Paris 1968-80), H. FRISK Etym. Wört. (1959-60), K. MAROT, "Die Anfänge d. gr. Lit. (1960), V. BERARD, "Les navigations d'Ulisse", Paris, 1971, pp. 374-471. L'idée d'une racine sémitique (sir-hen) n'est pas tout à fait invraisemblable. Voir aussi G. GRESSETH, "The homeric Sirens", TAPA, 1960, pp. 202-218.
9. La traduction citée est de A.J. Festugière, Artémidore, "La clef des songes" (*Onirocritikon*), II, 2-3, 116 *ιστός δὲ τῆς νεῶς τὸν κύριον σημαίνει ... ἀντιπρόσωπον δὲ τὸν πρῶμα ... ὄπλα τοὺς ναύτας.*
10. Athénée, Deipn. II, 474 d - 475 a *τοῦ γὰρ ἱστοῦ τὸ μὲν κατωτάτῳ πτέρνα καλεῖται, ἢ ἐμπίπτει εἰς τὸν ληνόν, τὸ δ' οἶον εἰς μέσον τράχηλος, τὸ δὲ πρὸς τῷ τέλει καρχῆσιον. ἔχει δὲ τοῦτο κεραίας ἄνω νεοῦσας ἐφ' ἐκάτερα τὰ μέρη, καὶ ἐπίκειται τὸ λεγόμενον αὐτῷ θωράκιον, τετραγώνον πάντῃ πλην τῆς βάσεως καὶ τῆς κορυφῆς· αὐταὶ δὲ προὔχουσι μικρὸν ἐπ' εὐθείας ἐξωτέρῳ. ἐπὶ δὲ τοῦ θωρακίου εἰς ὕψος ἀνήκουσα καὶ ὀξεῖα γιγνομένη ἐστὶν ἡ λεγομένη ἡλακάτη.*
Karchésion était aussi une sorte de verre dont la forme allongée était expliquée par la partie homonyme de mât (Athénée, loc. cit.)
11. Hom.Od. 12,401-425.
12. Il y avait des matières dont les marins envelopaient les pointes des mâts car, d'après les croyances de l'antiquité, ces matières possédaient une force d'opposition et pouvaient résister à la foudre. Plutarque mentionne le bois du figuier et la peau du phoque et de l'hyène. Plut. Oeuv. Mor. Propos de Tables, D, 664c *βολβὸς διαφεύγει τὸν κεραυνόν... ἔχων δύναμιν ἀντιπαθῆ καθάπερ ἡ συκῆ καὶ τὸ δέρμα τῆς φώκης ὡς φασι καὶ τὸ τῆς υἰαίνης, οἷς τὰ ἄκρα τῶν ἱστών οἱ ναύκληροι καταδιφθεροῦσιν.*
13. L'étymologie de l'*histos* est toujours rapprochée du verbe *histemi*.
14. *Ἐξῆμαρ μὲν ἔπειτα ἔμοι ἐρήρηες ἐταῖροι
δαίνυντ' Ἡελίοιο βοῶν ἐλάσαντες ἀρίστας·
ἀλλ' ὅτε δὴ ἔβδομον ἡμαρ ἐπὶ Ζεὺς θῆκε Κρονίων,
καὶ τότε ἔπειτ' ἀνεμος μὲν ἐπαύσατο λαίλαπι θύων, 400
ἡμεῖς δ' αἰψ' ἀναβάντες ἐνήκαμεν εὐρέϊ πόντῳ,
ιστὸν σπῆσάμενοι ἀνά θ' ἰστία λεύκ' ἐρύσαντες.
Ἄλλ' ὅτε δὴ τὴν νῆσον ἐλείπομεν, οὐδέ τις ἄλλη
φαίνετο γαίαν, ἀλλ' οὐρανός ἦδὲ θάλασσα,
δὴ τότε κυανέην νεφέλην ἐστησε Κρονίων 405
νῆος ὑπερ γλαφυρῆς, ἤχλυσε δὲ πόντος ὑπ' αὐτῆς.
ἢ δ' ἔθει οὐ μάλα πολλὸν ἐπὶ χρόνον· αἶψα γὰρ ἤλθε
κεκληγώς Ζέφυρος, μεγάλη σὺν λαίλαπι θύων,
ιστοῦ δὲ προτόνους ἐρρηξ' ἀνέμοιο θύελλα
ἀμφοτέρους ἱστός δ' ὀπίσω πέσεν, ὄπλα τε πάντα 410
εἰς ἄντλον κατέχυνθ'· ὁ δ' ἄρα πρύμνη ἐνὶ νηϊ
πληῆξε κυβερνήτεω κεφαλῆν, σὺν δ' ὅστε' ἄραξε
πάντ' ἄμυδις κεφαλῆς· ὁ δ' ἄρ' ἀρνευτῆρι εἰοικώς*

- κάππεσ' ἀπ' ἰκριόφιν, λίπε δ' ὄστέα θυμὸς ἀγῆνων.
 Ζεὺς δ' ἄμυδις βρόντησε καὶ ἔμβαλε νῆϊ κεραυνόν· 415
 ἢ δ' ἐλελίχθη πᾶσα Διὸς πληγεῖσα κεραυνῶ,
 ἐν δὲ θεοῖσι πλῆτο· πέσον δ' ἐκ νηὸς ἑταῖροι.
 οἱ δὲ κορώνησιν ἴκελοι περὶ νῆα μέλαιναν
 κύμασιν ἐμφορέοντο, θεὸς δ' ἀποαίνυτο νόστον.
 Αὐτὰρ ἐγὼ διὰ νηὸς ἐφοίτων, ὄφρ' ἀπὸ τοίχους 420
 λῦσε κλύδων τρόπιος· τὴν δὲ ψιλὴν φέρε κύμα.
 ἐκ δὲ οἱ ἰστὸν ἄραξε ποτὶ τρόπιν· αὐτὰρ ἐπ' αὐτῶ
 ἐπίτονος βέβλητο, βοὸς ῥινοῖο τε τευχῶς.
 τῶ ρ' ἄμφω συνέεργον ὁμοῦ τρόπιν ἠδὲ καὶ ἰστὸν,
 ἐζόμενος δ' ἐπὶ τοῖς φερόμην ὀλοοῖς ἀνέμοισιν. 425
 Ἐνθ' ἦ τοι Ζέφυρος μὲν ἐπαύσατο λαίλαπι θύων,
 ἦλθε δ' ἐπὶ Νότος ὥκα, φέρων ἐμῶ ἄλγεα θυμῶ,
 ὄφρ' ἔτι τὴν ὀλοὴν ἀναμετρήσαιμι Χάρυβδιν.
 παννύχιος φερόμην, ἅμα δ' ἠελίῳ ἀνιόντι
 ἦλθον ἐπὶ Σκύλλης σκόπελον δεινὴν τε Χάρυβδιν. 430
 ἢ μὲν ἀνερροιβόησε θαλάσσης ἄλμυρόν ὕδωρ·
 αὐτὰρ ἐγὼ ποτὶ μακρὸν ἐρινεὸν ὑψόσ' ἀερθεῖς
 τῶ προσφύς ἐχόμεν ὡς νυκτερὶς· οὐδὲ πη εἶχον
 οὔτε στηρίξαι ποσὶν ἐμπεδον οὔτ' ἐπιβῆναι·
 ρίζαι γὰρ ἐκάς εἶχον, ἀπήωροι δ' ἔσαν ὄζοι, 435
 μακροὶ τε μεγάλοι τε, κατεσκίαον δὲ Χάρυβδιν.
 νωλεμέως δ' ἐχόμεν, ὄφρ' ἐξεμέσειεν ὀπίσσω
 ἰστὸν καὶ τρόπιν αὐτίς· ἐλδομένω δὲ μοι ἦλθον
 ὄψ' ἦμος δ' ἐπὶ δόρπον ἀνήρ ἀγορήθεν ἀνέστη
 κρίνων νεῖκα πολλὰ δικαζομένων αἰζηῶν, 440
 τῆμος δὴ τὰ γε δοῦρα Χαρύβδιος ἐξεφαάνθη.
 ἦκα δ' ἐγὼ καθύπερθε πόδας καὶ χεῖρε φέρεσθαι,
 μέσσω δ' ἐνδούπησα παρέξ περιμήκεα δοῦρα,
 ἐζόμενος δ' ἐπὶ τοῖσι διήρεσα χερσὶν ἐμῆσι.
 Σκύλλην δ' οὐκέτ' ἔασε πατὴρ ἀνδρῶν τε θεῶν τε 445
 ἐσιδέειν· οὐ γὰρ κεν ὑπέκφυγον αἰπὺν ὄλεθρον.
 Ἐνθεν δ' ἐννήμαρ φερόμην, δεκάτη δὲ με νυκτὶ
 νῆσον ἐς Ωγυγίην πέλασαν θεοί, ἐνθα Καλυψῶ
 ναίει εὐπλόκαμος, δεινὴ θεὸς αὐδήεσσα,
 ἦ μ' ἐφίλει τ' ἐκόμει τε. τί τοι τάδε μυθολογεύω; 450
 ἦδη γάρ τοι χθιζὸς ἐμυθεόμην ἐνὶ οἴκῳ
 σοὶ καὶ ἰφθιμῆ ἀλόχῳ· ἐχθρόν δὲ μοὶ ἐστὶν
 αὐτίς ἀριζήλως εἰρημένα μυθολογεύειν.
15. Pind.Nem. V.50-52 εἰ δὲ Θεμίστιον ἴκεις / ὥστ' αἰεῖδεις, μηκέ τι ρίγει· δίδοι / φωνάν, ἀνά δ' ἰστία τείνον / πρὸς ζυγὸν καρχασίου.
 La date est proposée sous réserve par Puech qui suit, sur ce point, Gaspar. Voir sa notice sur la Ve Neméenne, Pindare (Budé), p. 62-63 et n.2 et 3. Pour l'analyse de la métaphore ainsi que pour l'ensemble des allusions qui touchent à la mer et à la navigation dans la même ode voir J. PERON, "Les images maritimes de Pindare", Paris, 1974, p.49 et suiv.
16. Pind.Pyth, l 86: νῶμα δικαίῳ
 πηδαλίῳ στρατόν et 91: ἐξίει δ' ὡσπερ κυβερνάτας ἀνήρ / ἰστίον ἀνεμόεν.
 cf. aussi Isthm. II, 30-42 οὐδὲ ποτε ξενίαν / οὔρος ἐμπνεύσαις ὑπέστειλ' ἰστίον ἀμφὶ τράπεζαν / ἀλλ' ἐπέρα ποτὶ μὲν Φᾶσιν θερεΐαις, / ἐν δὲ χειμῶνι πλέων Νεῖλου πρὸς ἀκτάν.
 où l' image d' une voile jamais carguée s' applique à l' hospitalité.

17. Pind. Pyth. IV 291-293: *ἐν δὲ χρόνῳ / μεταβολαὶ λήξαντος οὔρου / ιστίων.*
Les vers font partie des réflexions du poète qui plaident toutes pour le retour de Damophile à Cyrène d'où il était banni pour avoir participé à des émeutes politiques d'aspiration aristocratique. L'idée du changement du vent et des voiles que le temps amène s'applique probablement à l'espoir d'une modération attribuée aux deux côtés. Le plus long poème de Pindare, un des plus impressionnants aussi, conclut sur cette notion du changement ordonné par le temps (*ἐν δὲ χρόνῳ*).
18. Alcée, 54 (Reinach-Puech)
*ἄσυ<ν>έτημι τῶν ἀνέμων στάσιν·
τὸ μὲν γὰρ ἐνθεν κύμα κυλίνδεται,
τὸ δ' ἐνθεν. Ἄμμες δ' ὄν τὸ μέσσον
ναῖ φορήμεθα σὺν μελαίνα,
χειμῶνι μόχθευντες μεγάλῳ μάλα·
περ μέεν γὰρ ἄντλος ἰστοπέδαν ἔχει,
λαῖφος δὲ πᾶν ζάδηλον ἤδη
καὶ λάκιδες μεγάλαι κατ' αὐτο·
χόλαισι δ' ἄγκυλαι...*
Il est, évidemment, inutile de rappeler l'importance de la mer dans plusieurs poèmes d'Alcée, aussi bien politiques que symposiaques: cf. p.ox. fts 41, 49, 53, 59, (74a), 82, 146, 159 etc.
19. Munich, Musée d'Etat, 2044; Beazley ABV, 146 (21).
20. P.ex le *skyphos* du "Peintre de Thésée" (peu avant 500 av. J.C.) qui représente ce fameux bateau à roues.
21. L'histoire nous est aussi connue par Euripide (Cyclope v.10 sq). K.Kerenyi ("Mythologie..") n'est pas sûr qu'il faut reconnaître la légende de l'enlèvement dans la coupe d'Exékias. M. Daraki ("Dionysos", Paris, 1985, pp. 31-35) voit un déplacement de l'espace terrestre vers l'espace maritime et vice versa en la personne de Dionysos qui "fait pousser ses jardins au beau milieu du flot marin et change en voies maritimes les rues des villes où il se plaît à circuler sur des bateaux à roues" (p. 34).
22. Il n'est pas impossible que la nature des animaux apparaissant prodigieusement à bord soit inspirée des constellations du Lion et de l'Ours. Une mauvaise orientation et une fausse route dues, éventuellement, à l'ivresse des marins peut heurter un navire contre la terre. Cette idée qui relève du vécu réel et redouté reste aussi, je crois, impliquée dans ce naufrage mythique où l'univers terrestre se croise de façon terrifiante à l'univers marin.
23. Les commentateurs anciens ne sont pas toujours très précis quant à l'emploi des mots *πεύκη*, *πίτυς* et souvent même *ἐλάτη* pour le bois du mât, de la vergue et des rames. La tradition poétique, les diversités techniques, et la croissance variée des arbres dans les différentes régions de la Grèce sont les plus importantes raisons de cette confusion.
24. Plut. Oeuv. Mor., Propos de Table V.3.I, 675d-676c.
25. Hom. II 23, 852-881.
26. Athenée, Deipn. II, 475 a.
27. Artémidore, Onirocr. III,36. (trad. Flacelière)
28. Hom. Od. 10.222, 5.62, 19. 137-156, 24.125-150, etc.

THE TRIERES RECONSTRUCTION “OLYMPIAS”: SOME UNRESOLVED QUESTIONS

Building and operating OLYMPIAS have demonstrated many things about the *trieres* which have been matters of conjecture for centuries. Much has now been proved by experiment, or disproved beyond reasonable doubt. Yet a number of questions remain unresolved as might be expected. Of the more important, three concern construction namely

Design of oars

Use of rudders

Hypozoma

and three concern ship operation

Selection and training of oarcrew

Command and control of oarcrew

Passagemaking

We know how long oars were in *triereis* and nearly everyone now agrees that they were of the same length, except at the ends of the ships. So, they are in OLYMPIAS, but the present oars are too heavy and, as originally designed, too unbalanced to use rapidly and with power. These shortcomings arose from:

1. My fear of oar breakage by clashing together on a costly and demoralising scale at the start of learning how to row this crowded ship.
2. Difficulty, at the time of placing the building contract, in obtaining supplies of suitable spruce or fir, so that a denser timber, *pseudotsuga Menziesii*, had to be used.
3. Lack of working knowledge of high-g geared oars for fast sea-boats, such as gigs, which are now extinct. Those of a 1829 British racing “eight”, now in the Science Museum in London are among the very few of such oars still to be seen.

To achieve the attested performance of a fast trieres under oar, which is to maintain at least seven knots continuously for up to about 24 hours, calls not only for a fit, keen and skilled oarcrew but also for exactly the right oars and oar rig, the best possible with the materials and techniques available in antiquity.

The effective power (Fig. 1) needed to propel a trieres in good condition at 7 knots can be shown to be $8\frac{1}{2}$ kilowatts (+/-) 5% or so if rudders are immersed so little that their resistance is minimal. That calls for an effective power from each oarsman of 50 watts if all oars are in action, or, as is more likely during a long passage under oar, 75 watts if only two files are manned at a time. While a man can produce 200 watts effective power with an oar for a matter of a minute or two (Fig. 2); 130 watts would be a good figure to achieve for half an hour or so, given a good oar and a good oar rig. For longer periods power would fall still further, and the crowded conditions in a trieres would also have their effects on the freedom of oarcrew to develop power. Thus, if a reconstruction is to achieve the attested performance, there is little room for inefficiency of oar or oar rig.

The weight of the present oars in OLYMPIAS could, after the experience now gained, be reduced to half of their weight, 17 kg (including lead counterweighting in the loom), without undue risk of breakage (Fig. 3). Of course, less robust oars will be more easily broken in the hands of an unskilled crew, by clashing together. With such lightened oars, OLYMPIAS could be expected to exceed nine knots in a short sprint and hold not far short of seven knots on a long row, given a suitable oarcrew capable of maintaining a long stroke. To date the two-cubit *interscalmium* in OLYMPIAS has limited length of oar-stroke (Fig. 4). With the heavy oars, oar handle-stroke has been no more than 0.6 metre: with lighter oars and crew training it might be possible to lengthen the stroke of the handles nearer to the geometrical maximum of 0.85 metre. By that means nine knots should be attainable for a short time.

The Trireme Trust proposes progressive experiments with a few new oars made of fir or spruce (Fig. 5), with the aim of developing the best design for the *trieres* to find her potential performance under oar. These oars must be made by techniques known to have been practised in antiquity.

No sprint speeds for triereis have been attested. So we do not know whether their oars were, in effect, optimised in gearing or blade area for endurance or for sprint speed. The fastest recorded average speed by a fixed-seat "eight" known to the author is 9.7 knots in a race lasting just over seven minutes in 1870. The average effective power of each of those oarsmen has been calculated to have been about 190 watts, with a power on the oar handle of nearly 250 watts, a rate of rowing of 40 strokes to the minute and a stroke of about one metre. Long strokes are essential for high power, but as anyone who has tried to row fast in waves knows, waves interfere with making long strokes and therefore limit power, as several accounts of battles between triereis testify.

The steering and manoeuvring of OLYMPIAS are quite outstanding. She could be turned in a circle of a diameter of less than two ship (waterline) lengths. The rudders are light to handle but their resistance in the water when fully immersed is enormous, as indicated by the plume and wake created by them. Maybe I overdid the diameter of the rudder stocks, by comparison with the one shown in the Lindos Relief, but not by very much. I certainly did not want stocks to break and there have been many breakages of stocks of side-rudders in recent reconstructions.

The resistance of these rudders is due mostly to the stock, so its diameter should be reduced where it is immersed as much as one may progressively dare to do. I doubt if it could be reduced by much more than 15%, after which it would still be responsible for adding about 50% to the resistance of the hull when both rudders are fully immersed. Some further reduction in resistance could be achieved by fairing the rudder section. But when were both rudders fully immersed? Experience in OLYMPIAS has highlighted this question.

When triereis entered, left and manoeuvred within harbours both rudders would certainly have been fully immersed. Indeed any other state could well have been forbidden by regulations. In battle and of course during manoeuvring and battle exercises they would also have been down. Under sail and on passage under oar they would surely have been immersed (and probably only one) to the minimum degree necessary to keep course and general control in the prevailing conditions. More operating experience in OLYMPIAS is needed to find that best usage and to develop rudder gear so that they may be more readily pivoted and hoisted.

The *hypozoma* has been a difficult feature of the reconstruction. What we had hoped to rig in OLYMPIAS was a tension tourniquet, by which ropes are tightened by twisting them together so that it would indeed be "a well-twisted rope from within" according to the words of Apollonios of Rhodes. This device is often but wrongly called a "Spanish Windlass". However an insuperable problem cropped up with the arrangement proposed for OLYMPIAS at the last moment before launch, and we had to substitute a rather unsympathetically unyielding steel hawser for the intended fibre ropes. I hope this will be only a temporary expedient.

The problem just mentioned is not fundamental to the tourniquet. Indeed experiments with one-eighth scale tourniquets have since confirmed the need for an initial tension high enough to dispose of it. These experiments were necessary because I was unable to find any information of practical use about rope tension tourniquets, devices which have probably not been in any heavy constructional

use since the arrival of iron rods and opposed-threaded bottle screws centuries ago. The capacity of this kind of tourniquet as a device for increasing the tension in ropes seems to be limited, largely on account of the unwanted but additional strain imposed on the ropes as they are bent into helices round each other when the tourniquet is twisted. Twisting cannot do more than treble the tension in a flax tourniquet (Ref. 1), and it cannot sustain more than a quarter of the combined breaking tension of its constituent ropes, though that could be improved if twisting were limited to little more than maintaining tension as the ropes stretched under prolonged loading, as in a *hypozoma*. Thus the ropes of *hypozomata* should be rigged with the largest practicable initial tension before being twisted. This view of the matter goes far to explain why fifty men were, by the accepted interpretation, decreed to be needed to rig a *hypozoma*. It was to apply the initial tension, which would then have to be transferred from tackles by seizing the ends of the *hypozoma* ropes to their standing parts to form the tight loops between strong points at bow and stern. Only seizing can do this job without slipping, which is why it was always used in hemp standing rigging of ships, an analogous structural problem.

The combined breaking tension of four 47 mm diameter flax ropes could be expected to be about 65 tonnes force, and so a *hypozoma*, twisted to the limit to maintain tension as its ropes stretched with time, and made of such ropes could be expected to sustain a tension of between 15 and 20 tonnes. When rigged, it should be given a tension approaching 15 tonnes, that is 4 tonnes in each rope passing the length of the ship. A gang of fifty men with luff tackles (4 to 1 ratio) seems about right for the job if frictional forces are taken into account as well as some unavoidable slip in the seizing.

The extent to which flax, like all natural fibres, relaxes and therefore stretches under load amply explains the need for *trierei*s to carry a spare pair of *hypozoma* ropes on board. It would only have been a matter of time, though we do not know how long, before a *hypozoma*, progressively twisted to maintain its tension, reached its limit (or even broke). A new *hypozoma* would then have to be rigged, quite often presumably by the ship's crew. Two of my model *hypozomata* broke unexpectedly, so until we can learn more about flax under heavy loads it must be regarded as too unsafe to use in a *hypozoma*. If we are to move towards a more authentic arrangement than the present, we should out of prudence adopt a synthetic fibre. Polyester would be the most suitable because under load it stretches and relaxes with time relatively little. It is much stronger than flax so there would be no risk of unforeseeable rupture. So, equipped, OLYMPIAS would need no spare *hypozoma* ropes.

A tension tourniquet would, in my opinion, serve satisfactorily as a *hypozoma* in OLYMPIAS and it seems to be the most probable mechanism to have been used in *triereis*. More experiments are however called for to investigate ancient *hypozomata* including not only the relevant physical properties of flax and any other possible fibres, but also other conceivable mechanisms. In that way future work with this ship could be separated from the question of the *hypozoma* itself.

Passing now to operational questions raised by experimental work in OLYMPIAS to date, we may first consider the selection and training of oarcrew. The care demanded by both of these processes can now be seen to increase quite sharply with the level of performance to be expected. It is enough to say that a speed of 8 knots calls for 60% more power than 7 knots, while 9 knots would call for 150% more, a different league of performance. So far crews have reached only 7 or 8 knots and for a short time only. Over longer periods the ship has been rowed at speeds varying between 2 and 5 knots according to the strength and direction of the wind.

As far as can be judged, OLYMPIAS is about 2 knots short of the attested endurance speed under oar and this shortfall may be ascribed in roughly equal degree to oars and to crews. 2 knots may not seem too much but in terms of power it is a lot: the effective power required at 7 knots is about three times that at 5 knots. It is reasonable to suppose that on a long haul under oar ancient *keleustes* would not have had much of even one rudder in the water, whereas in OLYMPIAS both rudders have generally been fully immersed. The power shortfall is therefore more like 100% and not 200%. We have nevertheless a way yet to go to do as well as those tough ancients with their fully developed ships. If we try hard enough I believe we can close the gap.

Crews will have to be strictly selected for fitness, physique and stature as well as for keenness on the project. There is little doubt that crews aiming at attested performance will have to be male for strength and selected from a large field of volunteers to meet the demanding criteria now being proposed for this purpose. Recruiting powerful crews demands careful organisation across possibly more than one country.

On training crews for OLYMPIAS a whole symposium could well be held for no consensus seems yet to be in sight. Rowing the trieres has been found to differ from rowing any other craft, sea or river, more than most people have expected, indeed so much so that previous experience with an oar seems in many cases to have been of little help. Added to that, a large proportion of sport oarsmen nowadays

are too large to fit the *interscalmium* of the *trieres*. The best field from which to draw the high quality of oarcrew required for the attested performance is therefore a more open question than it might at first sight appear to be.

Probably the most severe training problem of all arises from the short time for which most oarcrews will be available, because paid crews will be very expensive and volunteers will have only limited time between their main commitments. Achievement of significantly improved performance is likely therefore to turn upon the development of some form of "off-ship" training in, for example, a rowing mock-ups on land (Fig. 6) or afloat (Fig. 7) which could be duplicated in a number of recruiting centers. The future programme of experimental archaeology for the *trieres* will largely depend upon the proper selection and effective training of oarcrews.

Much has been learnt about commanding and controlling the large oarcrew in a *trieres*. They are discussed in the reports of the trials of OLYMPIAS. It seems clear that different kinds of oarcrew (eg. paid, volunteer, young or mature) need different treatment to give of their best: there is much yet to be learnt.

On one point, keeping the large crew in time, we have found the notes of a high-pitched pipe very effective and it seems very likely indeed that this was the quite practical purpose of the auletes, much needed at higher powers or after long periods at the oar. Drums may be used in the paddled boats of the East but among the "clunking" noises of oars, their note would be too low to penetrate to the ends of the ship. We have not yet tried to extend the use of the pipe into passing orders to the oarcrew after the manner of a modern bosun's call. The number of oar orders would be quite large: nine distinguishable "pipes" would be necessary just to make any combination, port and starboard, of "Pull Ahead", "Easy" and "Back Down", without also being able to pick out particular files and parts of files, which would by our experience be necessary in any confined harbour.

OLYMPIAS has so far made only one coastal voyage and that was permitted only because an accompanying naval accomodation ship could be provided, no doubt at some appreciable expense. Much of the attested performance of *triereis* concerns making certain passages which are identifiable, so there is a desire to gain experience in that aspect of operations. Fleets of *triereis* were deployed over long distaces and it was of course essential to be able to do so to exercise long range naval power. It follows that the ship's programme should include a number of representative passages to gain some understanding of the realities of deploying *triereis* in antiquity.

However the safety of this expensive ship with two hundred lives on board must be the first consideration and there is naturally less than full confidence in the seaworthiness of this rather fragile and virtually novel vessel. It will take some years of operating experience with OLYMPIAS to enable the authorities responsible for her to judge her safe sea-going capacity. We should remember that losses of triereis at sea in antiquity were not uncommon, and certainly more frequent than would be acceptable today.

In the tightly programmed and financed modern world, the inability of a *trieres* in face of the weather to keep to any preplanned itinerary with any certainty raises practical problems of servicing her large crew in unpredictable locations and for unpredictable lengths of time, and that assumes that the right kind of crew could be recruited with such an open commitment in the first place. To make some progress with this difficult part of the ship's programme of experiments, some voyages might be synthesised within an accessible area to gain experience, while mitigating the problems raised by any more extended itinerary.

The resolution of the questions raised in this paper and of many others besides would involve OLYMPIAS in quite an extensive programme of experimental archaeology in the years to come. Carrying out such a programme calls for clear aims based on a firm grasp of the physical factors involved, determination and good organisation, and money, even if oarcrews are all volunteers, and a lot more money if they are not.

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ILLUSTRATIONS

- Fig. 1 Effective Power v. Speed for OLYMPIAS.
- Fig. 2 Power sustainable by a man during various periods of time.
- Fig. 3 A modification of OLYMPIAS's present oars.
- Fig. 4 Positions at Catch and finish to achieve a handle stroke of 0.85m.
- Fig. 5 An experimental oar in spruce.
- Fig. 6 Rowing mock-up at Boston, USA, July 1988.
- Fig. 7 Trieres trial section at Hanley, England, July 1985.

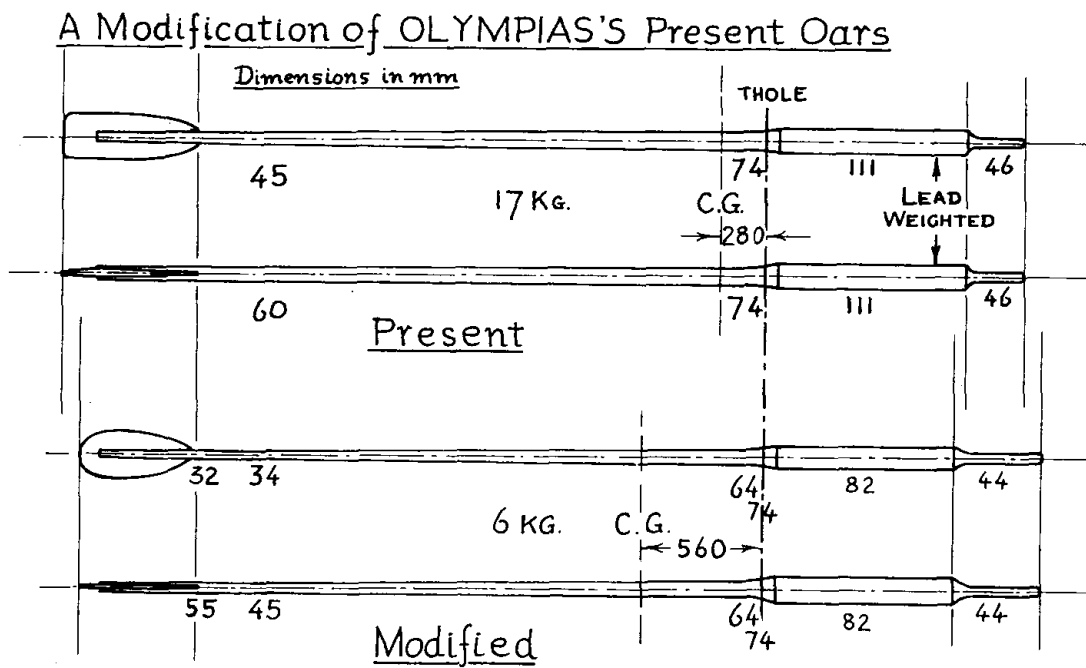
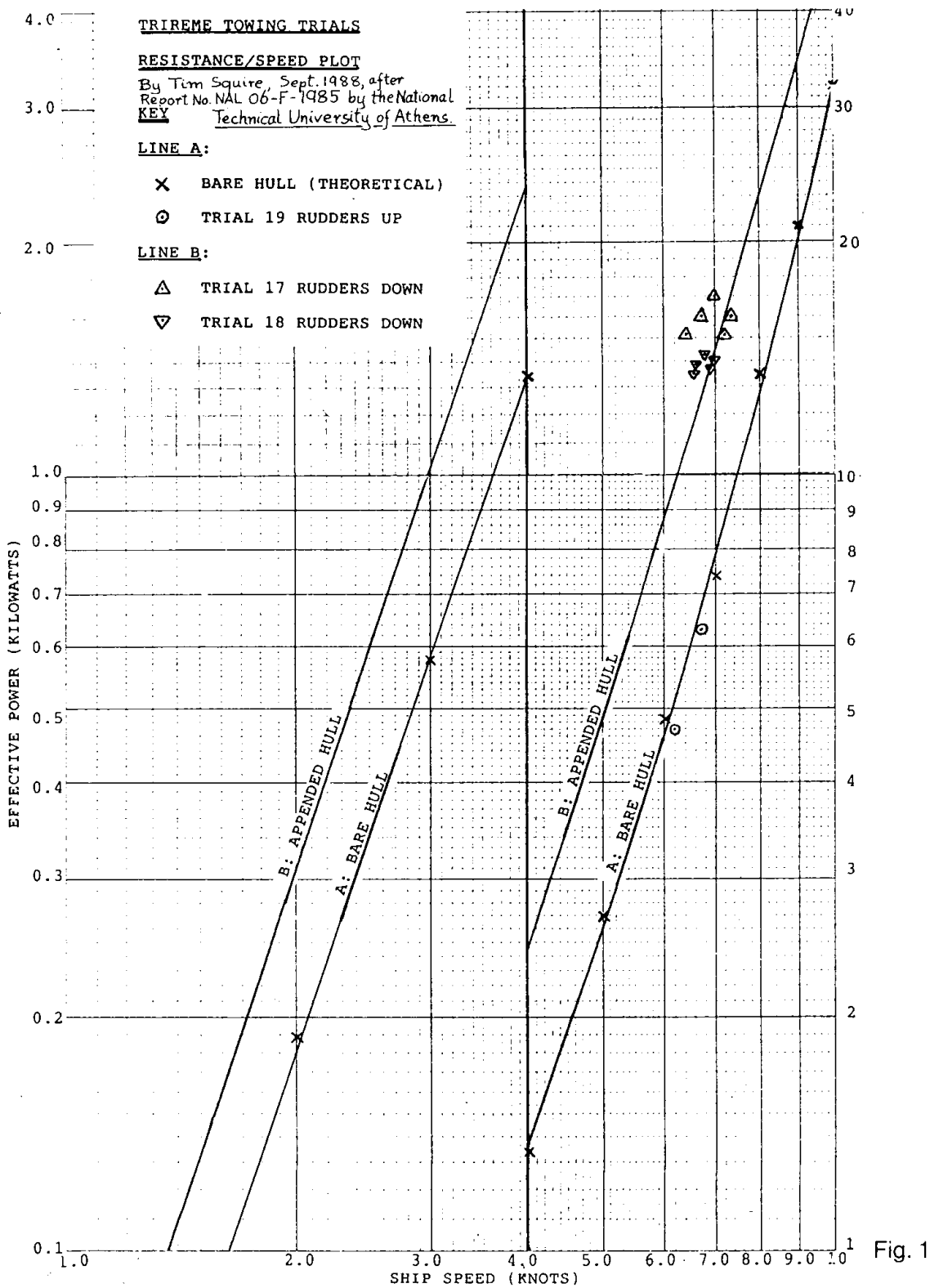


Fig. 3 Not to Scale. For Details see Trieres Plan No. 15e

THE TRIERES RECONSTRUCTION
 "OLYMPIAS": SOME UNRESOLVED QUESTIONS



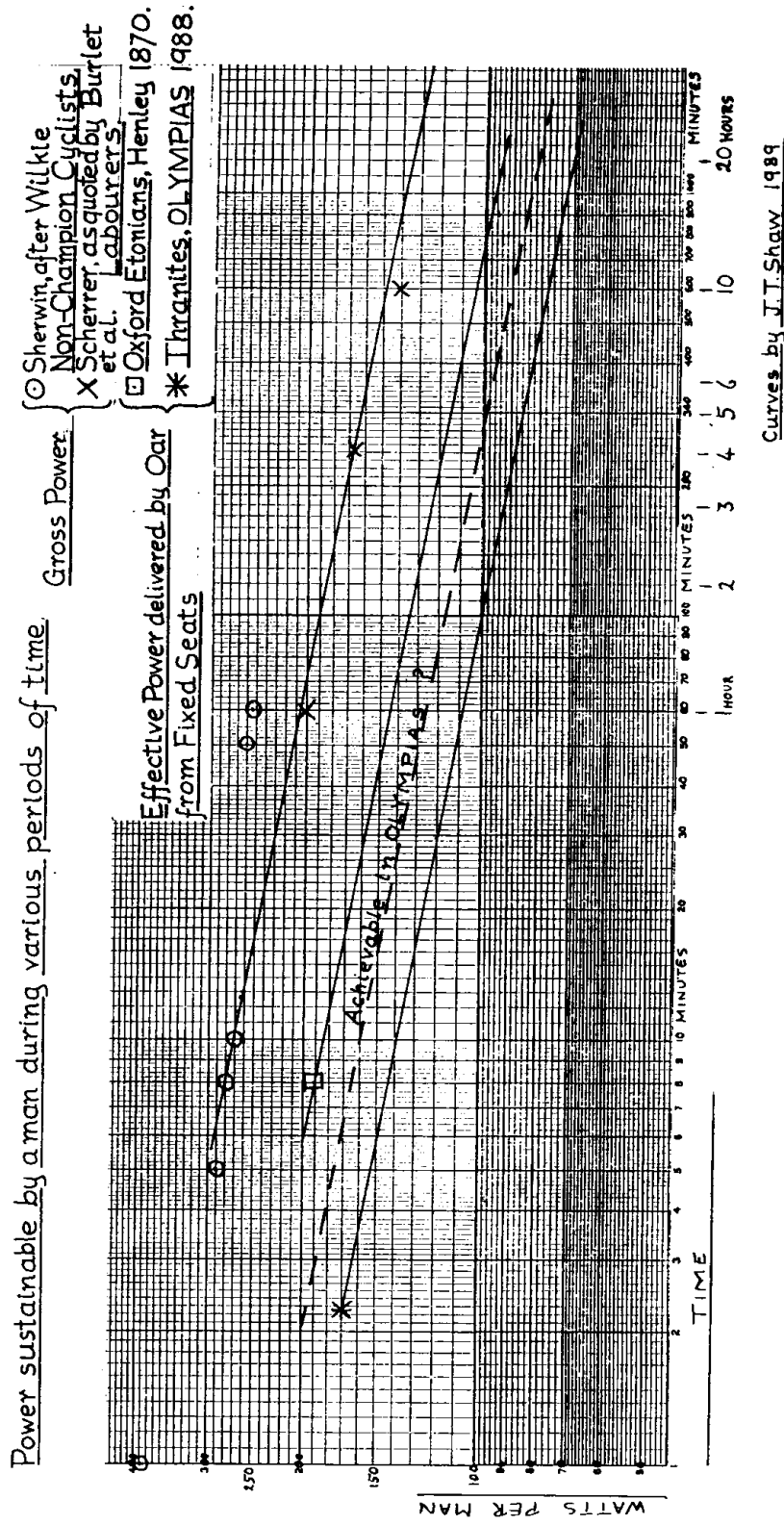


Fig. 2

THE TRIERES RECONSTRUCTION
 "OLYMPIAS": SOME UNRESOLVED QUESTIONS

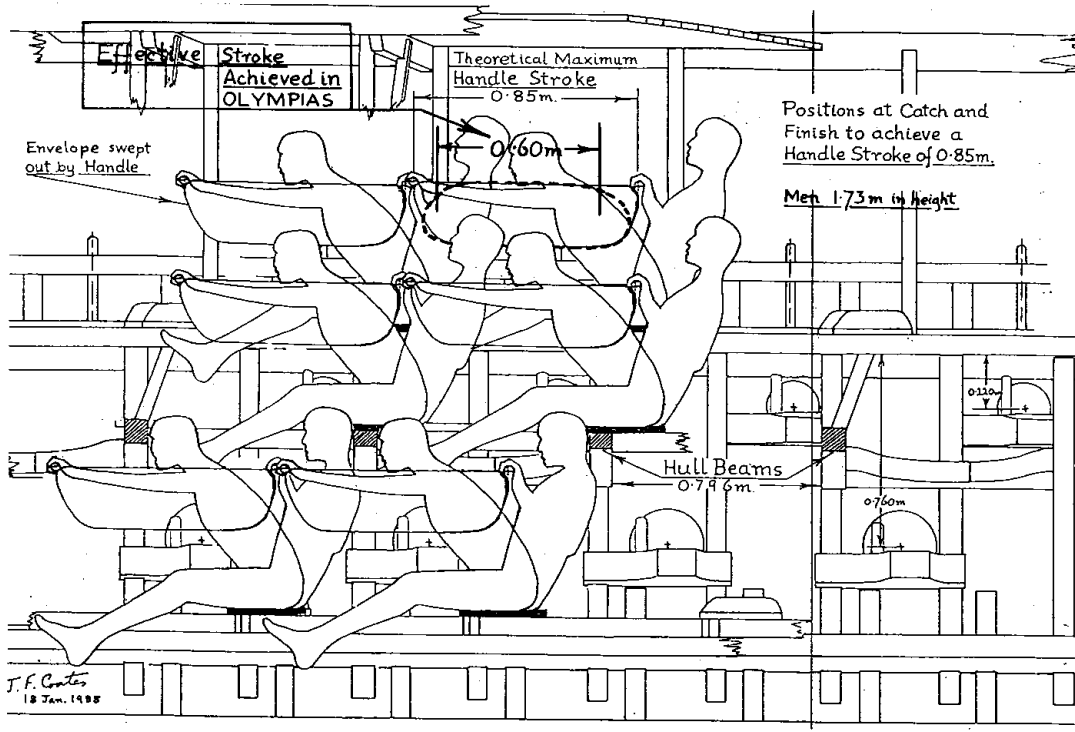


Fig. 4

An Experimental Oar in Spruce

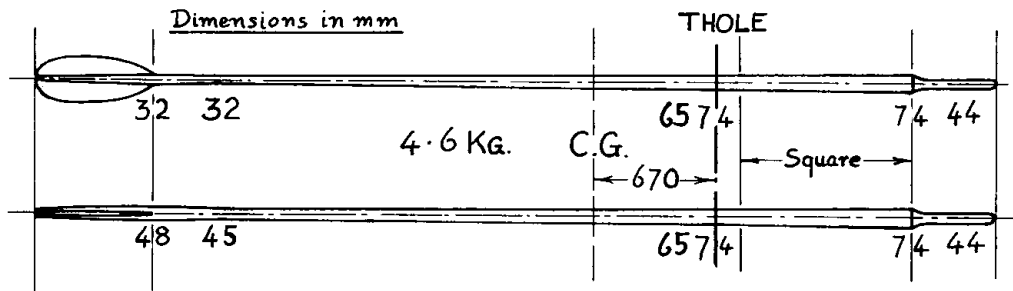


Fig. 5

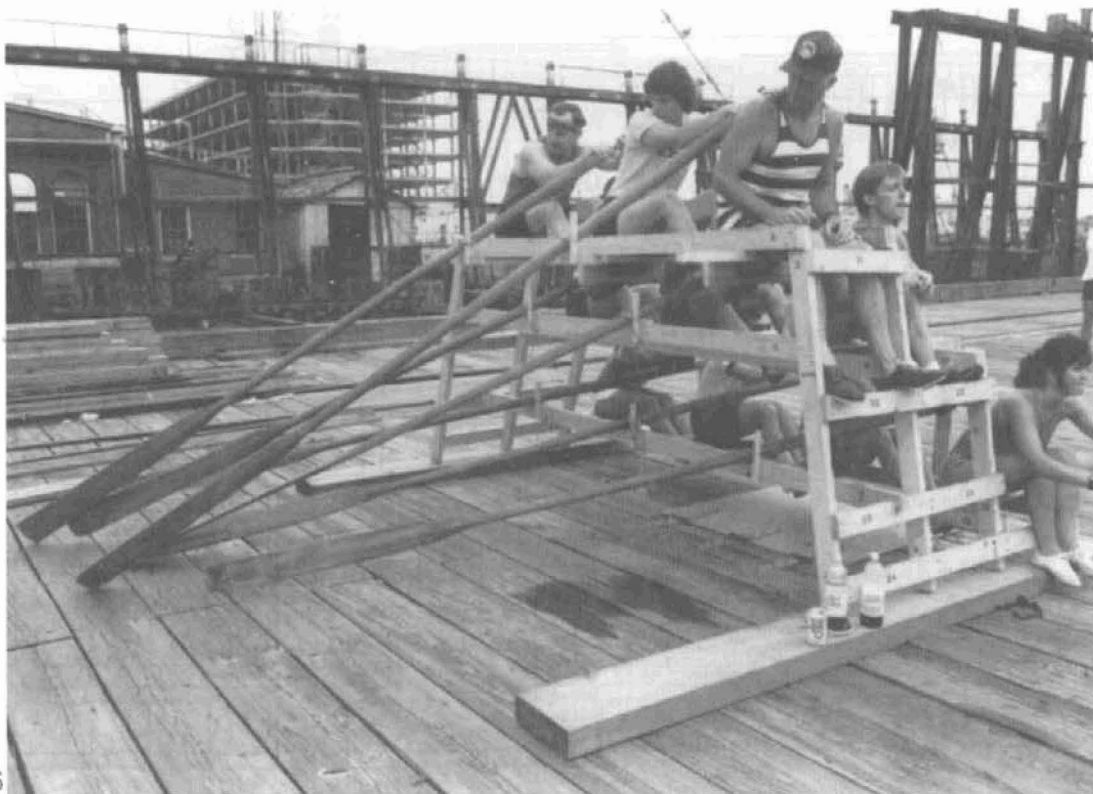


Fig. 6

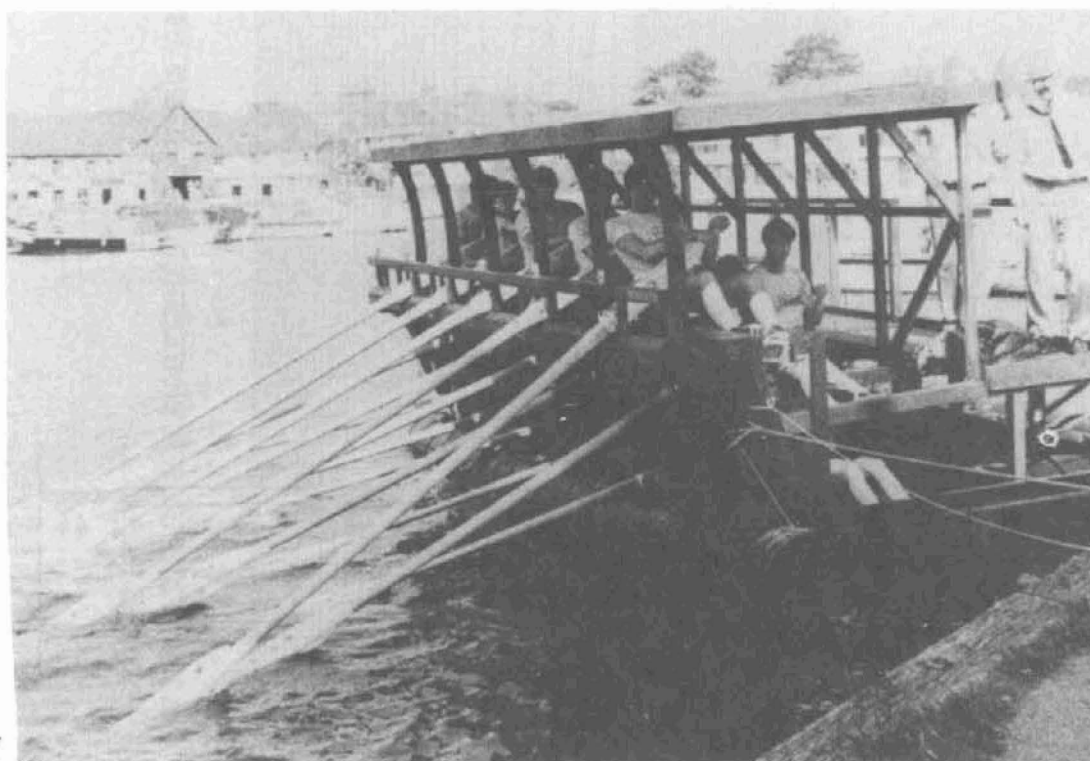


Fig. 7

EDITOR'S NOTE

Dr. Fanouria Dakoronia's communication "War-ships on sherds of LHIII Kraters from Kynos?" was published in *TROPIS II*.

As the quality of the illustration was not satisfactory-for reasons independent of the author's will- we are presenting the photographs of this important early war-ships under a better aspect.

ILLUSTRATIONS

Fig. 1. Two sherds of LHIII C krater with a nearly complete ship.

Fig. 2. Part of a LHIII C krater with a nearly complete ship.

Fig. 3. Part of a LHIII C krater with the prow of a ship and a warrior.

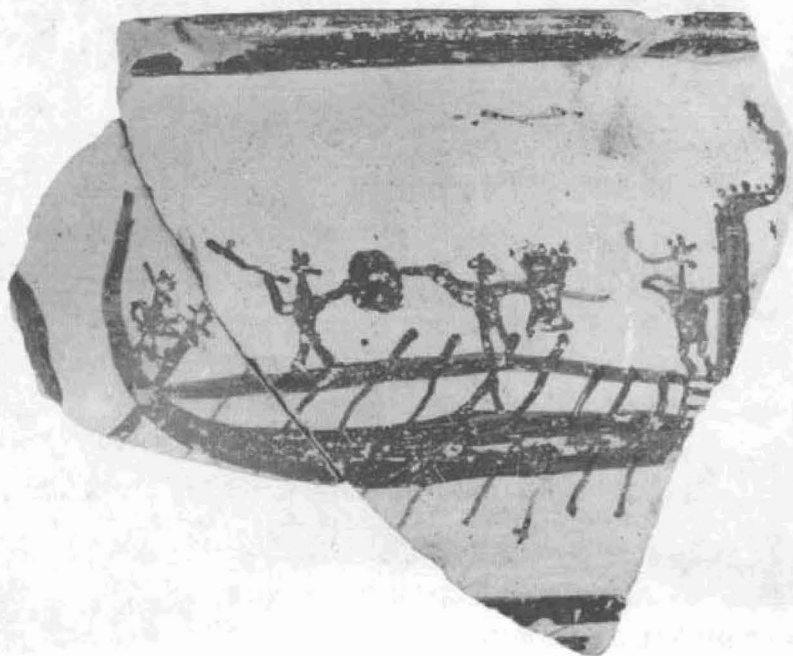


Fig. 1



Fig. 2



Fig. 3

SOME VESTIGES OF OLD PROTECTIVE RITUAL PRACTICE IN PORTUGUESE LOCAL BOATS

According to the title, the present essay is circumscribed to a very particular subject of an almost "utilitarian" kind: the formulas to protect the work, the goods and the lives of all those depending on some boat-trade. So I am not considering boats as ritual or mythical vehicles in a conception where life is seen as transient, namely

transiency = navigation

And I leave out every connotation with sun cults, the problem of the last journey on the cult of the dead - the function of the holy boats which, in hagiographies, miraculously carried the remains of the martyrs, etc. (O.L. Filgueiras 1978, 5-11, 78)(Fig. 1).

Resuming our subject, distinction has to be made between the formulas to protect the building of the boat and those propitiatory to its future "life" or those for the moments of peril or needs.

As far as I could determine, in the Portuguese local shipyards, the acts of selecting, cutting and fixing the pieces of wood were not the subject to mythical precautions (O.L. Filgueiras 1978, 17). Even when the shipbuilding was made after geometrical rules - as for the drafting of the moulds of the ribs, the stem post and the stern post - and with the help of the ribands, the masters have never referred any connection between this method and a conception of mystical numerology (O.L. Filgueiras 1978, 18-20; R. Barker, 75).

The shipwrights real concern was about the quality of their own work and how to protect it from bad luck and the evil eye. And the most usual practice is the nailing of an olive-branch, or of a cross made of olive branches¹, on the stem post at the beginning of the building (Fig. 2). As a variant, others would rather nail a leek on the outside of the prow (Póvoa do Varzim; Santos Graça, 78, 110).

In the Douro valley there was also a very curious fashion: a spurge-laurel (*Dauphnae Laureola*, Lin.) cross, with four equal arms, was nailed inside the stem, facing the stern and overlooking the inner part where the carpenters were at work

(Figs 3,4). It is possible to notice here some peculiarity: the universally recognised virtues of olive-branches-also used to protect dwelling houses when fixed on the roofs or painted on the doors (Figs 5,6), symbols of good luck, peace and wealth-being put together with the spurge-laurel and the leek, both of them well-known agencies against the evil eye and witchcrafts.

There are other formulas, as the nailing of horseshoes or sheephorns on the stem; the insertion of a coin, stamped with a cross² (Fig. 7), in the joint of the keel and the stem post (Póvoa do Varzim) or in the boxing of the mast foot (Douro); and the sprinkling with wine (*baldeação*), after the setting of the keel + stem and stern posts and stem, or after the setting of the ribs. Apparently all these formulas were intended to protect the existence of the boat rather than the builders' work (O.L. Filgueiras 1978, 25, 26, 33); Santos Graça includes the nailing of the leek in this group (S.G., 78, 110).

However the most significant examples of practices to protect the future of the new boat can be found in the launching ceremonies. The most well-known is the "baptism" with red wine, which could be accompanied with prayers, blessing by the priest or even by a Mass. Usually the boat was decorated with flowers (rivers Minho and Douro, Aveiro), with branches of olive (Póvoa de Varzim, river Douro) and of spurge-laurel or holly (Viana do Castelo), with pennants and flags (Aveiro), etc. (O.L.Filgueiras 1978, 29, 30).

But in the Douro, this ceremonial had very peculiar characteristics, convening all the people of the place where the boat belonged to (Fig. 8). No religious proceedings - not even a prayer - would interfere with its magical nature. An olive-branch was fixed on the stern (Fig. 9) and a branch of flowers or a wreath of paper flowers on the stem (Fig. 10). And that was all until the boat was launched, many of the participants helping.

Then wine and biscuits were served by kindness of the owner and of the shipwright (mestre) and his mates (Fig. 11). All this has nothing to do with the naming of the boat - if, later on, there was a name, it would be painted by the owner on the side boards.

There is a remarkable difference between the rituals to protect the work at its beginning - a spurge-laurel cross nailed by the builders - and at its end, ready to enter a dangerous life. As in Douro, where wine offering has nothing to do with the naming of the boat, in Algarve the *adiafa* (a sherry-party at the owner's expenses) has the sense of a kindly offer. On the contrary, the sprinkling of the boat with the red wine - the baptism of the finished work - has an occult sense that

is worth examining. J. Amades presents a complete and complex example of a tradition that used to occur in Catalonia (Spain). A feminine name was always given to fishing boats (*barcas*). The “godmother”, usually the *mestra*, would break a bottle of wine against the stern, and the craft was launched. Then all the participants jumped into the boat to make sure it was properly built. During this initial ride a cock was sacrificed and its blood spilt over the boat. The celebration was finished ashore with a supper (J. Amades, 13).

In this case, besides the double baptism (religious and magic) we also find a connection between the animist conception (boat = living being) and the magic practice that turns a lifeless object (the unbaptised boat) into an animated being by the sacrifice of an animal. That is life is conveyed by the spilling of blood, later on replaced by red wine. And all this is reinforced by giving the boat a name that no one may ever change or suppress.

The point is that animism is not absent from our nautical traditions. Quite the contrary! And it is manifest not only in these baptism ceremonies but also in the “decoration” of boats. I am using here the word “decoration” for there is no one better. However the present lack of (sacred) significance of the ornaments, the fact they are becoming meaningless from this point of view requires a note on the original meaning of such practices. Indeed until recently every detail in the decoration of traditional crafts was connected with either the expression of beliefs or some particular magic-religious function.

In Portugal boat decoration clearly illustrates the dominant cultural differences between the two main regions: the Atlantic and the Mediterranean (cfr. O. Ribeiro). River Douro appears as a boundary at least in what concerns the distribution of nautical species and of the human groups more closely related with them (Figs 12/01, 02). To the North of that river, the decoration of seafishing crafts has a mainly religious (Christian) character (Fig. 13), according to the historical process of independence in the XIIIth century, and the cultural identity of Northwestern Portuguese and Galician fishing centres and their presumptive connections with the North³(Fig. 14). We can also find some scarce magic symbols as well as frequent family marks similar to those used by Danish and Baltic fishermen (Fig. 15). These are illustrative of the underlying very old features (O.L. Filgueiras, 19).

To the South, the religious (Christian) invocation fades out, despite the numerous cases of syncretism (Fig. 16). The dominant feature is now the persistence of old Mediterranean/oriental beliefs prior to Christianization. This is exactly where

the plainest expressions of animism prevail. As a "living being" the boat must have his face - an area upon the bows - marked with a different colour and with eyes (Fig. 17). Such mark subsists even when the eyes are replaced by any other sign, where it is still possible to find the memory of the primeval symbol:

"The colonizing aptitude of the Phoenicians and Greeks and later the naval supremacy of Rome carried the *oculus* custom far and wide, so that to-day we find it prevalent and vigorous in Sicily, Malta and Portugal, and present but lessened strength on the South coast of Spain, in the ports of the mainland of Italy and in some of the Greek islands and in Cyprus; on the southern coast of France and sometimes in Italy, stars take place of eyes in token of dedication to the Madona." (Fig. 20; J. Hornell, 287).

Despite the fact that our documents on this dominant symbol date from the Age of Discoveries (ref. Cadamosto, 1455 in Quirino da Fonseca, 435) there is no doubt we have to accept its prior existence on account of the contacts with the Mediterranean navigators even before the arrival of the Phoenicians (O.L. Filgueiras 1975, 1977). Though they now appear merely as amulets, the meaning of the eyes cannot be understood but in connection with the belief in the sacred character of a boat that has been consecrated to a deity:

"The older and essential religious belief that eyes represented upon the bows of a boat signify intimate association between a specific deity and the vessel dedicated thereto, sketches far back in pagan times! At Knossos evidence has been found that the Great Goddess of the Cretans, in addition to her other functions, looked after the safety of seafarers, thereby anticipating the role filled in classical times by Isis Pelagia. In later days, when Christianity began to spread throughout Europe, belief in the protection given by these goddesses was transferred to the Madona who thereby became the Stela Maris of Catholic seamen and fishermen; to her they look for a safe conduct on their voyages and to her they present votive offerings when saved from shipwreck." (J. Hornell, 285, 286).

When studying the specificities of this belief in other parts of the world - as India - the same Author adds some important facts for us to understand the essence of the phenomenon:

"The custom of opening the eyes and the ritual followed are analogous to those that are obligatory before the image of a Hindu god may become a part of the godhead and thereby suitable for adoration in temple or in the home shrine of a Brahman. Whenever such an image is made

by a Hindu craftsman, he omits to indicate the pupil until just before the instalment or consecration of the image. (...) Till then they are lifeless images without sanctity. When, therefore, we find a similar custom of opening the eyes of a newly built boat immediately previous to launching, this fact confirms the statements, made that the *puja* ceremonies are specifically intended to instal the deity herself in the craft and to merge its individuality in that of the goddess whose protection is sought." (J. Hornell, 286).

In Portugal, the evolution of signs - eyes (Figs 17, 18), circles (Fig. 19), stars (Fig. 20), crosses (Figs 21, 22, 23), holy images (Fig. 21, 24, 25) - corresponds to the evolution of belief, as referred by J. Hornell and the lost of this traditional meaning (Figs 26, 27, 28). And there is something more striking: the study of the boat wigs that can be found from Peniche down to Algarve (incl.) On their rather high prow these boats used to wear a fleece like a scalp (Figs 29, 34).

It was commonly explained by the need to protect the lateen sails so that they would not be torn when rubbing against the stem head. However, J. Hornell presents a theory that clearly accounts for this. At the origin there was the sacrifice of a goat whose head was placed on the prow just before the boat was launched - a practice still in use in many Arabian ports. But this is probably the survival of much older ritual like those Herodotus refers when describing the sacrifice of a sheep during Amon's feast. Then the fleece of the victim was placed upon the statue of the god so that it could be identified with him:

"the similarity of this ceremony of draping the Amon's statue in the skin of the sacrifice with the ceremonial wrapping of the skin of a sacrificed goat around a ship's stemhead, is extremely suggestive of a common origin, but this is as far as we are justified in going." (J. Hornell, 282, 283).

Indeed from the remotest days Egyptian crafts used to wear the head of their votive animal on the prow (B. Landström 1961, Fig. 15 & 1970, Figs. 11, 12, 13, Fig. 30) in order that the close identification of the oblate victim with the votive deity was transferred to the boat so decorated (J. Hornell 283). This theory also explains the practice of nailing horns on the prow as if they were part of the boat itself (Figs 16, 31). And it settles the problem of the lack of accuracy of other explanations:

Peut-être les bateaux devaient avoir des cornes pour les mauvais esprits. Il n'est pas rare, chez les peuples sémites (sic), qu'au tracé de tel objet usuel s'attache un sens ésotérique. (La Poërie & J. Vivielly I, 35)

Distinction should be made between the original symbolism and the ritualism underlying the use of what has now become a mere amulet. This change into an amulet, already patent in the use of sheephorns to protect the building of the boat(4) is more clearly seen in the use of oxhorns on the stem (Fig. 24) or on the top of the masts (Fig. 32) as well as of *cornichos* hanging from the ropes around the stem heads (Fig. 33) or placed on the prow as a head (Fig. 17, 34). Still the sight of sheephorns “properly” placed on the prow (Fig. 31) is enough for us to recognise the trace of something deeper than the simple use of an amulet (Fig. 20). And all this is very (much) older than the modern religious ornaments as seen in the last pictures.

In general terms, these are the main features that can be found on the matter in Portuguese local boats. The underlying concepts and their embodiments clearly manifest two opposed worlds: the Atlantic and the Mediterranean. And this in spite of the chronological differences and of the changes or acculturations suffered by each original expression. Obviously this is a very difficult subject. But any investigation on it should reflect the love we devote to boats.

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NOTES

- 1 In Póvoa do Varzim, sometimes this cross was made of two pieces of wood.
- 2 According to L.V. the coins turned into amulets on account of the images, symbol or religious devices stamped on them.
- 3 The Northwestern river boats are not usually decorated, except for the *rabelos* that carried the spirituous wines from Douro down to Vila Nova de Gaia and that must be seen as an urban influence.
- 4 In some cases (r. Lavos, Fig. Foz and the Tagus *varinos*) we find the marking of the face with no trace of the opening of the eyes. Nevertheless the basic idea subsists.
- 5 In this case the horns were not seen as a part of the boat itself, “decorating” its stem head, but were nailed, inside the prow and turned to the inner part of the hull.

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- Fig. 02 Portugal: the "ports" (c. 1895/A. Vasconcelos)
- Fig. 1 The holy bark of the St. Vicente (arms of Lisbon/b.r. 14th cent.)
- Fig. 2 An olive branch and a cross made of olive branches to protect the shipwrights' work (Vila do Conde; O.L. Filgueiras).
- Fig. 3 The nailing of a spurge - laurel cross, inside the stem of a boat under construction (Castelo de Paiva; O.L. Filgueiras).
- Fig. 4 The carpenters at work under the protection of a spurge-laurel cross (id. ib.).
- Fig. 5 An olive-branch (together with a Solimon's Sign) painted on a door of a peasant house (id. ib.).
- Fig. 6 Detail of the same paintings (id. ib.).
- Fig. 7 A current old coin stamped with cross: a portuguese "cruzado"/1767 (by kind off. by Dr. Jorge Valadares Souto).
- Fig. 8 The launching of a boat in the Douro river, convening all the people of the place where the boat belonged to (Escamar' o; O.L. Filgueiras).
- Fig. 9 Id. ib.: the nailing of an olive-branch on the stern (id. ib.).
- Fig. 10 Id. ib.: the nailing of a wreath of paper flowers on the stem (id. ib.).
- Fig. 11 The wine party (at the owners expense): the shipwright and his mates (Pedorido, by kind off. by A.D.E.P.).
- Fig. 12 Portugal: types of boats: 1 - Germanic tradition; 2 - Box-like river barcs; 3 - Rafts; 4 - Local crafts; 5 - Masseiras; 6 - Mesopotamian tradition; 7 - Nordic tradition; 8 - Double-ended Mediterranean *barcas*; 9 - Aft transom craft (O.L. Filgueiras)
- Fig. 13 "Old" decorations of Póvoa do Varzim boats (A. Santos Graça).
- Fig. 14 The progression of the "colonies" of fishermen along the NW coast, starting from Galiza, 13th Cent. (O.L. Filgueiras, 1970).
- Fig. 15 The fishermen family marks of the NW coast.

- Fig. 16 Fishing boat in Costa Nova with a religious symbol and a pair of sheephorns nailed on the prow (Knut Weibust, 21).
- Fig. 17 The face of a boat marked with a different colour and with eyes; the name of the boat is "Morning Star" (Lagos, O.L. Filgueiras).
- Fig. 18 The first step of an evolution of signs: the eyes painted on the bow (Tavira, O.L. Filgueiras).
- Fig. 19 The second step: the circles (Nazaré, id. ib.).
- Fig. 20 The third step: the stars. Notice the horns nailed at the top of the stem post (Lagos, id. ib.).
- Fig. 21 After, the cross inside a circle. Notice the holy image (St. Peter) painted on the upper part of the bow (Furadouro, id. ib.).
- Fig. 22 Or a Christ cross inside a circle. Notice the snake head on the cutwater (Monte Gordo, id. ib.).
- Fig. 23 And an isolated Christ cross (Nazaré, id. ib.).
- Fig. 24 Finally the holy images like that of our Lady of Fatima encircled by two vine branches. Notice the bull horn at the top of the prow (Murtosa, id. ib.).
- Fig. 25 Or the image of St. Peter, crowning a sort of relics shrine, at the prow (Torreira, id. ib.).
- Fig. 26 The lost of this traditional meaning is documented by a painting of a fishwoman inside a circle at the face of the boat on the left; notice the horseshoe nailed on the upper part of the face, the guirland of flowers and the fetiche-doll at the prow. The other boat, on the right shows a painted wooden pair of (bull) horns (Ria de Aveiro, id. ib.).
- Fig. 27 The prow of a *moliceiro* crowned by an olive wreath and with a painted panel with decorating (but not magic) elements: a sea-horse and a siren (Ria de Aveiro, Estrela Santos).
- Fig. 28 The floral decorations on the face of the Tagus cargo boats were exempted of any magic connotation (Photo by F. Moura Machado).
- Fig. 29 At the top of the stem-posts of these *lanchas*, the (artificial) scalps (*cabeleiras*) made with pieces of ropes (Algarve, id. ib.).
- Fig. 30 "The foreign ship (A) carved on the Gebel-El-Arak knife compared with (B) an Assyrian vessel figured on a sculpture at Khorsabad by Layard; the other figures represent petroglyphs of foreign ships found on rocks in the Eastern Desert of Egypt" (after J. Hornell / Winkler).
- Fig. 31 Here the sheep-horns on the prow of a *bateira* as if they were part of the boat itself (Vieira de Leiria; Fernando Galhano).
- Fig. 32 Ox-horn on the top of the mast of a motorised fishing boat; hanging from a cable a wooden painted *figa*, a little hand with the fingers clinched, and the thumb sticking out between the fare and middle finger; the horseman figure corresponds to a weathercock (Matosinhos; O.L. Filgueiras).
- Fig. 33 A "cornicho" (wooden little-horn) hanging from the rope around the stem head of a *varino* (Lisboa; id. ib.).
- Fig. 34 A *calão*, from Algarve, with *eyes*, *cabeleira* (scalp), and a *cornicho* placed on the prow as a head (Monte Gordo; id. ib.).

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IN PORTUGUESE LOCAL BOATS

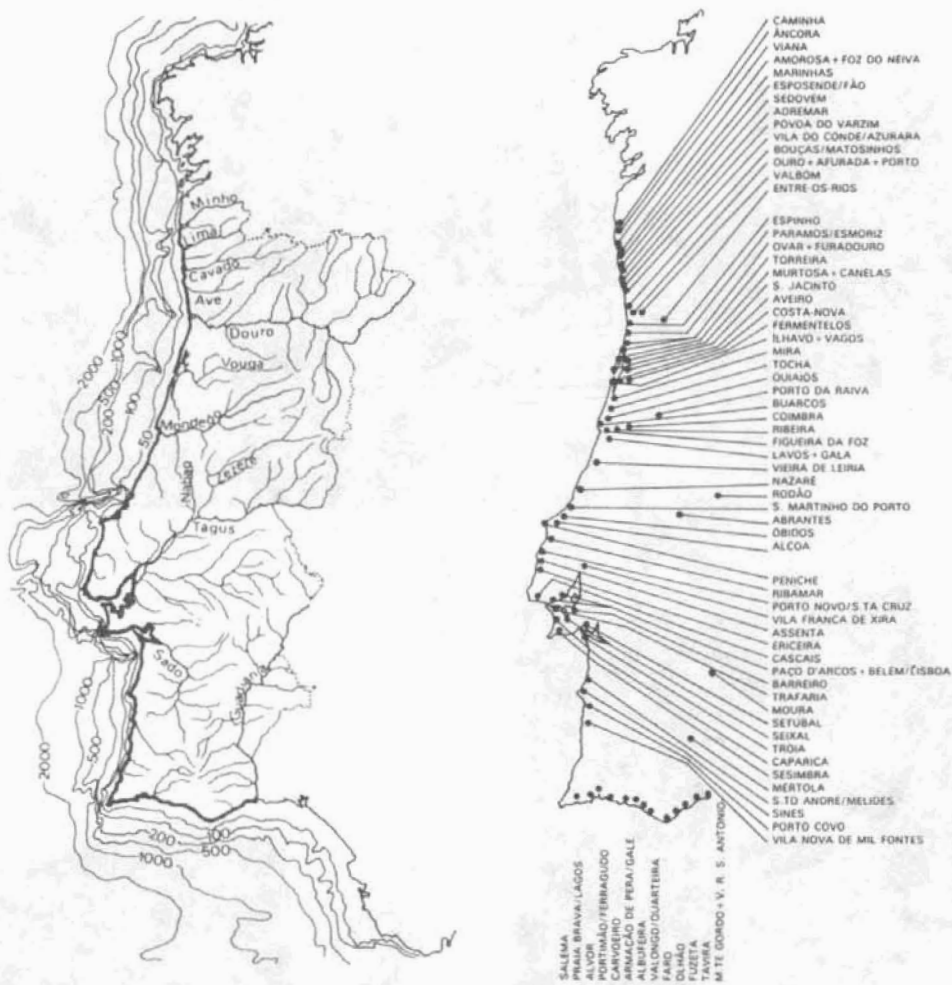


Fig. 02



Fig. 1



Fig. 2

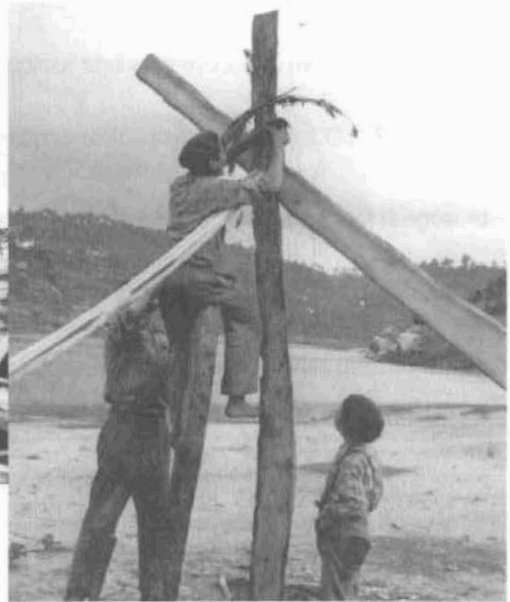


Fig. 3



Fig. 4



Fig. 5



Fig. 6

SOME VESTIGES OF OLD PROTECTIVE RITUAL PRACTICE
IN PORTUGUESE LOCAL BOATS



Fig. 7



Fig. 8

Fig. 9



Fig. 10

Fig. 11



- 1
- = 2
- ÷ 3
- 4
- ∨ 5
- 6
- ⊙ 7
- ☆ 8
- ★ 9
- × 10



Fig. 12

SOME VESTIGES OF OLD PROTECTIVE RITUAL PRACTICE
IN PORTUGUESE LOCAL BOATS

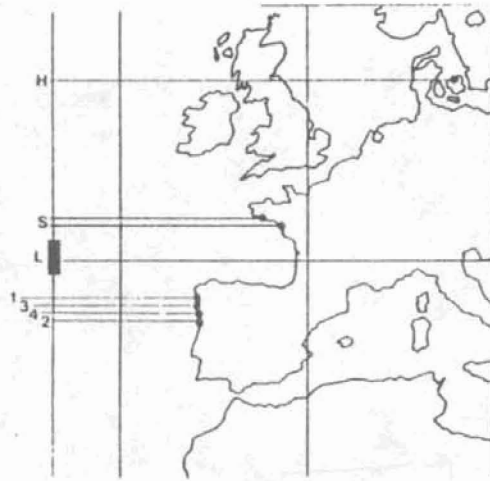


Fig. 15

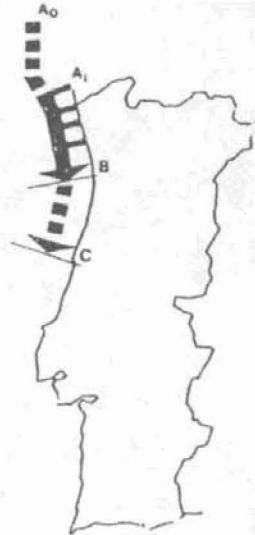


Fig. 14



Fig. 16

Fig. 17



Fig. 19



Fig. 18



SOME VESTIGES OF OLD PROTECTIVE RITUAL PRACTICE
IN PORTUGUESE LOCAL BOATS



Fig. 20



Fig. 21



Fig. 22



Fig. 23

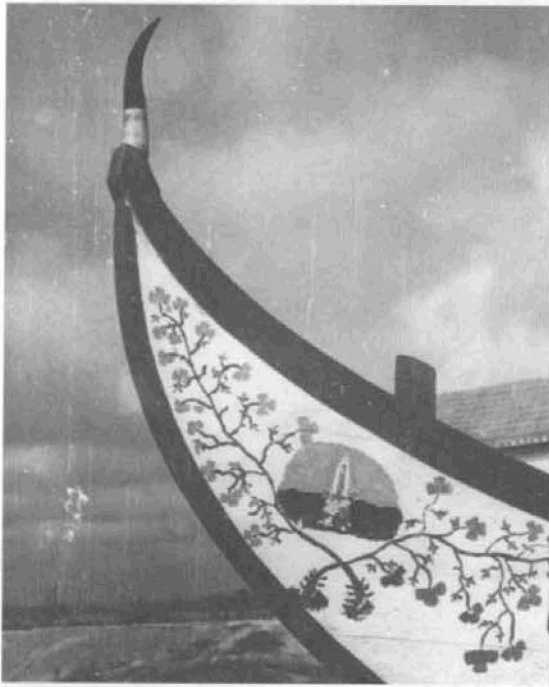


Fig. 24



Fig. 25



Fig. 26



Fig. 27

SOME VESTIGES OF OLD PROTECTIVE RITUAL PRACTICE
IN PORTUGUESE LOCAL BOATS



Fig. 28

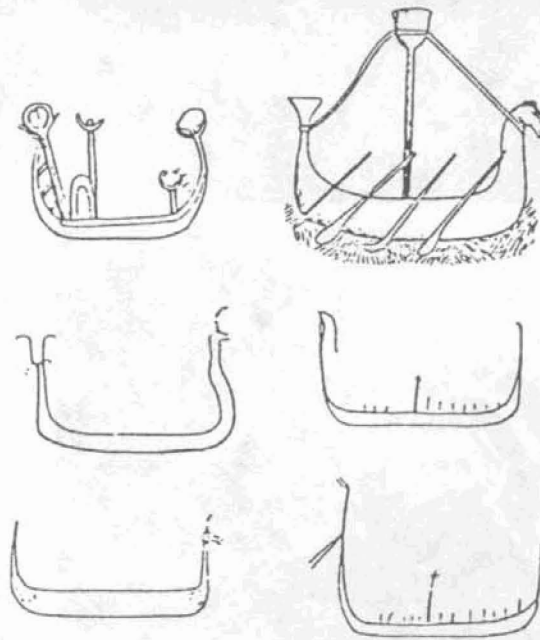


Fig. 30

Fig. 29 next page

Fig. 29



Fig. 32



Fig. 31



Fig. 34

Fig. 33



WHERE DID BRONZE AGE SHIPS KEEP THEIR STONE ANCHORS?

The question might seem trivial unless one actually gets the feel of such anchors. Imagine your largest suitcase turning into stone and - instead of a handle - having a hole through it! Its weight would have increased to about 100 kg. This would make it well nigh impossible to lift, even if it happened to be standing upright, but supposing it was lying flat on the ground? Having no handle, it would have to be levered up, so that rope could be passed underneath, then looped through the hole, as a substitute handle. Meanwhile if the stone fell over accidentally, it would probably break. Sorcerised suitcases are mythical, but the present corpus of Bronze Age anchors is both real and significant. The weights of such pierced-stones range from less than a kilo to over a ton, depending on the kind of floating object they were intended to immobilize (from fishing tackle to large vessels). The weights relevant to this discussion are in the order of 100 to 200 kg.

Technically, anchors made of stone are a most inefficient means of immobilising any vessel so, in order to compensate for this, and bearing in mind that square sails forced Bronze Age craft to drop anchor on dangerous mooring places, all Bronze Age cargo ships had to carry very large complements of anchors. Typologically, the date and shape of certain Bronze Age anchors can be gauged from the specimens offered in such places as the four Late Bronze Age Temples at Kition in Cyprus¹ and various sacred contexts at Ugarit Ras- Shamra in Syria, particularly in one of the two Temples on the Acropolis². This temple was dedicated to the Weather God, Baal Sapounah; whereas its twin temple, standing on the same hill, was dedicated to the Earth God Dagon (the latter, being of little use to sailors, got no anchors offered to him).

On these two Late Bronze Age sites there was a high percentage of very heavy anchors, whereas in the Middle Bronze Age temples at Byblos, only one anchor weighed as much as 200 kg³. At Kition, the number of anchors weighing over half a ton suggests that some Late Bronze Age craft must have been giants, analogous to the great Corn Ships of Rome (probably represented by the 4m. lead stock weighing 1,860 kg., found off Malta, now in the Maltese Maritime Museum Fig. 1). Bronze Age giants are, for instance, suggested in Temple No. 4 at Kition, by 6 anchors each of which weighs in the order of 850 kg., while another (so far unique) weighs 1,350 kg. The average weight at Kition can, however, be considered as around 100 to 200 kg.

Considering that a man cannot be expected to handle much more than 50 kg., especially on a moving boat, anything larger would have had to have been lowered mechanically (with the exception of certain pyramidal anchors with a wooden handle, designed to be lifted by two men⁴). The traditional mechanism used for lowering weights is a mast-derrick, such as the one appearing on a Cypriot jug in the British Museum (Fig. 3). This painting shows a vessel whose cargo is symbolised by two pithoi; at the prow, a sailor is depicted in a characteristic pose: with one of his hands steadying the wooden bar, or derrick coming from the mast, the other guiding the cable from which hangs a heavy stone anchor. Admittedly the jug is 8th rather than 13th century BC, but the device it shows is so simple that it probably came into being with the mast itself.

I must, however, draw attention to an iconographic pitfall which might puzzle anyone looking at a drawing of this much reproduced painting instead of either the jug itself, or a well-angled photograph of detail such as Fig. 2. Because the jug is round, when the painting is traced off it, the result looks distorted; as on Fig. 4, the hull of the ship curves like a half moon; the steering-oars are nearly horizontal, while the anchor at the end of its cable flies off obliquely. Looking again at the photograph, it becomes absolutely clear that the artist meant to show the boat floating horizontally and the anchor dropping vertically.

Mast-derricks being still in use, Fig. 3 shows a contemporary version of the jug painting; both the ancient and the modern sailors are in the same position: with one hand steadying the derrick, the other guiding the cable. Curiously enough the contemporary sailor is raising a concreted mass of Bronze Age ingots, for this photo was taken by the late Joan du Plat Taylor, at Cape Gelydonia, Turkey, during George Bass' first excavation in 1960.

Naturally, all stone anchors dangling in the air from ropes, are liable to hit something hard and so get their bottoms chipped. But once in the denser element, water, the danger is minimal. I will not demonstrate the point by dropping a carafe of water on the floor, because you all know it would break, whereas if I threw it into the sea, it would not. This law of nature is significant, because it relates to deductions regarding damage to anchors, made by two scholars of such eminence (the late Prof. Claude Schaeffer and more recently George Bass) that they are liable to be handed down to generations of students. Consequently, the causes of chips and breaks on ancient anchors need to be scrutinized, before passing on to the related subject of how and where stone anchors were placed on board a boat.

In the last volume of *Ugaritica*⁵, Prof. Schaeffer himself, commenting the Ugaritic Temple anchors, stated that the fact that their bottoms were chipped, proved that they had been used at sea before being "re-used as building stone" on land. Both statements are misapprehensions. Bass, writing recently in the *American Journal of Archaeology* about anchors still in situ on the magnificent B.A. ship (which he is at present excavating with Cemal Pulak, off Ulu Burun, near Kas, in Turkey) states that all the "Kas" anchors have chipped bottoms. He then quotes Schaeffer, agreeing with him that the damage must have occurred when the anchors landed upright on rocks on the bottom of the sea and reiterates the view that the anchors in the hill-top Temple at Ugarit had been re-used as building stone⁶.

Current research at Ugarit Ras-Shamra bears out the opposing view. I am grateful to the present Director of this excavation, Prof. Marguerite Yon, for the opportunity to re-examine the Ras Shamra anchors in the light of new evidence and revise the summary catalogue which I made of them some 25 years ago⁷. It is now clear that only some of the Ras Shamra anchors had chipped bases and that this damage had occurred in the air and not undersea. The 4 largest and most important anchors from the Temple of Baal were dug, for instance, during an Ottoman excavation in the late 19th century (Schaeffer took over the site in 1922). Inevitably, these like other anchor-stones were moved around and, since their significance was not understood until the 1960s, they were handled none too tenderly; most of them have ended in the Excavation's headquarters by the sea. By contrast the bases of anchors which remained built into temple walls had unchipped bases which were good as new. In addition, it has gradually become clear that on all the principal temple-sites : Ugarit, Kition and Byblos, not only were most of the anchors evidently new and without any certain sign of wear, but also there

were unfinished anchors on each of the sites. These unfinished anchors appear to have been made on the spot, indeed at Kition, examples were found in the Workshops attached to the Temples. Modern stone anchors (for it must be remembered that they are still used in the Mediterranean on small boats, see Fig. 5) are not, incidentally, characterised by chipped bottoms, but of course they are much lighter - in the order of 20 kg. - so that they can lie on deck and be lowered manually; I have often watched them underwater (Fig. 6) and have never seen one getting damaged on the bottom.

The chipped bases of the Kas anchors, as described by Bass in the *American Journal of Archaeology*, are more likely to be attributable to having had to have been kept upright - like amphorae - on board the boat, rather than to accidental damage on the bottom. Had they not been stowed upright, rope through their apical holes could not have been quickly tied to the end of the mast-derrick. This derrick had not only to drop anchors overboard, but also to pull them out of the sea again, then drop them back into their allotted positions on board. During the second operation the base of a dangling anchor would almost inevitably knock against something hard, especially if the sea were choppy. It follows that those anchors which survived long enough to be used twice (for losses must have been frequent) would not only have had to have been kept upright, possibly in compartments, they would also have had to be kept within easy reach of the derrick's "arm". Conversely, some 20 slabs of stone each about a metre long could hardly have been laid out on a fore-deck (nor were they so laid out, according to the plan of this wreck-site).

The latest, splendid phase-plan shows that the ship landed on a steep slope so that everything toppled over, then started slipping downwards. At the top of the slope we see a concentration of small cargo including Canaanite jars; then a stack of ox-hide shaped ingots; then a row of 6 large and 1 small anchors; then a row of 4 large pithoi which, because of their shape, because of the air originally trapped inside them etc. became displaced, rolling downwards around a rock which sticks up out of the bottom. There follows a second stack of ingots (which because of the increased gradient have slipped); a second row of 7 anchors (which for the same reason are also in worse order than the first). Beyond this point, at the other extremity of the hull, there are small finds (not shown on the plan). The full complement of anchors, so I am told, now stands at a total of 21! Fig. 7 is a hypothetical sketch (suggested to me by the published plan) showing how the many anchors might have been placed within reach of the derrick arm, some distance from the mast, which is itself forward of the ship's centre.

To sum up : a main complement of big anchors was essential for immobilizing Bronze Age vessels on the dangerous stops which their square sails forced them to make. On the wreck at Ulu Burun there appears to have been only one small anchor; I should, however expect that one or two might have been kept on deck for the ship's dinghy, for kedging and so on, but detailed descriptions of the "Kas" anchors are yet to be published; very wisely, the stones themselves are being left on the bottom to hold down and protect the wood of the buried hull until the time comes to excavate it.

That the anchors on this Bronze Age wreck are as many as 21 is not surprising to me, but two other findings are. Firstly that (although it is irrelevant to the present discussion), all the Kas anchors appear to be 1-holed weight-anchors. Secondly, it is unusual that a whole complement of anchors should be found in situ on any wreck, since the first thing to be done by a ship in distress is to drop anchors. Evidently the Kas ship must have sunk exceptionally quickly, unlike the two other Bronze Age wrecks have been excavated to date.

On the wreck at Newi Yam in Israel, paradoxically, it is the complement of 15 anchors which has survived, with only one adze, one chisel and a few haematite weights... just sufficient to testify the existence of a vanished cargo, thus proving the site to be a wreck rather than some kind of mooring improvised with 15 anchors. The site was excavated by Ehud Galili. The anchors are grouped within an area of 7x7 m., in shallow water near the beach. In antiquity, the depth is estimated to have been 1.50 m., consequently at the time when the ship ran aground, she could easily have been salvaged. Like most people, Galili was so surprised by the number of the anchors, that he has suggested that at least some of them must have been used as ballast (particularly on the grounds that he has not been able to trace missing fragments of 2 of the anchors)⁸.

Unlike "Kas", the Bronze Age cargo which Bass excavated at Cape Gelydonia, Turkey, in 1960 did not represent a complete wreck : there were two groups of finds, but no hull. At the time, it disappointed me that no anchors were found, but after over 20 years hope may be renewed, for the site has been revisited and a trail of artifacts discovered; if this trail is followed, it might eventually lead to the place where the distressed ship started casting her anchors.

Other Bronze Age wrecks will doubtless crop up, although it would be optimistic to suppose that many could be as complete as the Kas wreck. It confirms that anchors of the period could be too big for one man to handle and that their numbers could reach as many as 21. Both weight and bulk would have required

a mechanical means of lifting - in all probability a mast derrick - consequently the anchors would have had to have been kept in readiness, well within the reach of the lifting gear. To have laid such a number of such bulky anchors on a fore-deck, would have given Bronze Age cargo-ships the appearance of mini aircraft-carriers. I suggest the anchors were stowed upright in the areas implied by the two rows of anchors which show on the most recently published plans of this Ulu Burun, "Kas" wreck.

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6. George Bass, "A Bronze Age Shipwreck at Ulu Burun (Kas)", *American Journal of Archaeology* 90 (1987), p. 291; see too "The Oldest Known Shipwreck", *National Geographic* vol. 172, 6, 722 (1987). Note : earlier plans appear in *Tropis* I (Ed. H. Tzalas, Athens, 1985).
7. Honor Frost, "The Stone Anchors of Ugarit", *Ugaritica* VI (Paris 1969) 235-245.
8. Ehud Galili, "A Group of Stone Anchors from Newe-Yam", *IJNA* 14, 143-53 (London, 1985).

ILLUSTRATIONS

1. 4 m long lead stock being examined by Gerhard Kapitän; it is now in the National Museum, Vallatta, Malta.
2. Cypriot Bichrome IV jug (British Museum, 1926, 6-28, 9) showing sailor lowering a round shaped stone anchor, from a vessel's prow, by means of a mast-derrick.
3. Sailor using a mast-derrick to lift an object from the sea (photo : Joan du Plat Taylor).
4. Distortion caused by tracing (correctly) the painting on the Cypriot jug fig. 2 above.
5. A contemporary stone anchor ready to be used, on the deck of a small fishing boat (Island of Arwad, Syria, 1970).
6. The modern anchor in (Fig. 5) seen underwater as it was being lowered.
7. Schematic reconstruction howing stone anchors in an upright position, within reach of the mast-derrick, based on (below) the wreck-formation at Ulu Burun, Kas, as shown in the 1987 excavation plans (referred to in the text).

WHERE DID BRONZE AGE SHIPS KEEP THEIR STONE ANCHORS?



Fig. 2



Fig. 3

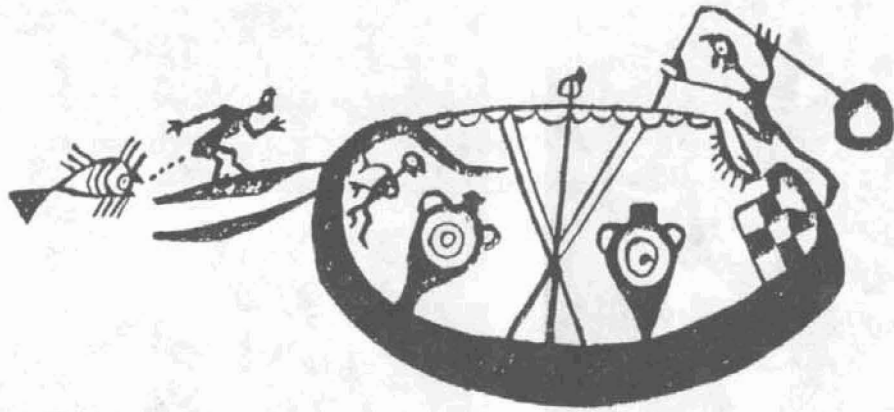
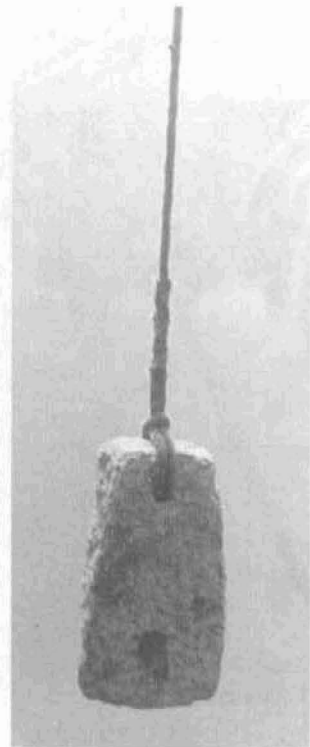


Fig. 4



Fig. 5



F

WHERE DID BRONZE AGE SHIPS KEEP THEIR STONE ANCHORS?

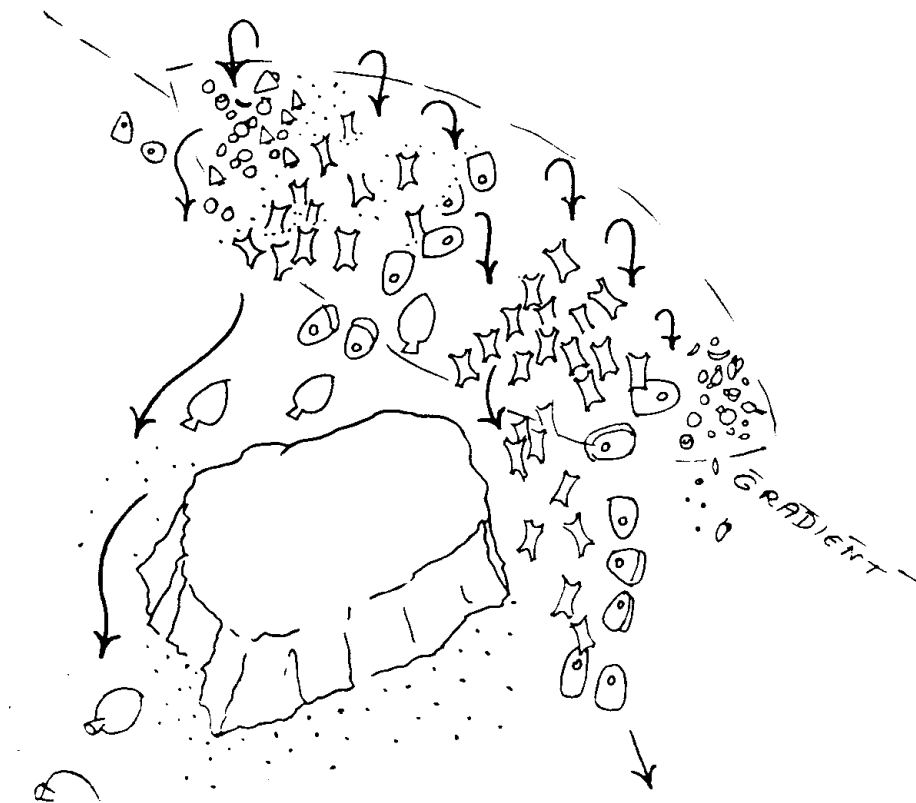
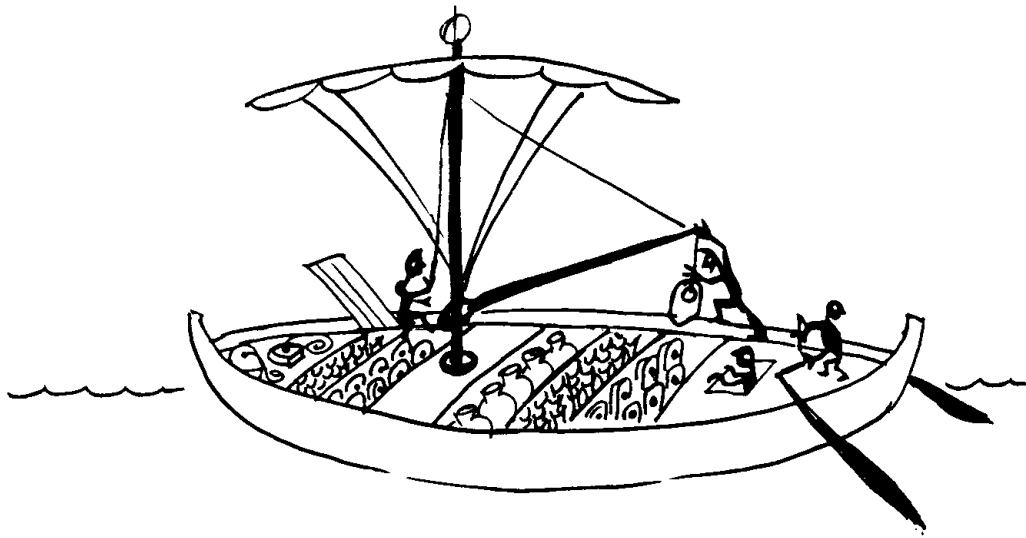


Fig. 7

FURTHER IDENTIFICATION OF FUNCTIONAL PARTS OF THERA FRESCO'S SHIPS

The archaeological work being supervised and directed by S. Marinatos near Akrotiri at Santorini during the season of 1972 uncovered the now well-known fresco that illustrated, for the first time, watercraft of the Minoan era. The fresco, when discovered, was extensively fragmented, due mostly to the volcanic eruption blast with accompanying earthquakes and the final covering of volcanic ash. This was based on geological investigation and research that the eruption of Thera approximately at 1510 BC.

So we are looking at a fresco with ships, presumably 3500 years old, plus or minus a factor of 100 years to account for variations of carbon dating and the painting's age before Thera was destroyed. This fresco is an illuminated picture for us in time, surrounded by centuries of dark and unknown nautical experience and activity. We must make of it what we can by logical reasoning, using parallel situations, knowledge of nautical science, and speculation based on archaeological knowledge. There is no way of knowing with certainty that the ships depicted, or for that matter the painting, is contemporary with the cataclysm of Thera.

Since the discovery of this important art work, there have been many and innumerable interpretations. This fresco is in the form of a frieze (originally), of which less than half has been recovered. Our major interest in the painting lies in the flotilla of ships, of which there are seven larger vessels proceeding from left to right, and of these there is only one which is nearly intact in its detail. The others, however, are with various amounts missing, fragments and in various locations on the ships. It is possible to see that the major ships are all very similar, and the missing parts of some are present in others, and vice versa, and that all together they match closely with the intact ship. Their sizes are also variable, but not excessively different. At any rate, our attention will largely be concentrated for obvious reasons on the intact vessel, the second from the left in the procession beginning with the very interesting island village scene.

It is not the intention to describe the entire fresco here. It is assumed that the majority of readers and audience are familiar with this remarkable and most valuable ancient art. It is necessary to begin this short discussion, however, by referring to Fig. 1, a reproduction of the portion of concentration on this famous

fresco. It shows the vessel referred to above, the most intact ship. Its actual length in the fresco is 75 cm. from end to end, but eliminating the long, stem-like extension on its forward end, the basic vessel is but 62 cm. Quoting Professor Marinatos, this projection, which he refers to as a bowsprit "is an additional, thin wooden² spar, attached to the prow when necessary apparently a device for the ship's festive decoration." The archaeological drawing taken from the fresco of this ship is shown in Figure 2 and this decorated extension can be easily identified.

Referring to the related paper presented at the first Symposium, "Ship Construction in Antiquity", Athens, 1985, "Theories on Ship Configuration in the Bronze Age Aegean,"¹ this same ship as above was identified and discussed. It was determined by reconstruction that it was a vessel whose dimensions were:

Overall length = 24 meters
Waterline length = 16.2 meters
Draft of water = 1.0 meters
Beam (extreme) = 5.0 meters
Displacement = 24 tons
Sail area = 61.5 square meters

Fig. 3 is the profile drawing, and Fig. 4 is the lines drawing (three view configuration) as reconstructed. These illustrations are repeated with the kind permission of the Symposium Administration merely to provide a basis for further discussion.² The validity of the reconstruction has been reasonably argued and for purposes of this paper it must be considered the basic ship.

Perhaps the most controversial focus in the ships of this fresco has been the appendage on the stern of the larger ships. It appears on each one except the vessel under sail. Let us concentrate on this feature. It appears to be as it was first described in the first official report,² Excavations at Thera VI, (1972 Season) ... "attached to the stern and well over the sea's surface ... it is clear that the object is composed of a bifurcated wooden shaft and of a massive piece also of wood fastened vertically to it". This writer would agree that this is a good description of the object from which to proceed. It would be proper to add that the vertical "massive" piece is shaped like a wooden knee historically used in ships of wood for stiffening and strengthening. The bifurcated shaft is quite probably in two parts, being lashed or fastened at the after extremity of the vertical knee with a single common junction from which each extends forward one side to port and the other to starboard to fasten just below the rail's edge. This is visible, Fig. 5, in each of the major ships showing the stern appendage. In the profile views of the fresco

ships in which they all are proceeding from left to right, we are looking only at the starboard side, unless there was an identical part on the port side lying in exactly the same place. As it is described, it is an assembly making a three-point attachment, port, starboard, and center on stern. (Fig. 5A).

In order to demonstrate the practicability as well as the basic function of the stern appendage, it has been assembled as described and attached as shown in Fig. 6 on the scale model first introduced in reference¹.

This assembly has been constructed to scale and configuration according to Fig. 2 as was the model. Fig. 7 is an extension of the lines drawing (Fig. 4) showing the profile with the stern appendage located as attached. The three attachment points on the model were as described above, and the actual attachment was accomplished with very simple touches of rubber cement. The solidity of this three point suspension was surprising. The assembly is convincing as one which is removable and re-attachable with a feature of stowability. When it is removed, it folds into a flat package that could very easily be hoisted inboard for stowage in the ship at some suitable place in the hold. This latter feature has been discussed elsewhere and assists in the explanation of temporary usage as a landing platform or gangway astern.

Further shown in the model illustration, Figure 6, there is the clearance question when the vessel is moored stern-to on a beach. There is a common phenomenon on sandy and gravel beaches of the world's seas that involves the gradual slope of the beach to the water and to an extent beyond. This slope is at an angle that remains within narrow limits at approximately 6°. This is something, of course, related to the constant force of gravity rearranging the washed sand or aggregate of gravel inside the surf line as the waves surge onto the beach in continual reversal of flow.

Referring to the model of the photograph in Figure 8, it has been set up in a position with its stern to a beach angle of 6° and the model on a horizontal plane at the waterline, a situation that would exist when such a vessel as the Thera ship places her bow at an anchor to seaward and allows the stern to touch lightly the slope of the beach below the waterline. It will be observed that the stern appendage just clears the beach slope as it reaches aft toward solid, dry land. From the end of this projection, when diagrammed on the scale drawing (Fig. 7), there measures a step down in this position of 25 cm (9.8 in). Such measurement closely approximates the height of one riser used by carpenters in making a standard stair step.

Actually, it is believed that the mode of attachment of stern appendage is such to make it removable and available when and as needed. It is held by two strap arrangements that pass through the stern knee piece and up to the hull's after deck, where they most probably are tightened up and secured inboard. This would allow adjustment to a higher position on the stern when needed for a stern landing at a stone-built embarkation (Fig. 9).

This mode for embarkation and disembarkation very naturally adapts to the classic usage in the Mediterranean in antiquity. There are abundant illustrations of Mycenaean ships and later Attic paintings showing vessels carrying ladders on the stern or actually with some in place and boarding, illustration.³

The stern-to beaching or landing custom seems to have extended into the Minoan culture, which may even have established it as the common standard. It truly is for the experienced sailor, a natural and simple way of going ashore. The boat may be hauled up lines ashore or merely touching the bottom with anchor to seaward and lines ashore from port and starboard quarters. It is for either a friendly or hostile shore the most simple; the quickest and safest way of getting to sea. It can be done gracefully and graciously in departing from a friendly host. From a pursuing host, the well-organized crew can take to a ship presenting the minimum target, cast off, and haul to a seaward anchor while underway with oars, sail, and/or other propulsion.

Tying up to a quay or slip, it is still considered best seamanship to have the stern to shore and bow to seaward. Only for cargo vessels and large commercial ships in protected harbors or rivers is it considered more practical to load and discharge cargo and passengers from the side. The stern-to bow-out system has been practiced universally for centuries. It had its beginnings in the Mediterranean - no doubt with the Eastern civilizations, it has been known among maritime people for this indefinite time as the "Mediterranean moor". It is for these reasons together with the natural adaptability in model experiments as indicated that the stern appendage of the Thera ship is most believably an embarkation platform.

As far as a trimming device⁴ is of alternative possibility, it must be pointed out from the fresco that the few additional people in the stern will not cause a significant change in trim. The vessel was determined to be 16.2 m (53.2 ft) waterline length and approximately 5.0 m (16.4 ft) beam. This means that it would have a trimming moment which would allow five men to be in the stern, where we see them in the fresco, without changing the trim on the waterline at the stern more than 5 cm (2 in). This result is computed as a function of the vessel's length

and waterline area, and involves a common parameter in examining and predicating performance in ship design. It indicates that for every 5 cm (2 in) change of trim, it is required to move 349 kg (770 lbs), 8 m (26.25 ft) aft from amidship.

Leaving the stern appendage, it is of further interest to examine the function of the objects shown on the forward ends of each of the large vessels on the rails. It is very clear on the rail of the intact subject ship, Figs 1 & 2, that this attachment is similar to the modern-day chock or fairlead for a rigging line or rope of some kind. It will be noted in the illustrations that the opening or hole in this rail-mounted "fairlead" type object falls almost directly below the end of the sail's yard arms, which are supported in the fore and aft positions by crutches or in modern terminology, "gallows".

The type of sail used on these vessels is apparent on the vessel under sail, and by the accumulation of furled sail and yards on the above-named gallows, to be a square sail with upper and lower yards. Such a sail is raised and lowered by a multiple halyard system, which is visible in some detail. The mast heads fitted with sheaves for these separate halyards are visible on mast head as eye-like sheaves lashed in vertical arrangement to each side of the mast. This system is identical to that used on Egyptian ships of the same and earlier periods.

These nearly identical mast head halyard sheaves in the Egyptian vessels we know to be essentially of wood, with rope lashings. This is an unquestionable thing, as well as their use, essentially because there are many more contemporary Egyptian illustrations of ships as well as funerary models of their ships. It is quite reasonable, with no evidence to the contrary, to judge that the mast head halyard sheaves are also of smooth polished wood on these Bronze Age Aegean ships which parallel the 18th Egyptian Dynasty of the New Kingdom. They also would appear much like the today's similar object of rigging which is used in Aegean fishing vessels as well as in other contemporary working rigs of Europe. They are called "bull's eyes" in English and serve well the need for changing the direction of a rigging line under a pulling force without the complexity and expense of adding a rotating sheave to a block of wood. Their multiple use in this case lightens the strain on each as the yard is raised. This function today would be accomplished through a three or four part tackle in one block with as many rotating sheaves.

The arrangement of upper suspension points distributed on the yard allow for canting it down forward at a leading angle to the horizontal wind force, which improves the sail's aerodynamics. These conclusions have been arrived at by sailors over the millennia without the advise of ship designers technology¹.

The ends of the lower yard as the sail is braced around to beam wind or somewhat forward of the beam as is the condition of the model, Fig. 5, would be most effective when the leading (forward) edge of this square sail is stretched taught. This sort of hardening down can be accomplished by hauling hard in on the two forward lower boom braces, which are shown rove through the rail-attached fairleads described above. (Fig. 10). At the same time, the after end of the upper boom must be hardened down by that brace. This sail can thus be set very effectively, aerodynamically, in this manner, although in today's world of fore and aft rigged vessel, the term must be relatively applied. We can at least see that the single square sail rig as is most clearly illustrated in this famous fresco of Thera, is a flexible, workable rig of the age in which it was used.

This ship, under sail, is rather an enigma. There is no question that it is sailing, believably so; there is no after landing gear rigged, the helmsmen (here there are two) are standing, both well braced with legs apart, indicating they are maintaining the head-up to wind in a stiff breeze. Because of the extensive fragmentation, we depend on the restoration with some misgivings. It is for this reason that the rigging is very sparse. There is evidence of taught halyards to the left on the upper yard and a pair to starboard on the lower yard as well as a portion of two braces coming off the yards. There also appears to be halyards coming down on the aft side of the sail forward of the mast. All of this is correct, but the whole forward end of the ship is missing from the original fresco, as is the stern.

It is difficult to tell whether the *ikrion* was rigged, although the restoration seems noncommittal on this, having inventively been painted in a shapeless lump at this location. It is felt in this analysis that there should be this aft structure shown even under sail. The *ikria* apparently were of considerable importance to the owners and/or captains of these Thera ships. In the house where the ship's fresco was found these command stations are exhibited particularly as wall frescos, each one individualized and painted apparently at some scale between half and full size.

Each exhibits different decorations, which indicate something of the reverence or elevated rank associated with them. According to Professor Marinatos, the owner of the house was the commander or "Admiral" of the flotilla² portrayed in the fresco. It suggests itself as a possibility that his murals of various *ikria* may be those from his past commands. Their placement on the ships indicate the location of command as in the later profiles of trireme⁵ and/or war vessels which exhibit very prominent throne-like chairs.³

In further examination of the fresco ship #2 of the procession, we observe in it, and at least on one other ship, an object rising from a forward location just beyond the rail sheaves that appears to be a two-pronged fork or cradle. It is very distinctly delineated, and seems to be standing approximately 0.75 m (2 1/2 ft) higher than the rail or forward deck, if there were such. At first sight, this would appear to be the top of a crutch, and with considerable further examination and comparative considerations, one still returns to this conclusion. There is strong evidence - archaeological evidence as well as practical requirements - that lead to the identity that this crutch is an installation to receive the end of the mast when it is being lowered and stowed in its horizontal position as shown in five of the seven ships. The mast, when not in use, would, for practical reasons, be stored in an overhead arrangement where tall post-like gallows can support it. These mast stowing structures are seen in the fresco on the ships where the masts are not stepped. There are in the abundant Egyptian iconography, largely in Middle Kingdom and earlier, detailed paintings and reliefs of ships in the process of lowering and raising masts.⁵ Many of these examples show a crutch forward where the mast's lower end is apparently being braced or held temporarily when the upper portion is held up by a taller post-like crutch amidships.⁵

The detailed procedure in unstepping the mast is not entirely clear. It must be lifted vertically, however, from its support (mast step) in the bottom of the ship by means of a rope sling or slings. A mast of the dimensions shown in the fresco ship #2, approximately 8.8 m (28.9 ft) in overall length and with an average diameter (mid diameter) of 16.5 cm (6 1/2 in) would weigh approximately 267 kg (588.6 lbs). (This is assuming the mast was of some appropriate wood native to the Aegean area such as pine or cedar). It is obvious from this weight that such a mast would be handled by a crew of sailors, approximately 6 to 10 men. Lifting it between two parallel crutches with a rope slings would bring it up to a position where its upper portion must rest on one of the taller post-like crutches. The lower end, or reel of the mast, could then be carried forward to the lower forward crutch, where it would rest safely for an indefinite time. It could at least be secured, until the midship crutches are in place, the sails made up between their yard arms, and other items stowed and ready for landing. At this time, it would no doubt be raised at its upper end, which now points aft, and lifted and moved to the upper stowage level on the supports. These supports can be seen on Fig. 2, where there are four in place supporting the furled sail and sail yard as well as an assortment of poles below them.

It suggests itself when comparing all the ships in the fresco, notable in the areas of the painting where there was no restoration necessary, that these upright post-crutches or gallows are fashioned to receive the masts and sail-yards separately. The upper ends have a "T" bar shaped as in a shallow, side by side double cradle, seen on close examination, Fig. 2. This can be seen on vessels numbers 1, 2, 3, 4, and 7. Inasmuch as can be seen in unrestored portions of vessel number 5, which is under sail, there are no such vertical supporting posts, and it is reasonable to conclude that these, like other non-sailing or seagoing gear like the stern appendage, must be removable and stowable.

Examination of ship number 5 must be necessarily restricted because of the extensive fragmentation and missing portions. It may be seen in this vessel #5 that there is a portion of the original fresco in it that clearly shows just forward of the second helmsman's legs a corner of an object that must be the after portion of a weather cloth or wind screen. This is broken off by a missing fragment, but continues again to include the lower portion of the mast above its edge and including several heads and arms of crew or passengers above it until it ends at a forward stanchion. These weather cloths are shown in many ancient paintings and reliefs of ships from the late Egyptian dynasties. Greek paintings on pottery of the 7th and 8th century and down through the centuries to our own time, not only on Aegean fishing craft, but on modern yachts that go to sea. Any watercraft with low freeboard will find that these fabric shields along their sides are a useful adjunct to their low rails in keeping their decks dry and crew more protected from flying spray.

The various details as noted in this paper are all of them a part of maritime culture that utilizes functional equipment that is recognizable still after 3500 years. It is of satisfaction to see that there is such constancy in facing the forces of the sea, but it is not surprising. It is, on the other hand, surprising to this writer that some of these recognizable things in the beautiful fresco from Thera are so often contested. It has been pointed out in past writings and interpretations of the fresco that I have accepted this painting too literally, that I have lifted the ship's profile line by line to be the basis for a blueprint. It is said with truth that before accepting ancient iconography, it must be submitted to a deep critical analysis. This has certainly been done, and because of the many realities in the fresco beyond the ships; the very identifiable species of dolphins, as well as other animals and flora, it is most believable. What else must we find to doubt?

One most credible critic says we must see the entire fresco as fantasy because it contains one rampant griffen. True enough, there is among the other fauna, lions, stags, fowl chased by spotted cat, a panel from the east wall (the ship panel

was on the south wall) , a single rampant griffen. It is drawn in much by outline and not filled in with color as are the other animals, as though perhaps the artist knew and appreciated that he is illustrating a supernatural beast. This strange beast is all there, just as our modern dictionary defines a griffen; lion's body, eagle's head and wings. It certainly, rather than stamping the whole fresco as a figment of some overcharged artist's imagination, does for this analyst, give the painting a mark of authenticity. The griffen is most accurately drawn.

To paraphrase and apologize to the poet Gelett Burgess, it is not resistable to conclude with the following:

I never saw an ancient Griffen,
I never hope to see one;
But I can tell you here and now,
That this one is a real one.

It is not in the details of this fresco that any major and very few minor details should cause doubt. Perhaps we are misreading some of them or putting some unrelated interpretation on others. This is not where the trouble may lie. It is an extensive and major archaeological milestone with considerable importance. We can easily see the portrayal of ships and people , towns and hillside of animals and saltwater with dolphins. We can count the paddlers on the ships and thus judge their dimensions with reasonable accuracy; we can even, from their profile and mast and sail extent, judge their third dimension and reconstruct their shape. The greatest question in this beautiful fresco has not been answered nor has it even been asked, perhaps indirectly once by Professor Casson, and that question is; how old are these ships and when did they sail? It may be, as has been assumed, that they are contemporary with or shortly before the destruction of Thera, which has been dated both geologically and by carbon dating. The age of the fresco and/or the scene of the fresco may be presumptuous.

There is evidence that may be quite supportive of this in the similarity of the masts as well as the profiles and other features of Egyptian ships in the reign of Sesostris III from the Twelfth Dynasty or Middle Kingdom of Egypt. This would date them only as late as 1780 BC or older, if the similarity could be substantiated with their time. The very visible stripes, on the masts both parallel and spiral, could be the woldings to hold together composite wood assembled masts or the stripes may be decorative. There is no evidence that Egyptian masts were composite assemblies and this question's answer is irrelevant in either case. The masts appear the same in the Egyptian tomb painting ship procession and the ship's

profiles, as do the Thera ships. The low mast crutch on the forward deck as well as the higher supporting crutches are also the same. These similarities seem more than coincidental.

In closing, I beg forbearance and ask the kind consideration of all the Scholars, classicists, archaeologists, and others here assembled for this form of direct examination and analysis taken by an old sailor, teacher, and successful practitioner of ship design for many years.

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ILLUSTRATIONS

- Fig. 1 Original Fresco Showing Ship #2, Least Restored Portion of Fresco's Ships. Dr. S. Marinatos, Athens, 1973.
- Fig. 2 Archaeological Construction of Ship #2. Dr. S. Marinatos, Athens, 1972.
- Fig. 3 Profile of Thera Ships #2 With Dimension. T. Gillmer. 1st Symposium of Ship Construction in Antiquity.
- Fig. 4 Lines Configuration of Thera Ship #2, Three Views. T. Gillmer.
- Fig. 5 Unrestored Fresco Fragments Showing Stern Appendage of Ship #4.
- Fig. 5A Detail of Stern Appendage Attached.
- Fig. 6 Model With Stern Appendage Attached.
- Fig. 7 Drawing of Stern Appendage In Place on the Lines Configuration.
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Editor's note

Since Professor Gillmer presented his communication the chronology of the Thera eruption has been much debated. Ice-core dating is giving a date of around 1645 BC, while tree-ring chronology a date around 1628 BC.

At the Third International Congress on Thera and the Aegean World, held in Santorini, Greece between the 3rd-9th September 1989 no less than 28 papers, dealing with the chronology, were presented. At his closing address Professor Colin Renfrew among other said, "When we turn to the historical dates, the archaeological chronology is still a matter of debate: whether it should be the traditional date of around 1500 or 1520 BC or much earlier in the middle of the 17th century ..."

The Proceedings were published in 1990 in *Thera and the Aegean World*, Editors D.A. Hardy with A.C. Renfrew, The Thera Foundation, London, 1990. Volume III deals with the chronology and it was thought appropriate to provide the reader with the above reference.

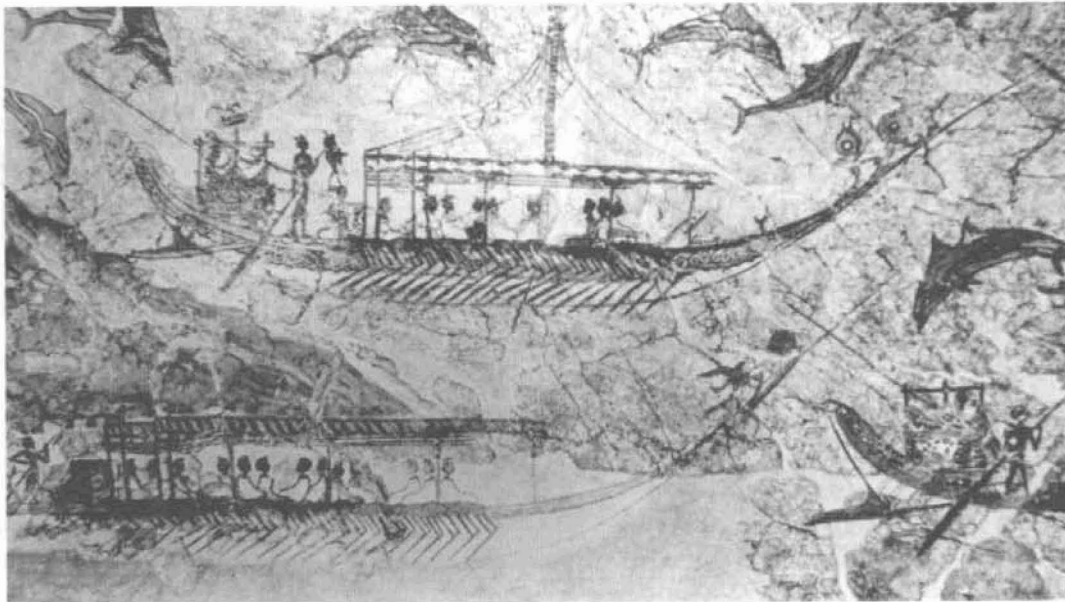


Fig.

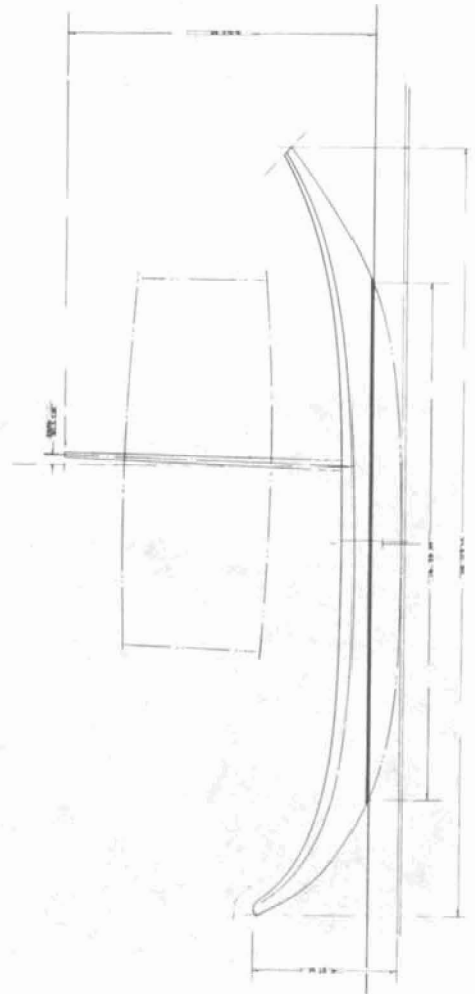
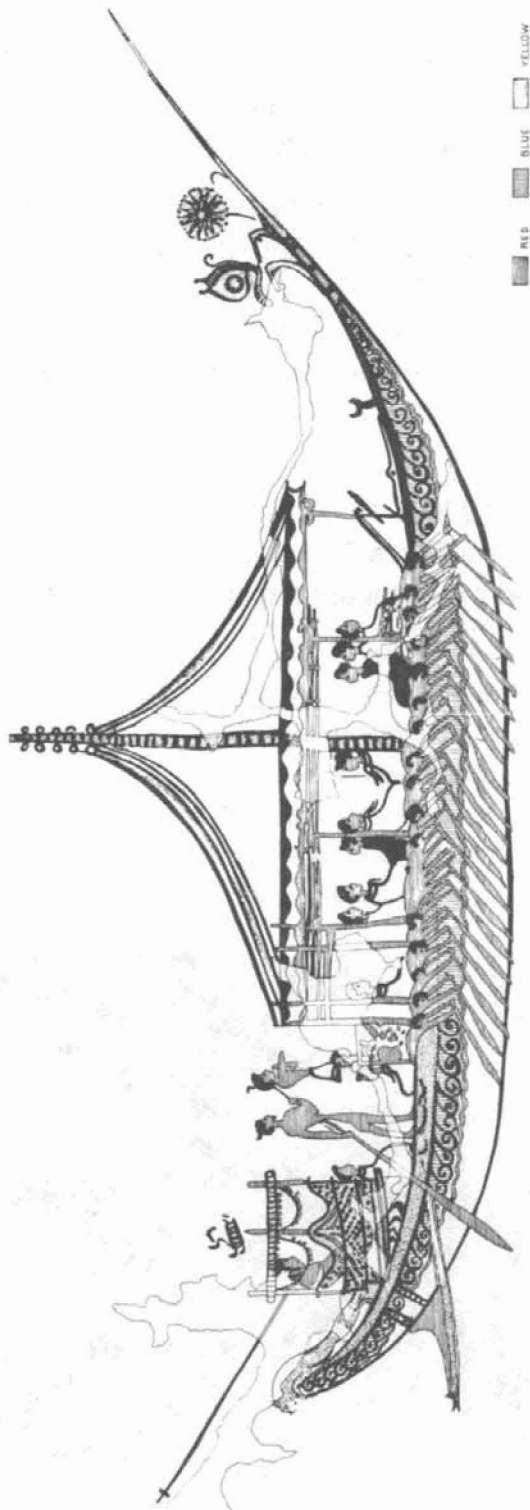


Fig. 2

Fig. 3

FURTHER IDENTIFICATION OF FUNCTIONAL PARTS
OF THERA FRESCO'S SHIPS

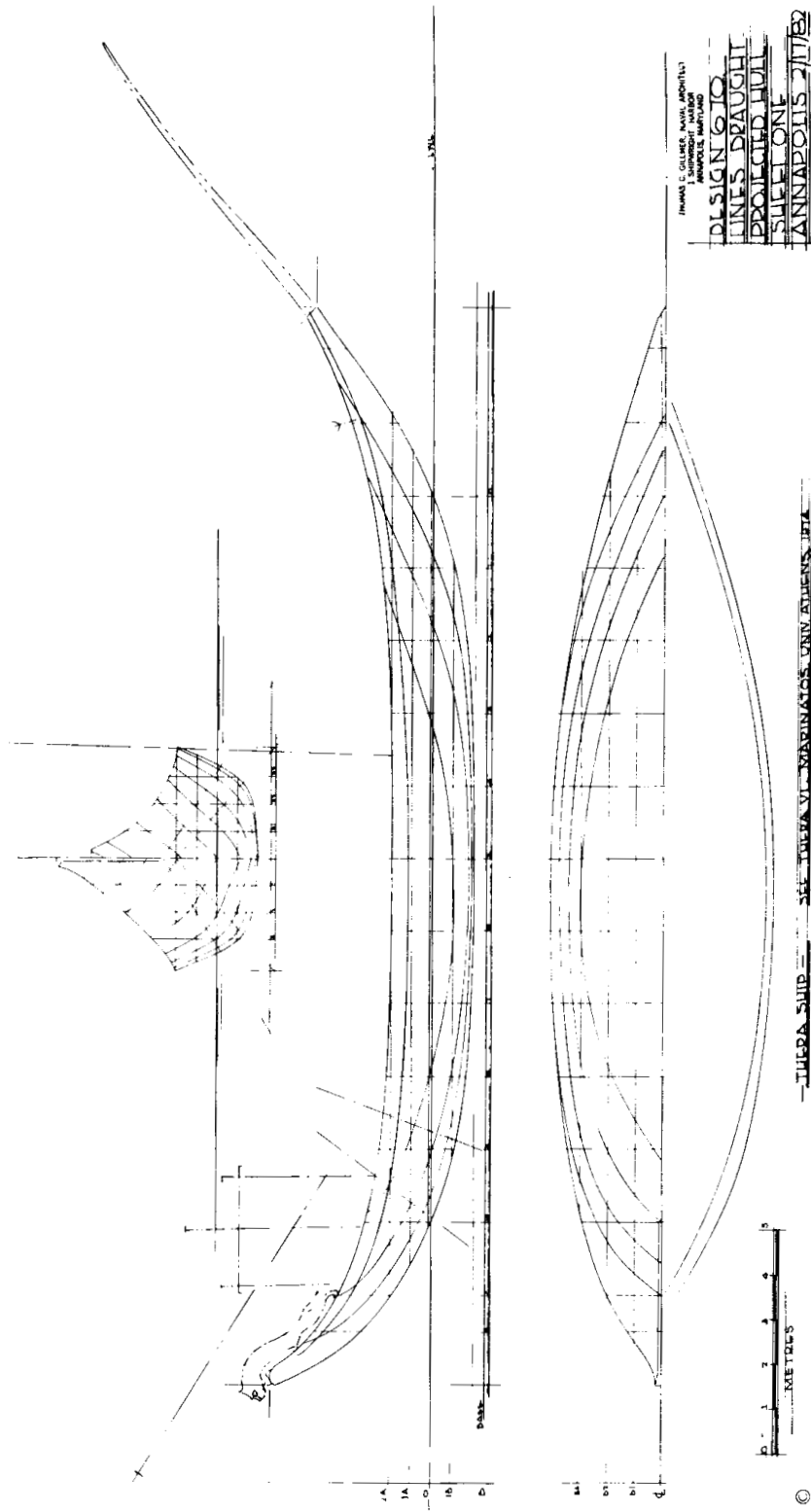


Fig. 4



Fig. 5

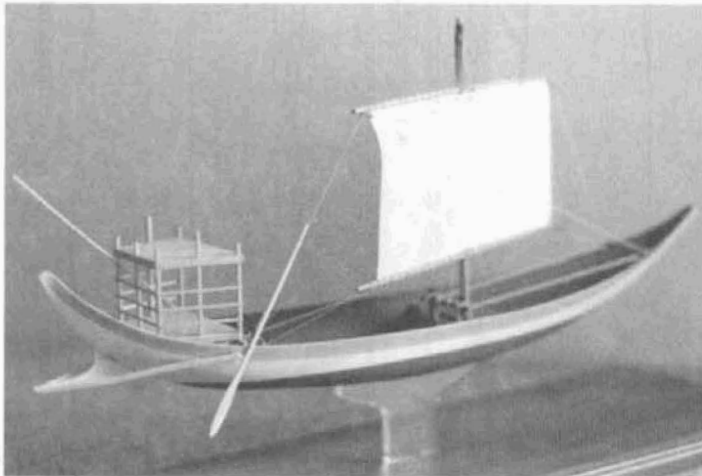


Fig. 6

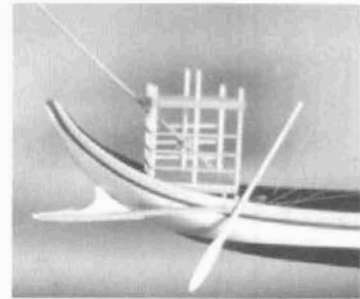


Fig. 5A

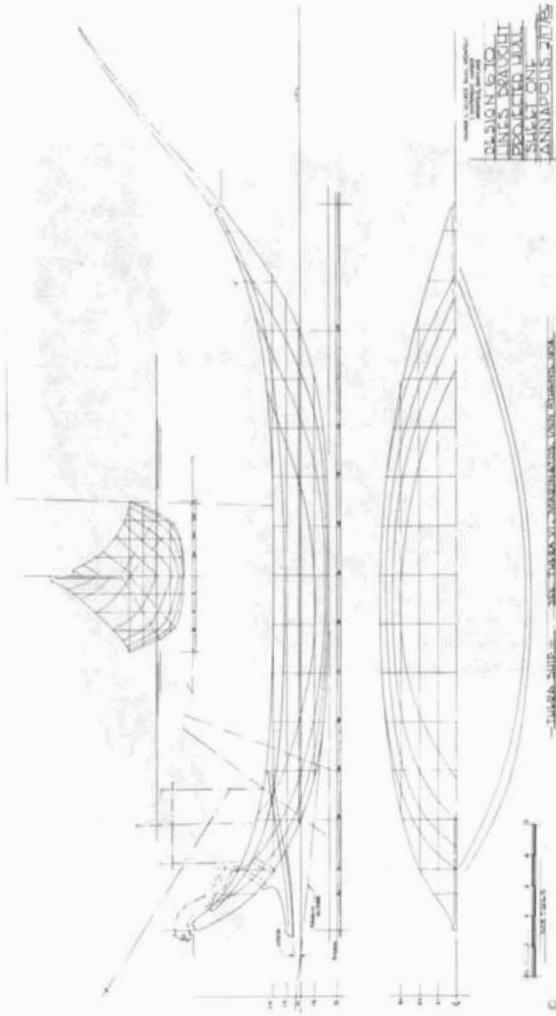


Fig. 7

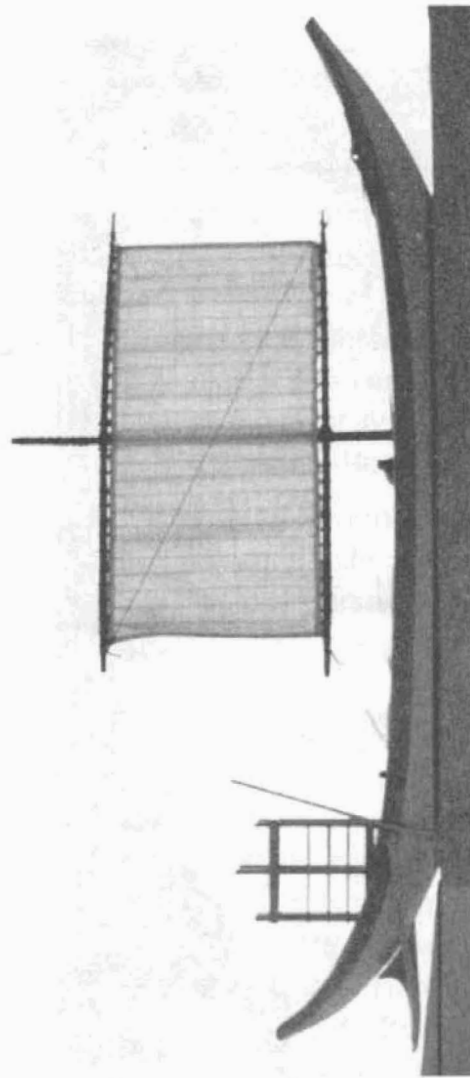


Fig. 8

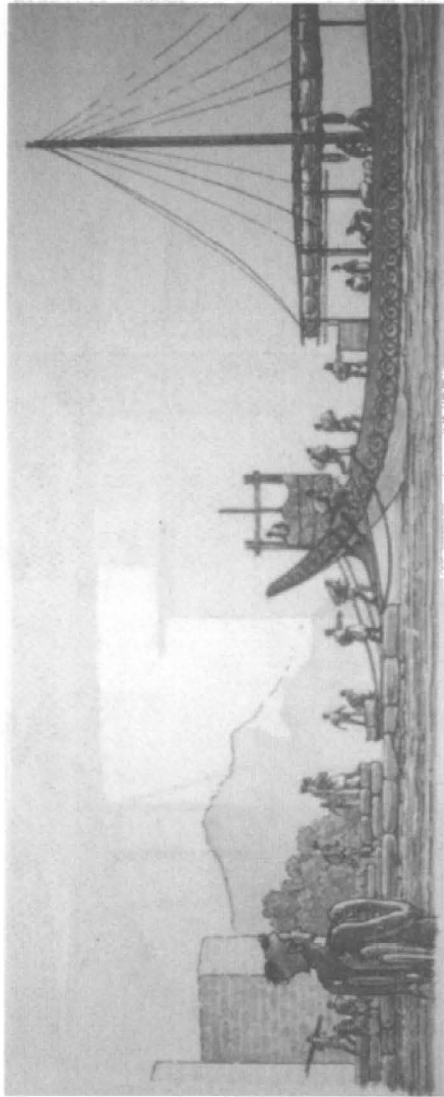


Fig. 9

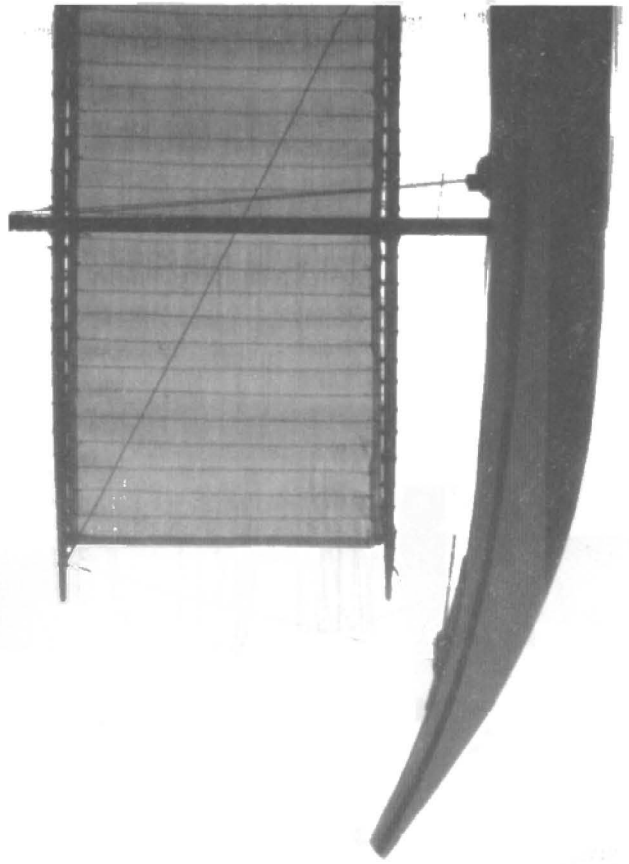


Fig. 10

ARCHAEOLOGICAL EXCAVATIONS AND EXPERIMENTAL ARCHEOLOGY: THE PUNIC SHIP OF MARSALA AND THE TRIREME “OLYMPIAS”

I would like here to render homage to Auguste Jal, whose *Glossaire Nautique* we are re-editing at the *Laboratoire d'Histoire Maritime* of the Sorbonne, homage as the father of naval archaeology and of experimental archaeology. In the latter, he did not hesitate in urging Napoleon III to reconstruct a trireme. I studied this case which is usually now hold up to ridicule but we must remember Dupuy de Lôme supplanted Jal and constructed a monster. If Dupuy de Lôme had accepted collaboration with Jal, he would have certainly missed considerably, for instance the knowledge of mortise and tenon joint construction or the Zea shipsheds; but he would have had the epigraphy and, so, made a light vessel instead of a boat like a “trois-ponts”. Thanks to the texts, he would have put 170 rowers instead of 130 in his giant. Unlike Dupuy, a military engineer of genius, Jal was an erudite who thought that science advances progressively by the trial and error system, according to the experimental method of their contemporary Claude Bernard.

Since then, underwater archaeology has revolutioned our data. Nevertheless the act of interpreting an excavation is not neutral and it can't be done without the texts and epigraphy as we shall see in relation with the Punic Ship of Marsala. On the other hand, excavations, even after correct interpretation, don't show everything - which justifies experimental archaeology.

Coming back to the Punic Ship of Marsala, excavated, emerged and partially reconstructed by Honor Frost, she is the only ancient war vessel we possess, even if we don't know her row system. According to the authors of the Excavations Report, she seems to be a 30 row (approximately) vessel, that is either a *triacontor*, light boat used as a scouting vessel or for piracy, or an *actuaire*, a combined ship (sail and rowing) used as support ship. The *triacontors* date back from pre-homeric times, even if later they were used marginally; the mere existence of *actuaire*s is questionable. That is why the authors did not give none of the two names to the ship, but they called her *liburne*, a later word than the year 241 BC, in ancient literature that simply means (war) galley and not *bireme* as it has been repeatedly mistranslated despite the texts (c. for instance Suetonius, Caligula, 35)

Actually, the ship of Marsala, sunk in 241 BC in the Aegades Islands, formed part of a homogeneous Carthage fleet that fought at undoubtedly equal number the 200 Roman *penteres*. According to Polybe, we know that this fleet wasn't composed of any transport, due to the tactics of Hamilcar.

Near 200 punic *quinqueremes* charged with wheat, material and young recruits should have disembarked by surprise at the foot of the mount Erice in order to reinforce the camp of Hamilcar Barca, and to embark him and his veterans, instead of the cargo, to fight the battle.

Neither slow cargo ships, nor extremely light triacontors were chosen for such a task but only powerful and fast war ships, charged with provisions (just as the Japanese supplied Guadalcanal with heavy destroyers and cruisers at the end of the fights). But the Cartaginians were attacked before by the Romans and taken or sunk, that put an end to the First Punic war.

The Carthaginians were sure of their superiority in speed thanks to the hull deflectors inaugurated on the *quadrireme* the Rhodian, captured shortly before by the Romans. But this enabled the Romans to construct a fleet based on the model of the Rhodian, therefore as fast as the Punic fleet which, despite having the wind astern, could not break the blocus of Lutatius Consul that intercepted it at the last moment.

For Polybe, only *penteres* are present in the Aegades battle. According to Honor Frost, the Punic Ship had 17 rows on each side, all at a single level and at 1.40m one from another. But this 1.40m spacing corresponds only to the attachment spaces of an outrigger or a fighting deck. Between each space, two rows fit as well as a single one, and the existence of two of them is more plausible since a 1.40m space per row seems excessive as the Olympias example shows. On the other hand, since the topsides were not kept, we could think of a ship with three ranks of rows - the most common during the Roman age in epigraphy - while moneres are very rare - this is certainly not an effect of a hazardous finding.

The reconstituted measures of the Punic ship (37m x 4,8m), minimized in my opinion, means she would fit inside the 40m x 6m dockings discovered in 1977 by Hurst in Carthage (Admiralty Island) where we know *quinqueremes* were kept. Everything seems to prove that the Punic ship is a *pentere*, statistically probable if we remember that "during this war, there were lost for sure: 700 by the Romans, those in the wecks included, and around 500 by the Carthaginian" (Polybe, *Histories*, Book I, 63-6), 50 of them sunk only in the Aegades...

Epigraphy finally confirms our thesis since, even if we do not have a reproduction of the *monoreme* endowed with the beak-shaped ram so particular of the Punic ship, the Trajan Column offers the whole of the Danube fleet entirely composed of *polyremes* - *biremes*, normal for a fluvial fleet - and also an admirable *trireme*, Trajan's own admiral ship. No need then to make such a big effort of imagination to see the resemblances between Trajan's *trireme* and the *quinquereme* of Marsala.

My opinion on the dimensions of the ship of Marsala is confirmed by the essential work of Michel Reddé, *Mare Nostrum* (Ecole Française de Rome, 1986, pp 36-37). According to him, the Punic Ship has at least the size of a *trireme*; which is not surprising when we know that the hellenistic port of Carthage housed "3" and later "5", without modifying the dockings. We are therefore far away from a small vessel and closer to a *quinquereme*.

Despite its great contribution and the fact it is an unforgettable fragment of the past, the Punic Ship - emerged and reconstructed once then dismantled by "unknown" interests and reconstructed again thanks to the unrelenting activity of Miss Honor Frost - is yet not enough for the researcher. In my opinion the error of making her a 68 rowers liburne explains itself by the intellectual background of the time when most experts denied the possibility of ever finding a warship for lack of freight. Therefore in the excavation report, (*Lilybaeum*, Honor Frost and alii, 1976) dating from 14 years ago, a compromise was made that, as we have said, explains itself by the sociology of knowledge.

Since then, we have had Hurst's excavations confirming those of Blackmann in Zea; the ram of Athlit, whose weight - in default of the form - should be compared with that of the reconstituted ram of Marsala; the "sockets" of the Trophée of Actium from which the size of the Athlit ship can be deduced; and specially the discovery of the ship of Giens (that explains the *Foro delle Corporazioni* in Ostia where merchantships are seen with what is believed a ram) confirm that 68 men couldn't have manoeuvred a vessel such as the Punic ship and even less used her ram, since she surely did have a ram and not a stem bulge. This fades away the existence of *actuaires* while generally Polybe shows clearly the distinction between warships (*penteres*) and support ships but never the existence of dual-propulsion ships.

The last discovery, if I may say so, was the trireme of John Morrison, reconstructed according to the texts and the epigraphy. The total lackness of archeological fragments could be criticized; but considering the abundant references of John Morrison and John Coates' knowhow as a naval architect, as well as what both have told us about the Olympias's performances comparable to the Ancients, I would say that the trireme is 90% authentic and that the other 10% can be discussed in one sense or the other, this is considerable (who would say as much for a Physical theory?)

Now Olympias is smaller in beam than the Punic ship considering the fusion of the outrigger with the fighting deck:

	L	I
Olympias	37m	5,5m
Punic Ship	37m	6m

which explains why the latter has two men per row on the topside according to Honor Frost, this was not possible for the Olympias, and it could form the *thranites* of a *quinquereme*.

On the other hand, we think the speed of “3” and “5” must have been equivalent. And we have several hypothesis: first during the battle of Amorgos the Athenians could not escape, I think they would have it if they could! Second, the lack of “3” as scouting vessels during the First Punic war (Polybe would have mentioned it) - their uselessness made them soon disappear from Roman fleets. Another example is the “5” that captured the Rhodian (a “4”) and finally Anthony who escaped on a “5” to come up with Cleopatra, leaving his *decere*.

We may conclude that the speed of “3” and “5” was more or less the same, which means a “5” needed much superior human engine: adding seaman and “marines”, a vessel charged on the topside therefore ballasted, that the human engine had to reckon with.

Now that we have reconstructed a *trireme*, theoretically nothing keeps us from reconstructing a *quinquereme*, the largest ship useful to thalassocracies after the *trireme*, with three ranks of rowers an two men per row on the two upper levels (cf John Coates, *American Scientific*, 1989). We think this task is possible only on the basis of the ship of Marsala that we are fortunate to have, under the condition, of course, that she is repaired and housed in a museum protecting and exposing her. If still some doubts exist regarding the vessel, the hull can be finished using the CAO (computing aided conception) and then the method by segments used for Olympias to reconstruct the rowing system. A combination of both models would be a real scientific breakthrough. I would like to try from 68 to 268 rowers, I think the latter is the appropriate solution, nearer the speed of this one “5” - had approximately that number of rowers according to what we can deduce from Polybe. In exchange, such a vessel could offer useful information on the “3”.

This is my conception of science and the reason why I don't think there should exist any conflict between Experimental Archaeology and Underwater Archaeology.

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LEAD HULL SHEATHING IN ANTIQUITY¹

Thin exterior sheathing of lead is a relatively common feature of ancient shipwrecks in the Mediterranean. It normally consists of large sheets, one to two millimeters thick, laid over some sort of fibre impregnated with resin or pitch and held in place by copper tacks in a characteristic “quincunx” pattern. It has been suggested, perhaps on analogy with the development of copper bottom sheathing in the 18th century CE, that ancient hull sheathing was intended to protect the underlying wood from attack by marine borers, such as the mollusc *Teredo navalis*, and other destructive sea life.² Such protection would certainly be useful in the Mediterranean, where wooden vessels have exceptionally short working lives, even with modern anti-fouling paints and preservatives. Metal could provide a barrier to such organisms, and, indeed, was eventually chosen as the most effective means of preserving modern wooden vessels travelling to the even more destructive tropical waters of the West Indies.³ Alternatives to metal include the use of light wood sheathing, which could be stripped off and replaced before infestation reached structural timbers.

Careful examination of the way lead sheathing was used in antiquity suggests that the primary purpose was not, in fact, protection against borers. Where sheathed hulls have been sufficiently preserved, the lead (or evidence of it) usually extends well above the waterline, generally to the limits of preservation.⁴ Borer protection is not needed on most of the topsides, and modern copper sheathing stopped just above the load waterline. More importantly, several of the sheathed hulls seem to have been poor candidates for this sort of protection. The Kyrenia ship was already old and teredo-riddled when it was first sheathed in lead,⁵ and the Nemi barges were employed on a freshwater lake with no navigable connection to salt water, and thus no shipworm.

Surely protecting a worn-out, infested hull such as the Kyrenia ship was false economy; could sheathing be reasonably expected to extend the life of timber already seriously deteriorated? It has been suggested that the Nemi barges were covered in lead because they were imperial state vessels and as such should

have reflected the best techniques of Roman shipwrights, whether appropriate or not.⁶ While I am not qualified to interpret Roman attitudes towards conspicuous consumption, many construction features on the Nemi barges indicate that they were not typical of Roman commercial shipbuilding. The framing system, if system it is, is unique in the ancient Mediterranean and must have been a deliberate solution to the problems presented by the wide, flat floors of these immense vessels. Similarly, the heavy spikes used as edge fastenings in the planking and iron strapping in the deck structure are quite clearly responses to the peculiar requirements of floating pleasure palaces rather than examples of contemporary deepwater practice. Nevertheless, while the vanished upperworks of these hulls were the height of extravagance, there is nothing frivolous or superfluous about the underwater structure that supported them. Should there not be a more rational, practical explanation for lead sheathing on the Kyrenia and Nemi vessels? What need do they share that lead might satisfy?

All three must have leaked quite badly. As vessels age, the timbers work against each other, compressing and wearing adjoining surfaces. Joints and seams become loose, and more and more caulking is required between the planks. For larger vessels, the problem is exacerbated by the greater difficulty in providing adequate initial stiffness in long, heavy structures made of elastic materials (such as wood). The trials of the replica Kyrenia II have shown that when new, the Kyrenia ship was quite watertight,⁷ but the soft, worn-out hull of the Kyrenia ship as excavated was probably well past the point where plank swelling and mortise and tenon joints could keep all the seams watertight. The Nemi barges, because of their sheer size and weight - they must be two of the largest mobile wooden structures built in the ancient world - must have been nearly impossible to provide with much stiffness. Large Roman seagoing ships, such as the Madrague de Giens wine carrier, used complex curvatures and deep sections to create a box-girder effect within the hull, increasing the overall strength and stiffness of the structure, but the relatively shallow, flat shapes of the Nemi barges add little to overall rigidity, which must then depend on the properties of the materials and the fineness of the joinery. The barges have extraordinarily large mortise and tenon joints in the planking, plus the heavy iron spikes mentioned above, but working and leaking must have been a problem even when new. Fortunately, a small inland lake does not usually produce the waves and extreme differential hull stresses that the open sea does.

Mortise and tenon joints are effective at keeping the seams closed in new construction, at least in smaller vessels such as the Kyrenia ship, but they also discourage the use of driven caulking between the planks when the hull starts to

leak. While there is written evidence of driven caulking in the later Roman period (see below), careful examination of several Hellenistic and earlier Roman hulls has failed to produce any evidence of caulking in the seams.⁸ Seam caulking, in the form of resin-impregnated fiber, has been found on a late (4th century CE) Roman vessel, Port-Vendres I, but it is not apparent from the published information whether the caulking was driven in after planking or laid between planks during construction.⁹ If caulking cannot be driven into the seams, it must be applied to the surface of the planking, either outside or inside. Many excavated hulls, both sheathed and unsheathed, display evidence of extensive coating with resinous products on the interior, either as bedding under the frames or as a complete coat. Whether this was done to keep seawater outside or to prevent the interior of the hull from absorbing rain and bilge water, which foster rot, it is difficult to say. Pitch coatings on the outside must be for caulking, as they are certainly not antifouling.

Lead is extremely effective for sealing joints and seams, as it is malleable enough to be beaten into and around lumpy, irregular contours with ease. It was widely and cheaply available in the ancient world and could be had in large sheets of uniform thickness.¹⁰ It has been a common material for roofing, flashing, and marine patching from classical times to the present. The earliest evidence of the use of sheet lead on a ship's hull is from the Porticello shipwreck, which dates to the 5th century BCE. The excavation produced several narrow strips of lead sheet with tack holes; these strips have been interpreted as seam patches.¹¹

Unlike medieval cathedral roofing, lead sheet in marine usage does not usually form the watertight barrier itself. It is normally laid over some sort of resin-impregnated fiber, such as woven cloth, felt, fur, or leaves. The lead limits ingress of water to the seams between sheets, but it is the resin that actually displaces water. The lead serves to hold the tarred fiber in place and protect it.¹² Lead may also have performed an anti-fouling function, as bare pitch collects all sorts of floating trash.¹³ Hardening agents may be added to the resin to reduce tackiness, but if they make the compound brittle, they greatly reduce the effectiveness of the caulking, which should give with the swelling and shrinking of the wood.

The Kyrenia ship was first sheathed when old and already infested. While this makes little sense if the lead was to protect against borers, it is a practical way to squeeze a few more stadia out of a tired, leaking hull without extensive, uneconomical repairs such as major replanking or structural reinforcement. One might think of it as patching expanded to cover the entire hull. Worm protection well above the load waterline also makes little sense, but caulking is needed quite

high in the ship to accommodate rolling, heeling, pitching, and heavy seas, all of which put substantial portions of the upperworks under water.

The concept of sheathing as expanded patching suggests that it was first applied to old, decaying ships, but there is ample evidence that it was eventually used as part of new construction. The Marsala ship, from the mid-3rd century BCE, seems to have been quite new when it sank, but was completely sheathed.¹⁴ If, as Honor Frost suggests, the ship was built in wartime haste,¹⁵ a thorough caulking job might be a more economical use of labor and time than precise fitting of seams. Large vessels, such as the Madrague de Giens ship, might also profit from lead sheathing as part of original construction. Sheathing could well be an economical alternative to the massive structures necessary to assure sufficient rigidity and limit working. Note that the immense ship built for Hiero of Syracuse in the 3rd century BCE. was equipped with lead sheathing when new.¹⁶ This is not to say that ships were built “soft” or sloppily and that caulking covered a multitude of sins, but that sheathing was a practical solution to problems encountered in the construction of large vessels. Alternatively, one could say that a larger ship is susceptible to leakage earlier in its working life than a smaller one and thus should be sheathed earlier; thus it follows that eventually, a large enough ship should be sheathed before launching. The double planking found on some large Roman merchantmen from the 2nd and 1st centuries BCE may also be a response to the same problem¹⁷.

It may seem that a dense substance, such as lead, placed around the perimeter of the hull could serve as a form of external ballast.¹⁸ In fact, the ballasting action of lead sheathing is minimal. First, the total weight of sheathing is relatively small. Richard Steffy has calculated a total sheathing weight of under 1200 kg for the Kyrenia ship, of which about 200kg is the weight of the copper tacks used to hold the lead sheets to the hull.¹⁹ This represents less than four percent of a total loaded displacement of thirty-two metric tons.²⁰ As the sheeting used varies little in thickness for a wide range of hull sizes, and larger vessels have less surface area per unit of volume (and thus less surface area per unit of displacement), the weight of sheathing as a percentage of total displacement actually decreases with increases in ship size. One could thus reasonably expect the sheathing of a vessel the size of the Madrague de Giens ship to represent considerably less than four percent of the total weight of the ship, despite the slightly greater thickness of the lead commonly found on larger vessels. Second, the even distribution of weight around the perimeter and above the waterline negates much of any ballasting effect. To be effective as ballast, dense material must be concentrated low in the hull, well below the center of gravity. An appreciable amount of lead sheathing lies beside

or above the center of gravity, cancelling out the ballasting effect of much of the sheathing below. In the end, only a small part of a relatively small total sheathing weight has any effect on the stability of the ship.

Although lead sheathing has a long history in the ancient world, it can only be said to have been really common in the Hellenistic/Republican period. The earliest excavated example is from the Kyrenia ship, at the end of the 4th century BCE²¹ Earlier hull remains are unsheathed²² or only patched.²³ Most of the excavated ships from the 4th and 3rd centuries BCE. in the Mediterranean and Black Seas exhibit evidence of sheathing,²⁴ but from the 2nd century BCE onward, sheathing is less common and disappears from the archaeological record by the end of the 1st century CE. The latest securely dated evidence is from the Nemi barges, of the mid-1st century CE²⁵ but there are deepwater vessels that may have been sheathed and may date to the same period.²⁶ The apparent abandonment may only be a fluke of preservation and excavation - the "canon" of well-documented, dated ancient wrecks is notably biased toward the centuries BCE, with virtually no securely dated hulls from the 1st century CE - but the general trend does seem to be away from lead sheathing.²⁷ If it was successful enough to warrant widespread use in Hellenistic and Republican times (and perhaps into the early Empire), we must ask what changes in shipbuilding or ship-owning conditions led to its abandonment.

The simplest explanations are the development of more effective caulking methods, or a significant rise in the cost of lead. The latter is the easiest to discount, as lead was a cheap and plentiful material throughout the Roman period. Short-term fluctuations in the price of lead are to be expected, but other products that contained large amounts of lead, such as plumbing and anchors, do not seem to have abandoned it in the same period.²⁸ The exploitation of new mines in Spain and Britain probably led to a long-term drop in price, if anything.²⁹ The development of alternative caulking methods is attested by some of the written sources. Pliny and Vegetius both mention the use of wax in pitch-based hull coatings, and these mixtures may have been less tacky and more durable than pitch alone.³⁰ Certainly there is archaeological evidence for pitch or pitch-based coatings on both the interior and exterior of unsheathed hulls. More importantly, Pliny directly mentions the use of beaten reeds for caulking *interiecta navium commissuris* ("inserted in the joints [seams?] of ships") in the 1st century CE³¹ Strabo, however, describes the caulking driven into the seams of the heavy ships of the Venetii in such a way that implies that such construction was contrary to Mediterranean practice.³² Driven or clamped seam caulking has been a characteristic of northern European craft since the Bronze Age, so it is at least

possible that the concept was imported into the Mediterranean after the Roman conquest of the northern rivers. The Port Vendres I vessel shows that driven caulking may have been in Mediterranean use by the 4th century CE³³. Still, lead remained the preferred material for a multitude of terrestrial and marine waterproofing jobs, such as patching leaks, capping exposed and grain and sealing repairs, throughout the Roman period and into our own times.³⁴ It is difficult to imagine that an unprotected surface coating could be superior in any quality other than cost. Once edge-to-edge mortise and tenon joints were abandoned, driven caulking could be employed more easily. This is a superior general caulking method, as it strengthens the hull, is less subject to damage through abrasion and less trouble to apply.³⁵

Lacking good evidence for a significant long-term rise in the cost of lead or the widespread adoption of driven caulking before the end of the Empire, we must suppose a change in the economic environment that would render lead sheathing an expensive luxury. In this regard, Lionel Casson has suggested that economic pressures in the form of growing labor costs (due to the decline of slave labor) during the early Middle Ages stimulated the abandonment of mortise and tenon joinery in hulls and the growth of “frame-first” shipbuilding.³⁶ I believe that the roots of this trend can be observed in the early Imperial period, and offer a serviceable explanation for the demise of lead sheathing.

Ancient shipbuilding reached a peak of sophistication (or complexity) in the 1st century BCE or CE. Large vessels pushed traditional mortise and tenon joinery to its limits. Double planking, complex backbone structures (such as the sternpost of the Madrague de Giens ship³⁷), recurved hull sections, large and closely-spaced tenons, and lead sheathing all reflect a classical approach to structure in which stresses were shared more or less equally among shell, frame, and shape. Later vessels relied increasingly on internal timbers for strength, with a corresponding decrease in shell strength and complexity along with greater variation in hull form.³⁸ Large vessels from the later Imperial period, such as the merchantmen from Caesarea Maritima³⁹ and the Bourse at Marseilles,⁴⁰ as well as the marble carrier at Torre Sgarrata,⁴¹ have a single, thick layer of planking reinforced by massive, closely-spaced frames and are characterized by a greater overall simplicity of shape and construction. The exaggerated hollow garboards of earlier ships were reduced until they eventually disappeared in straight deadrise or flat floors. The Nemi barges are considerably simpler in hull structure than the Madrague de Giens ship, yet no expense was spared in their construction and they are admirably suited to their purpose.

It is possible that the growing reliance on heavier internal structures and more frequent connections between keel and frames increased the stiffness of ancient hulls. Stiffer hulls work less and are thus less prone to leak. Driven caulking, if properly applied, contributes to hull stiffness, a property of which at least some Romans were aware. Tighter hulls have less need of extensive surface caulking, so it is conceivable that lead sheathing was abandoned because it was no longer necessary. If this is the case, one could expect to find its use increasingly restricted to larger ships, which are more difficult to build with adequate rigidity. The archaeological record (although the sample is too small to be statistically significant) seems to support this, as the known and possible 1st-century CE examples (Nemi and Caesarea) are enormous ships.

An economic explanation will also serve. I believe that economic pressure for reduced capital costs is largely responsible for the growing overall simplicity of mortise and tenon construction, just as it later prompted the abandonment of such joinery all together. The ships of the Empire were cheaper to build because they took somewhat less material but substantially less labor is not free. The labor of skilled slaves, such as shipwrights and tutors, is especially valuable and not spent needlessly. The single-planked, unsheathed ship also has maintenance advantages; planks in need of repair are detected and replaced more easily.

In return for savings on the initial investment and some operating expenses, the Roman owner was apparently willing to sacrifice the extra amount of working life the Kyrenia ship's owner was trying to obtain. On the other hand, any decrease in ship life was probably more than compensated for by the initial savings if an average cost per ton of cargo is figured. In an environment where marine life is hard on ships, an extremely long working life is unlikely in any case. Still, one would expect to find lead sheathing lasting the longest in the construction of large ships, which depended more than small vessels on external caulking for watertightness.

As for the cause of such a change in the economic climate, that is a topic too immense for this paper. Perhaps the reorganization of provincial administration under Augustus streamlined and stimulated long distance commerce, thus creating a greater demand for cheap tonnage, especially in bulk cargoes. The long distance transport of bulk goods is only profitable as a regular endeavor where supplies and markets are relatively steady and transport costs are minimal. Low transport costs (freight) depend on ships that are relatively cheap to build and cheap to operate. In such a climate, lead sheathing, which was never ubiquitous, became one of several costly options.

What this change represents is a distinct step in the evolution of the western economy. Where ships of the Classical Greek and Hellenistic eras had been built expensively, even lavishly, in terms of the labor involved, Roman ships were increasingly subject to a wider range of economic influences. Craftsmanship had a more tangible price. Comparing ships separated by a millennium, the Kyrenia vessel and the 7th-century ship from Yassiada,⁴² the difference in the level of craftsmanship is startling. The Byzantine ship is a crude but efficient packing crate next to the yacht-like Hellenistic ship. In this context it is tempting to see the growing simplicity of Roman construction as a decline in quality, but it should instead be seen as a rise in economic consciousness and sophistication.

Frederick Hocker

NOTES

1. This paper began as a discussion with Cemal Pulak, who simply will not let an idea pass by unchallenged. It later formed part of a paper submitted for a seminar on classical seafaring taught by George Bass at Texas A&M University. Since then, it has benefitted from comments by Richard Steffy and Michael Fitzgerald. I thank them all for their interest and assistance, but any fault for errors lies solely with the author.
1. Linder and Rosloff, Ma'agan Michael wreck
2. Lionel Casson, *Ships and Seamanship in the Ancient World* (Princeton, 1971) 209-10; Fernand Benoit, "Fouilles sous-marines: L' épave du Grand Congloué à Marseille", Supplement 14 to *Gallia* (Paris, 1961) 154; Jurgen Hausen, *Schiffbau in der Antike: Beitrag zur Geschichte des Schiffbaus. Konstruktion und Festigkeit der Schiffe in der Antike* (Herford, 1979) 183; D.J. Blackman "Further early evidence of hull sheathing," *IJNA* 1 (1972) 117, among others.
3. See Peter Goodwin, *The Construction and Fitting of the English Man of War 1650-1850* (London, 1987) 226-27 on the copper sheathing of English warships. The Royal Navy tried lead as an anti-worm barrier between 1670 and 1770, but eventually judged the material too soft for this purpose - John Fincham, *A History of Naval Architecture* (London, 1851) 94-95.
4. J. Richard Steffy, "The Kyrenia ship: An interim report on its hull construction," *AJA* 89 (1985) 99; Guido Ucelli, *Le Navi di Nemi*, 2nd edition (Rome, 1951) 153 and Fig. 70, p. 70; André Tchernia, Patrice Pomey, and Andrea Hesnard, "L' épave romaine de la Madrague de Giens (Var) (Campagnes 1972-1975)", Supplement 24 to *Gallia* (Paris, 1978) 85. The Marsala ship is an exception, as its sheathing appears to stop at the lower edge of the lower wale - Honor Frost et al., "Lilybaeum (Marsala) - The Punic ship: Final excavation report," Supplement to *Atti della Accademia Nazionale dei Lincei* 8th series, 30 (1976) 262.
5. Steffy (*supra* n. 4) 98.
6. Benoit (*supra* n. 2) 154; Hausen (*supra* n. 2) 183. Ucelli (*supra* n. 4) 153-54 notes that the sheathing was not needed for watertightness or protection from the worm, but suggests that it represents the extreme, even excessive, care lavished on these hulls.
7. After minimal time in the water, the timbers of the replica swell sufficiently to prevent the entry of water even under extreme conditions of hull stress (Richard Steffy, pers. comm.)

8. For example, Kyrenia: Steffy (*supra* n. 4) 98; Madrague de Giens: Tchernia, Pomey and Hesnard (*supra* n. 4) 86, n. 27; Nemi: Ucelli (*supra* n. 4) 152-53. Steffy notes ([*supra* n. 4] 98) that pitch may have been laid into the garboard seams before assembly of the garboards to the keel.
9. Bernard Liou, "L' épave romaine de l'Anse Gerbal à Port-Vendres," *Comptes rendus de l'Académie des Inscriptions et Belles-Lettres* (July-October, 1974) 422.
10. J.D.C. Boulakia, "Lead in the Roman world," *AJA* 76 (1972) 142-44.
11. Cynthia J. Eiseman and Brunhilde Ridgway, *The Porticello Shipwreck* (College Station Texas, 1987) 16.
12. Honor Frost (*supra* n. 4) 263 suggested that this was the purpose of the lead sheathing on the Nemi barges.
13. Indeed, bare pitch was originally used on *Kyrenia II* but was abandoned in favor of modern marine anti-fouling paints due to the amount of disgusting harbor refuse that became attached to the sticky goo (Richard Steffy, pers. comm.)
14. Frost (*supra* n. 4) 262-63.
15. Frost (*supra* n. 4) 278.
16. Athenaeus 5.207a. The relevant passages concerning this ship were translated with commentary by Lionel Casson (*supra* n. 2) 191-99.
17. For example, the wrecks at Madrague de Giens: Tchernia, Pomey, and Hesnard (*supra* n. 4) 85; Grand Congloué: Benoit (*supra* n. 2) 152; and wreck A at Dramont: Claude Santamaria, "Note préliminaire sur la construction de la coque de l' épave romaine Dramont 'A' (Cap Dramont - Commune de Saint Raphael)," *CahArchSubaq* 2 (1973) 133.
18. This aspect of lead sheathing was not originally addressed in this paper, but was brought up by Avner Raban after the paper was delivered. As Prof. Raban's point was well taken, I hope he will forgive me if I take the liberty of responding to his question here in the text.
19. J. Richard Steffy, pers. comm.
20. The replica *Kyrenia II* was weighed, with spars but without sheathing, when launched at 8.7 tons. The amphora cargo (if full of wine) plus the millstones weighed in the vicinity of 22 tons; J.R. Steffy, pers. comm.
21. Steffy (*supra* n. 4) 98. A wreck off the Crimean coast of the Black Sea has produced several moderately-sized sheets of lead and may date to the late 4th century BCE - V.D. Blavatsky and B.C. Peters, "Korablekrusheniye kontsa IV - nachala III vv. do n.e. okolo Donuzlava", *Sovietskaya Arkheologiya* 1969 (3) 151-58, published in English as "A wreck of the late 4th or early 3rd century BC near Donuzlav," D.J. Blackman, trans., *IJNA* 2 (1973).
22. The Porticello wreck, dated to the 5th century BCE is only patched: Eiseman and Ridgway (*supra* n. 11) 16. The Ma'agan Michael wreck, described elsewhere in this volume by Elisha Linder and Jay P. Rosloff (see), dates to the late 5th century BC and has no evidence of lead sheathing or patching, but it appears to have been a very new ship at the time of its loss.
23. Of Hellenistic wrecks, only the Secca de Capistello ship lacks evidence of sheathing: Don Frey, Faith D. Hentschel, and Donald H. Keith, "Deepwater archaeology. The Capistello wreck excavation, Lipari, Aeolian Islands," *IJNA* 7 (1978) 295. In addition to the more accessible published material, Cemal Pulak reports that two Hellenistic wrecks surveyed by the Institute of Nautical Archaeology off the Turkish coast, one off the southwest coast and one in the Sea of Marmara, present convincing evidence of lead sheathing; Cemal M. Pulak, "Turkish coastal survey yields wrecksite inventory," *INA Newsletter* 12.2 (1985) 2-3. See also Cemal Pulak and Rhys Townsend, "The Hellenistic shipwreck at Serce Limani, Turkey: Preliminary Report," *AJA* 91 (1987) 35.

24. Ucelli (*supra* n. 4) 153.
25. Chief among these is probably the large, single-planked vessel off Caesarea Maritime. While no sheathing or tacks have been found on the hull remains themselves, large, crumpled sheets of lead were found in the vicinity and much of the bottom of the hull remains unexamined. Michael A. Fitzgerald, "The Ship," in John Peter Oleson (ed.), *The Harbours of Caesarea Maritima: Results of the Caesarea Ancient Harbours Excavation Project, 1980-1985 II: The Small Finds and the Ship*, BAR International Series (Oxford, forthcoming). I thank Mr. Fitzgerald for sharing this information with me.
26. This trend has been noted by Casson (*supra* n. 2) 214-17, App. I, and forms part of a series of general trends in Roman shipbuilding observed by Patrice Pomey, "L'architecture navale romaine et les fouilles sous-romaine 5. Recherches d'archéologie celtique et gallo-romaine (Paris, 1973) 41.
27. Lead-stocked anchors are extensively covered in the literature; see, for example, Piero Gianfrotta's paper in this volume.
28. Boulakia (*supra* n. 10) 139-41, 143.
29. Pliny, *NH* 16.56; Vegetius, 4.44.
30. Pliny, *NH* 16.158. Casson (*supra* n. 2) 209-10, note 39, translates *commissuris* as "seams," and I see no reason to disagree.
31. Strabo, 4.195, as noted by Casson (*supra* n. 2) 209, n. 38.
32. Liou (*supra* n. 9) 422.
33. The Kyrenia ship was patched with lead on the interior Steffy (*supra* n. 4) 97; The keel-to-post scarf of Port-Vendres I was sealed with a lead sleeve - Liou (*supra* n. 9) 417 and 421, Fig. 6.
34. Pliny was aware of these advantages; *NH* 16.158. By the 11th century CE, driven caulking was certainly in use. Crushed fiber, possibly a tarred grass, was observed (and samples removed) in the plank seams of the 11th-century vessel from Serce Limani (Frederick van Doorninck, Jr., pers. comm.), and this vessel also carried a complete set of caulking irons and reefing tools, the earliest such set known (I am currently preparing the tools from this wreck for publication).
35. Lionel Casson, pers. comm.
36. Patrice Pomey, "Le navire romaine de la Madrague de Giens," *CRAI* (1982) 137, Fig. 3.
37. Pomey (*supra* n. 36) 37-51.
38. Fitzgerald (*supra* n. 25).
39. Jean-Marie Gassend, "Decouverte d'une épave antique," *Archaeologia* 79 (February, 1975) 72 and Jean-Marie Gassend and Jean-Pierre Cuomo, "Un acquis récent des recherches d'architecture navale: La 'construction alternée' des navires antiques," in *VI Congresso Internazionale de Arquelogia Submarina, Cartagena, 1982* (Ministerio de Cutrura, 1985) 343-50.
40. Peter Throckmorton, "The Torre Sgaratta Ship," in Harry Tzalas (ed.), *Tropis I: Proceedings of the 1st International Symposium on Ship Construction in Antiquity* (Athens, 1989) 264-65.
41. Frederick H. van Doorninck, Jr., "The hull remains," in George F. Bass and Frederick H. van Doorninck, Jr. (eds.), *Yassi Ada: A Seventh-Century Byzantine Shipwreck* (College Station, Texas, 1982) 32-64.

SOME THOUGHTS ON THE GREEK PENTEKONTER

Before the era of the *trieres* the Greek warship par excellence was the *πεντηκόντερος ναῦς*, so named for being propelled by fifty oars.¹ It is first mentioned in the *Iliad*, and often in later literature. Thucydides (I, 14) states that prior to the Persian War the Athenian navy also consisted of *pentekonters*. So we may recognise this type in the many low-sided warships painted on late Attic black-figure vases (cf. note 1). As far as may be judged by their silhouettes, they seem to have been sleek ships for war and piracy, fast under oars but also carrying a light mast for sailing. The bows bear rams, often similar to boars' heads in shape. There is evidence of single-level (*monokrotoi*) as well as of two-level ships. I shall leave aside the discussion about the latter ones being *ἡμιολίαι* or not²; at any rate, two-level ships, *δίκροτοι* in Greek, existed. Some Greek states had large pentekonter fleets in the 6th century, e.g. Samos who at the time of Polykrates or a hypothetical predecessor owned no less than 100 ships of this type.³

At the same time, about the middle of the 6th century, the Phokaians used pentekonters for their trade in the western Mediterranean⁴ and, earlier, Battos took to sea in two *pentekonters* to found the colony of Kyrene⁵. Such voyages would call for vessels much more seaworthy than the light inshore craft on the Attic vases seem to be. It looks as if there were two different types of ships both indiscriminately called *pentekonters*. The second should have been big enough to carry a certain amount of cargo, as is implied by the use the Phokaian traders made of their *pentekonters*.

Surprisingly enough, though, we learn that these same Phokaians, when colonising Massilia about 600 BC, fought the Carthaginians in a real sea battle.⁶

Apparently their high-seas *pentekonters* were also efficient fighting vessels. The same may be inferred from Herodotus' (I, 164) mention that the Phokaians in 546 BC evacuated their city, then under Persian siege, and sailed away to Alalia in Sardinia with most of their population, their movable possessions, and even the statues of their gods. A few years later their piracy became so menacing to the Carthaginian and Etruscan shipping in the Tyrrhenian Sea that both powers joined forces against them to fight the famous sea battle somewhere near Alalia, about 535 BC⁷ There the Phokaians kept *ramming* their enemies until the rams of all their own surviving ships had been "twisted off".⁸ I consider it likely that these were the same ships with which Phokaia had been evacuated. The high-seas *pentekonter* apparently was proficient in combat, too.

At about this time Polykrates of Samos had at his disposition a fleet of *σάμαιναι*, vessels beamy enough for use as merchantmen but also capable of doubling as men-of-war.⁹ They are said to have had rams in the shape of boars' heads - but this feature was so widespread in the 6th century that it hardly can have been diagnostic for the *σάμαινα*; see, e.g., Fig. 3,1.4 and even the Lycian ship in Fig. 3,5¹⁰ - In my opinion, these *σάμαιναι* were identical with the Samian *pentekonters* mentioned before.

In the early 5th century the *trieres* became the standard warship of all major naval powers. Poorer states retained the *pentekonter*, however - apparently mostly in that type's inshore version. But also the bigger and stronger high-seas version seems to have survived, as a mention by Thucydides indicates. When in 413 BC the Etruscans dispatched an expeditionary force of hoplites to Syracuse in support of the Athenians' assault on the city, the hoplites were taken there by only three *pentekonters*¹¹. Since at a critical moment of the fighting at Syracuse the Etruscan corps proved able to save the Athenian ships from a determined attack, the Etruscan force should have consisted of more than 150 *hoplites* - the number arising if all these *hoplites* had sailed to Syracuse in the function of rowers on single-purpose warship *pentekonters*. It seems these Etruscan ships had complements far in excess of 50.

All these literary hints combine to indicate that there were two rather different types of ships that were both called *pentekonters* by landlubber writers: a light inshore man-of-war on the one hand, and a stronger high-seas type equally suited for long-distance trade and for combat, on the other.

In the following I shall present a selection of archaeological evidence for the high-seas *pentekonter*. It should be characterised by higher sides, and a

deeper draught, than may be deduced from the Attic black-figure vase paintings (cf. note 1).

These features are best shown in an Attic early red-figure vase painting of c. 490 BC of Odysseus sailing by the Sirens (Fig. 1, 1); for this reason the artist is called the Siren Painter¹². Since most of Odysseus' voyages were located in the Far West, we may suppose the painter gave his ship some conspicuous features of the type of rowing ship then used for long-distance voyages, viz. the high-seas *pentekonter*. - The ship's side is rather high, with a pronounced sheer. The vessel is under oars, arranged in a single row however, passing through round ports somewhat below the gunnel. Above the gunnel the oarsman's bodies are visible; so the hull was not decked. Fore of the mast, *behind* two rowers, there is a structure looking like a tent-like awning rather than a raised foredeck. Whatever it is, it cannot have spanned the whole width of the hull. There is also a mast, as high and strong as those of sailing *holkades*. These features all indicate that the ship was meant for rough sailing, presumably as the primary means of propulsion during long-distance voyages.

One might think the artist had Odysseus travel in a merchant galley, as shown in an Attic bf. vase painting¹³. But this hull differs markedly from that in Fig. 1, 1. Odysseus' ship has a high vertical stempost with a metal ram in boar's head's shape jutting out at waterline level, whereas the galley prow's outline looks more martial, but unequivocally has no ram. So the painter conceived of Odysseus' ship as being able to fight by ramming whereas the merchant galley is only mimicking fighting potential. - The high stempost and marked sheer of the hero's ship, differing from contemporary single-purpose warships, should be meant to improve its seaworthiness. This was a matter of minor relevance for pure warships since fighting was avoided in foul weather until the closing years of the Peloponnesian War.¹⁴

Giving Odysseus' ship 25 oarports three feet apart, leads to the reconstruction in Fig. 1, 2. Its high sides and ends imply seaworthiness. The gunnel may have had some sheer all over, but since the oarports had to be at uniform height above the water I preferred to reconstruct the gunnel as being horizontal too. The plan is mere conjecture. Anyway a ship with so heavy a mast should have been rather wide on the one hand whereas, on the other, her lines should have been fair in order to allow high speed in combat.

Another black-figure painting of the sirens' adventure shows a two-level rowing ship (Fig. 2, 1)¹⁵. Its horizontal gunnel, and its bow, are like those of Attic

inshore *pentekonters* (cf. note 1). But the sides seem to be higher, and in the foreship there is again a raised structure *behind* an oarsman that in this case looks like a narrow raised deck.

A source of a different kind is a stone foundation for a real ship, formed by nine parallel walls, at Hera's sanctuary at Samos (Fig. 2.2), apparently dedicated after some unknown naval feat¹⁶. It is dated to c. 600 BC. Since Herodotus (IV 152) states that at about this time the Samian shipowner Kolaïos by chance found his way to the kingdom of Tartessos in southwestern Spain, and returned with incredible riches, the excavator, E. Buschor, tentatively suggested that the foundation might once have carried Kolaïos' ship. Herodotus does not mention such a dedication, but at any rate the base exists, and may be expected to give some idea of the measurements of the ship for which it was built.

What kind of vessel may this have been? A round-bellied *holkás* may be dismissed right away: the base is too long and too narrow. At first glance it seems to have supported a very sleek, streamlined vessel. This impression is misleading, however, since it would imply a shape of hull with a perfectly flat bottom resting right on top of the foundation. Such a shape is not known from the ancient Mediterranean. Instead, all of the many sailing freighters investigated up to now, as well as the Punic warship from Marsala¹⁷, display cross sections with the keels jutting out prominently from the actual bottom. This is V-shaped on the Marsala ship, and on many freighters. In fact, John Coates chose a similar section when designing the *trieres* replica¹⁸. In my opinion, the hull once placed on the Samian foundation will also have had a cross section with the keel jutting out from its bottom.

This implies that only the keel rested on the walls. To keep the hull in balance, further supports were necessary. In my opinion, we should consider something like stanchions that rested on the surface of the walls - that would have been the easiest functional solution.

If we conceive of the hull having had a bottom V-shaped in cross section, the stanchions by necessity would have had to be placed at an angle, pointing inward in order to meet the ship's bottom at an angle, not too far from 90°. In view of the relatively short length of the walls, the hull would have been rather too slender even for an inshore craft. Moreover, obliquely placed stanchions would have exerted a lateral thrust bound to push the walls' ends outwards. Such distortions, however, are neither mentioned in the excavation report nor are they to be seen in the photographs.¹⁹

Such damage should even be expected if another layer of stone blocks, now missing, had once formed the surface of the walls. In my opinion, this situation calls for a hull with a bottom more or less flat in part, but incorporating a keel jutting out sharply, as is suggested in Fig. 2.2 as section B. In this case, the Samos ship's midship could have rested on short vertical stanchions which would not have needed any insertions and would not have pushed the ends of the walls out of place.

What about the longitudinal section of the foundation and the hull in question? Fig. 2,2 shows the outline of the red-figure Siren Painter's ship, dealt with before, together with the black-figure *díkrotos*, drawn to the same scale and marked grey. It becomes apparent that the *monókrotos* ship considerably surpasses in length the maximal extension, c. 23,2 m. of the foundation. This difficulty is overcome by the, as yet unpublished, suggestion by H.T. Wallinga that a *díkrotos pentekonter* might have stood on the foundation (cf. note 16). To test it I chose a scale drawing of the black-figure *díkrotos* in Fig. 2, 1. It indeed fits on the foundation well enough in both sections (Fig. 2,2). Its wide beam was a surprise to me when reconstructing its cross section, but it is indispensable for placing two rowers abreast at each side of the hull. Such a short and wide hull should be better fitted for high-seas sailing, and more maneuverable in combat, than the much longer *monókrotos*. - The necessity to place two rowers abreast has been my reason for suggesting that the ship's sides turned outwards at the lower oarports' level, to serve as a kind of outrigger for the oars on the upper level. The same feature is indicated in a large terracotta model of a warship that was found in the sea off the Spartan port of Gytheion (Fig. 3,2)²¹. The Gytheion model is thought to be Roman, but - as far as my knowledge goes - it differs crucially from Roman ships known. This not only holds true for the lateral rowers' compartments just mentioned, or for the narrow central "fighting-deck" bulwark so similar to Phoenician warships of the late 7th century BC²², but even more for the curious square fields at the sides of the stern that, in my opinion, indicate some kind of cloth hanging down from the gunnel; I propose calling them "stern blankets". They recur in a number of Archaic and Classic pictures of ships (Fig. 3)²³. The ram also looks definitely un-Roman. All of this makes me think the Gytheion model is Archaic. If so, its sides turning out like outriggers would precede the real outriggers of the first trieres, indicating the path of development that lead to this trieres' feature.

To come back to the Samos foundation, I think the arguments named above entitle us to believe it was built for a relatively short, and squat, *díkrotos pentekonter* that in its fore and aft sections would have provided some space for stowing cargo,

and thus fits the specifications implied by Herodotos' mention of the Phokaian dual-purpose high-seas pentekonteres.

I would like to put another find into the same context, viz. a fragment of a terracotta model found in a mixed context of the late 6th century at the acropolis of Lipari (Fig. 4)²⁴. At first glance the model's clearly indicated *proembólion* reminded me of Classic triereis. But there is a sheer that is absent from all warship representations prior to the grave stele of the marine Demetrios, now at Munich, from the early 3rd century²⁵. I had thought at first it should be dated to this time. But archaeological evidence, not only stratigraphical but also in its technical execution and polychrome painting, leaves no doubt about its date at the end of the 6th century BC.

The model's bow is considerably less sharp than of the Punic "Sister Ship" sunk near Marsala in 241 BC²⁶. On the other hand, it comes rather close to what has been suggested above, on purely technical grounds, for both the Siren Painter's ship and the one that once stood on the Samos foundation (Fig. 2,2). Both are likely to be referred not to sleek single-purpose inshore warships but rather to a more seaworthy dual-purpose type of ship. I thus dare propose the suggestion that the Lipari model fragment should be taken as evidence of the high-seas pentekonter's features just prior to the moment when this type was eclipsed by the emergence of the triere.

To come to a conclusion, I hope to have been able to present arguments for the idea that there were two constructionally different types of ships, both indiscriminately called *pentekonteres* by the ancient writers. They were no naval architects and so will have been content with rather vaguely describing the types of ships they talked about - not too different from present writers still speaking of "steamers".

In my opinion, there is reason to think that the high-seas dual-purpose version of the pentekonter might by naval people of Antiquity have been called *kérkouros*²⁷. The name goes back to Semitic "*kirkarrah*", meaning a kind of dual-purpose vessel fitted for trade and combat.²⁸ Such Phoenician vessels would have been perfectly appropriate predecessors for the Greek type whose characteristics I tried to demonstrate.

ADDENDUM

When I prepared this paper, basing myself on archaeological sources only, I did not yet know John Coates' paper "*Pentekontors and Triereis Compared*", at a later date most graciously sent me by the author and now published in *TROPIS II* (pp. 111-116). The technical, tactical, and economic advantages of the two-level *pentekonter* over the single-banked one are neatly defined here. I am not quite sure, though, if Coates does not underestimate the dual nature of this type indicated by the ancient writers. The same applies to Sleeswyk's reconstruction of the two-banked ship (n. 1).

If lateral "troughs" are reckoned with for accommodating the lower-level oarsmen (in its turn leaving room for stowing the payload), beam data may differ from those of a hull with straight sides. There even might be intricate variations in the beam depending on whether the ship is on an even keel (only the central hull being immersed) or is listing to one side. In the latter case the added resistance of the one "trough" now immersed would seem likely to bring the ship off course. Such bad habits are unfavourable for any kind of ship. Nevertheless, in my opinion, our Figs 2,1 and 3,2 leave little doubt that lateral "troughs" actually existed.

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ABBREVIATIONS

AS	O. Höckmann, <i>Antike Seefahrt</i> (München 1985, Italian edition: "La navigazione nel mondo antico": Milano 1988).
GOS	J.S. Morrison - R.T. Williams, <i>Greek Oared Ships 900-322 BC</i> (Cambridge 1968).
Hdt.	Herodotus
MIMA	L. Basch, <i>Le musée imaginaire de la marine antique</i> (Athènes 1987).
SSAW	L. Casson, <i>Ships and Seamanship in the Ancient World</i> (Princeton 1971; paperback reprint with Addenda and Corrigenda: Princeton 1986.)
Thuc.	Thucydides

NOTES

- 1 Ancient writers (e.g.): Homer, *I1.*, 2, 718 f.; 8, 34 ff.+48; 16, 169 f. - *Hdt.* 3, 59. - *Thuc.* 1, 14. Recent discussions (e.g.); P. Gille, Les navires à rames de l'antiquité. *Journal des Savants* 1965, (36-72) 54 ff. - *GOS* 46 f.; 109 ff.; 131; 133; 155; 194 f.; 200 f. (complement c. 80). - *SSAW* 58 f.; 61 ff. - J. Alvar, Los medios de navegación de los colonizadores griegos. *Archivo español de arqueología* 52, 1979, (67-83) 71. - J. Morrison, *Long Ships and Round Ships* (London 1980) 14 ff. A.W. Steeswyk, A New reconstruction of the Attic trieres and bireme. *IJNA* 11, 1982, 35 ff. - *MIMA* 197 f.; 216; 222.
Vase paintings (e.g.): *GOS* pl. 13-19; 20. a-d. - *SSAW* Fig. 81-85; 88-90. - *AS* 98 Fig. 70-71. - *MIMA* 205 ff. Fig. 425 - 472.
- 2 *GOS* 109; 245 f. - *SSAW* 61 f.; 128 ff. - W. Nowag, *Raub und Beute in der archaischen Zeit der Griechen* (Frankfurt 1983) 125 f. (noteworthy ideas about *hemioliai* being normal *dikrotoi* but for a short phase during piratical attack on merchant vessels). - *AS* 100.
- 3 *Hdt.* 3, 39. Cf. *GOS* 129; 131. - R. Tolle-Kastenbein, *Herodot und Samos* (Bochum 1976) 20; 22. - Nowag (n. 2) 120.
- 4 *Hdt.* 1, 163.
- 5 *Hdt.* 4, 150 ff.
- 6 *Thuc.* 1, 13. Cf. *GOS* 139.
- 7 *Hdt.* 1, 166, 1 f. Cf. *GOS* 131.
- 8 *Hdt.* 1, 166, 2. Cf. *GOS* 131; 133. - L. Basch, Another Punic wreck in Sicily: its ram. 1. A typological sketch. *Internat. Journal of Nautical Archaeology* (henceforth *IJNA*) 4, 1975, (201-228)
- 9 *Hdt.* 3, 59. - Plutarch, *Per* 26, 3. - *Suda* s.v. Σαμίων ὁ δῆμος. Cf. *GOS* 130. - *SSAW* 63 f. - G. Dunst, Archaische Inschriften und Dokumente der Pentekontaetie aus Samos. *Athenische Mitteilungen* 87, 1972, (99-163) 159 ff. - B. Freyer-Schauenburg, *Samos XI* (Bonn 1974) 187. - Nowag (n. 2) 120.
- 10 A.S. Toby, A Warship from Elmali, Turkey. *IJNA* 8, 1979, 7-12. - *AS* 101 fig. 74.
- 11 *Thuc.* 6, 103.
- 12 *GOS* 114 Arch. 94; pl. 21 e. - F. Brommer, *Odysseus* (Darmstadt 1983) pl. 35. - *MIMA* 270 fig. 574.
- 13 *SSAW* fig. 91. - *AS* 58 fig. 45. *MIMA* 28 fig. 474.
- 14 Xenophon, *Hellenika* 1, 6, 19.
- 15 Brommer (n. 12) pl. 33 b; 34. - *AS* 99 fig. 72.
- 16 E. Buschor, *Archäologischer Anzeiger* 1935, 328. - id., *Arch. Anz.* 1937, 204 (+ photograph); 211 f. fig. 7. - D. Ohly, Holz aus dem Heraion . Athen. Mitt. (cf. n. 9) 68, 1953, 111 (length erroneously "60 m"). - E. Buschor u. O. Ziegenaus, *Heraion* 1959. *Athen. Mitt.* 74, 1959, Beilage 1. - E. Homann-Wedeking, *Samos* 1964. *Arch. Anz.* 1965, 432+428 fig. 2. - H. Walter, *Das Heraion von Samos* (München 1976) 50+47 fig. 47. - H. Kyrieleis, Führer durch das Heraion von Samos (Athens 1981) 88 ff.+89 fig. 65. The connexion with Kolaïos (*Hdt.* 4, 152) has first been suggested by Buschor 1935 (above). It was explicitly put forward in a lecture, held at Mainz in 1979, by Prof. B.B. Shefton (Newcastle upon Tyne), and has since been published (in: H.G. Niemeyer/ed./, *Phönizier im Westen. Madrider Beiträge* 8/Mainz 1082/337 ff. particularly 344). The plan, hitherto unpublished, has kindly been supplied by Dir. Dr. H.J. Kienast (German Arch. Institute, Athens). I express my appreciation of his gracious permission to cite his idea of a dikrotos pentekonter once having stood on the foundation.

- 17 H. Frost et al., *Lilybaeum. Notizie dei scavi 8th ser.*, 30, 1976 (Roma 1981). Supplem., 248 fig. 156.
- 18 J.S. Morrison - J.F. Coates, *The Athenian Trireme* (Cambridge 1986) 203 fig. 59.
- 19 cf. n. 16 above.
- 20 L. Basch, Un modèle de navire romain au Musée de Sparte. *Antiquité classique* 37, 1968, 136-171. - Basch 1975 (n. 8) 213 fig. 222. - A Göttlicher, *Materialien für ein Corpus der Schiffsmodelle im Altertum* (Mainz 1978) 89 No. 478. - I had no access to the book by W. von Mondfeld, *Das große Piratenbuch* (München 1976; p. 32), cited by Göttlicher; according to him, the author calls the Gytheion model "Greek". - P. dell' Amico, La nave de Gyteion. *Archeologia viva* 4 no. 11, 1985, 40-43. - AS 97 fig. 67. - *MIMA* 427; 432 ff. fig. 936 ff.
- 21 Galerie Nefer. Katalog 6 (Zürich 1988) no. 6 (correctly dated to 6th cent. BC).
- 22 GOS 162; pl. 22 a. - SSAW fig. 76. - Basch 1975 (n. 8) 212 fig. 19. - AS 97 fig. 66. - *MIMA* 180 fig. 379; 311 ff. fig. 655 ff.
- 23 "Stern blankets", Archaic Greece: 1) Protocorinthian aryballos, Boston: GOS Arch. 39; pl. 12 b. - 12 b. - Brommer (n. 12) 84 fig. 40. - *MIMA* 238 fig. 497. 2) Gytheion model: see n.20 above. 3) "Zürich" model: see n. 21 above. 4) Fresco from Kizilbel near Elmali, Lycia: Toby (n. 10) 10 fig. 4. - AS 101 fig. 74. 5) Attic bf. amphora from Tarquinia, Italy: *Corpus Vasorum Antiquorum Tarquinia* 1 (a cura di G. Jacopi; Firenze 1955) pl. 5,3= Italia 1137. 6) Attic bf. vase paintings of Dionysus in wheeled boat: A. Frickenhaus, Der Schiffskarren des Dionysos in Athens. *Jahrbuch des Deutschen Archäologischen Instituts* 27, 1912, 61-79 + Beil. 1 ff. - P.F. Johnston, Ship and Boat Models in Ancient Greece (Annapolis 1985) 141 ff. Rep. 2-5. - *MIMA* 228 fig. 475, 1-3. 7) Attic rf. amphora by Siren Painter: see n. 12 above. Some of these finds are mentioned by Basch as formal parallels to the Gytheion find in spite of the latter being dated to the 1st cent. BC. - "Stern blankets" on Classic coins, *Phoenicia* (e.g.): *MIMA* 321 fig. 675.676.678 (Sidon, since end of 5th cent. BC); 322 fig. 680 (Sidon, 380-374 BC). Representations of "stern blankets" from the Hellenistic or later periods are not known to me. - The closest parallel for the long and narrow shape of the Gytheion ram, cut off vertically at its tip, that I know is on a boat-shaped necklace pendant from Saite Egypt, now in the Louvre: *MIMA* 335 fig. 719-720. A model at Oxford, "from Cyprus, probably Hellenistic", might also be taken into closer consideration: *MIMA* 340 fig. 724. Evidence from the Roman period is scanty and differs from the Gytheion ram insofar as the rams are bent upwards in a continuous curve (*MIMA* 452 fig. 996; 456 fig. 1011 = 458 fig. 1016. - AS 117 fig. 102), so coming close to the "Liburnian ram" identified by Basch (n. 8). On the ram of a river warship from Cologne (Author, *Jahrbuch Röm.-German. Zentralmuseum* 33, 1986, pl. 51,3) the upper edge forms a similar curve while the lower is horizontal. The resulting high vertical "working edge" seems to be adapted to the task of fighting small boats as the Germans on the Rhine then used.
- 24 Johnston (n. 23) 78 f. Clas. 1; 79 fig. ("from bothros"). I express my gratitude to dott. ssa M. Cavalier (Lipari) for supplying the scale drawing and archaeological data, and for her gracious permission to publish them here.
- 25 AS 107 fig. 80. - *MIMA* 300 fig. 638. - B. Vierneisel-Schiörb, Glyptothek München. Katalog der Skulpturen III. Grabdenkmäler und Votivreliefs (München 1988) 59 ff. no. 11; pl. 24. A similar upward curve of the foremost section of the gunnel towards the akrostolion is to be found on a great many Hellenistic, Punic, and Republican Roman representations (e.g.): *MIMA* 275 fig. 583-584; 355 fig. 743-745; 367 fig. 794-796.798 (=AS 112 fig. 92); 388 fig. 810; 391. 816.817; 396 fig. 823 (= AS 111 fig. 85).
- 26 H. Frost, Another Punic wreck in Sicily: its ram. 2. The ram from Marsala. *IJNA* 4, 1975 (219-228) 224 fig. 35. - id. (n. 17) 267 ff. fig. 168. The discovery of the Athlit ram (e.g. J.R. Steffy, The

- Athlit ram. *Mariner's Mirror* 69, 1983, 229-246) has, however, shown that the "Liburnian ram" of the Sister Ship was not the only type known in antiquity.
- 27 Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft* 3 (Stuttgart 1899) col. 1969 s.v. *Cercurus* (Assmann). Admittedly a definition as a rather small oared vessel is predominant, but there should also be noted those by Pliny, *nat. hist.* 7,57 ("merchantman from Cyprus"), and *Nonnos* 533 ("oversize Asian ship").
- 28 Pauly-Wissowa (n. 27 above). - A. Salonen, *Die Wasserfahrzeuge in Babylonien* (Helsinki 1951) 51. - R.D. Barnett, Early shipping in the Near East. *Antiquity* 32, 1958, 229.

ILLUSTRATIONS

- Fig. 1.1 Attic early red-figure vase painting by Siren Painter (early 5th c. BC): high-seats rowing ship with strong sailing mast and metal ram. Ropes are dark red in original, grey sections are light brownish (redrawn after GOS).
- Fig. 1.2 Hull of same, reconstructed as *monókrotos* pentekonter. Cf. note 12.
- Fig. 2.1 Attic late black-figure vase painting (late 6th cent. BC.): high-seas rowing ship with oars at two levels (after AS).
- Fig. 2.2 Hull of the same, reconstructed as *díkrotos* pentekonter (light grey), placed on stone ship foundation at Samian Heraion (dark grey) together with *monókrotos* of fig. 1 (outline only). In the cross sections the left half refers to the latter, the right one (light grey) to the former (foundation walls are dark grey). Drawing of foundation walls provided by Deutsches Arch. Institut, Athens. Cf. note 15.
- Fig. 3 Archaic representations of ships with "stern blankets" (cf. note 23).
- Fig. 3.1 Aryballos at Boston.
- Fig. 3.2 Terracotta model from Gytheion.
- Fig. 3.3 Terracotta model formerly at Zürich.
- Fig. 3.4 Vase painting of Dionysus' ship cart.
- Fig. 3.5 Fresco from Kizilbel near Elmali, Lycia.
- Fig. 3.6 Vase painting from Tarquinia (redrawn after sources named in note 23; not to scale). See also fig. 1.1.
- Fig. 4 Bow fragment of Archaic terracotta model (late 6th c. BC) from acropolis of Lipari, Italy. Upper wales are rising towards stern, forming kind of a *proembólion*. Grey sections are painted red in original. Drawing provided by Museo archeologico di Lipari. Cf. note 24.

SOME THOUGHTS ON THE GREEK PENTEKONTER

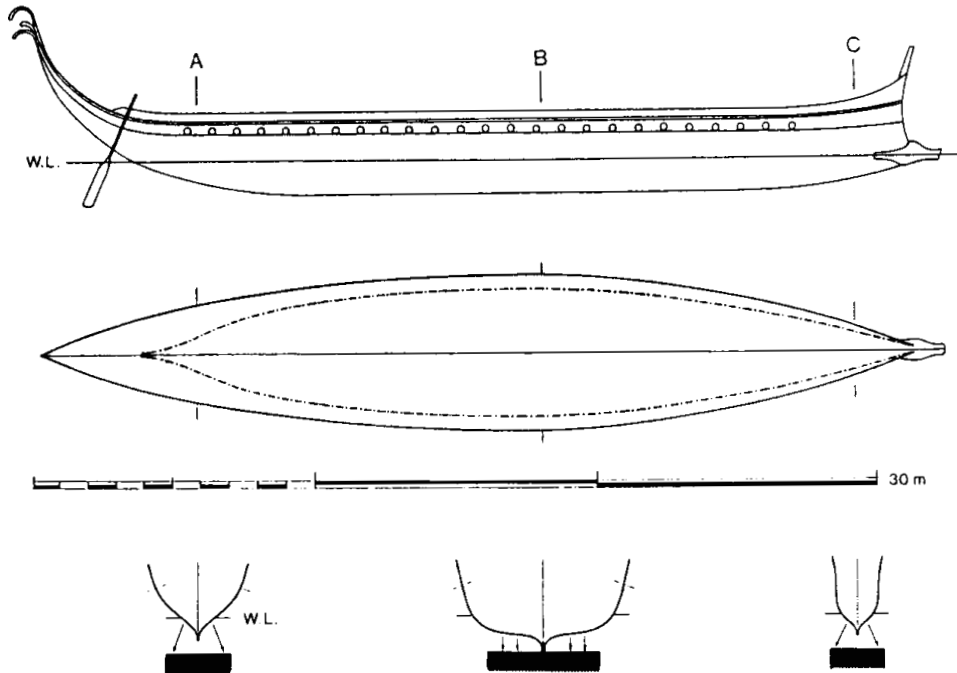
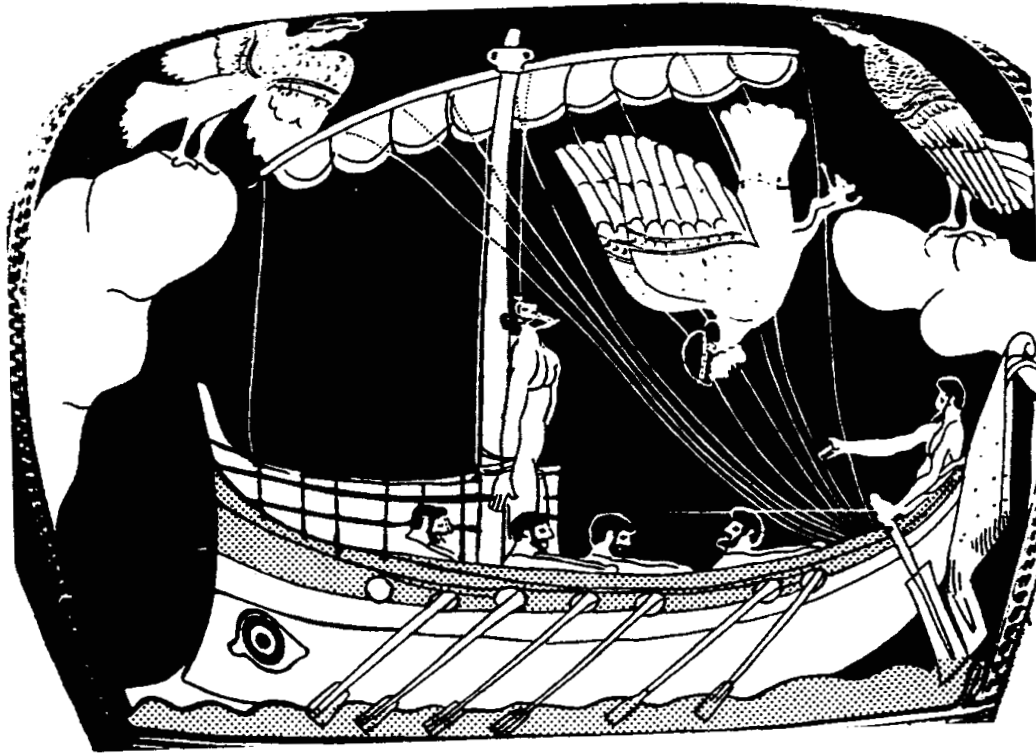
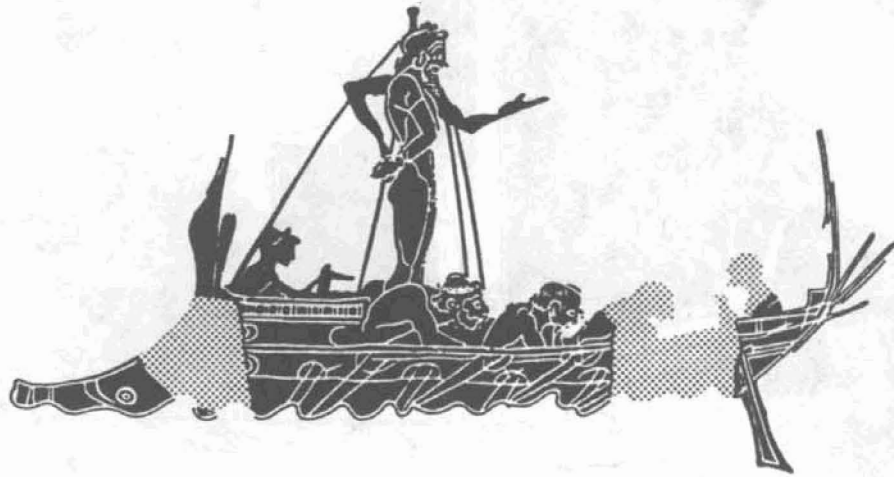
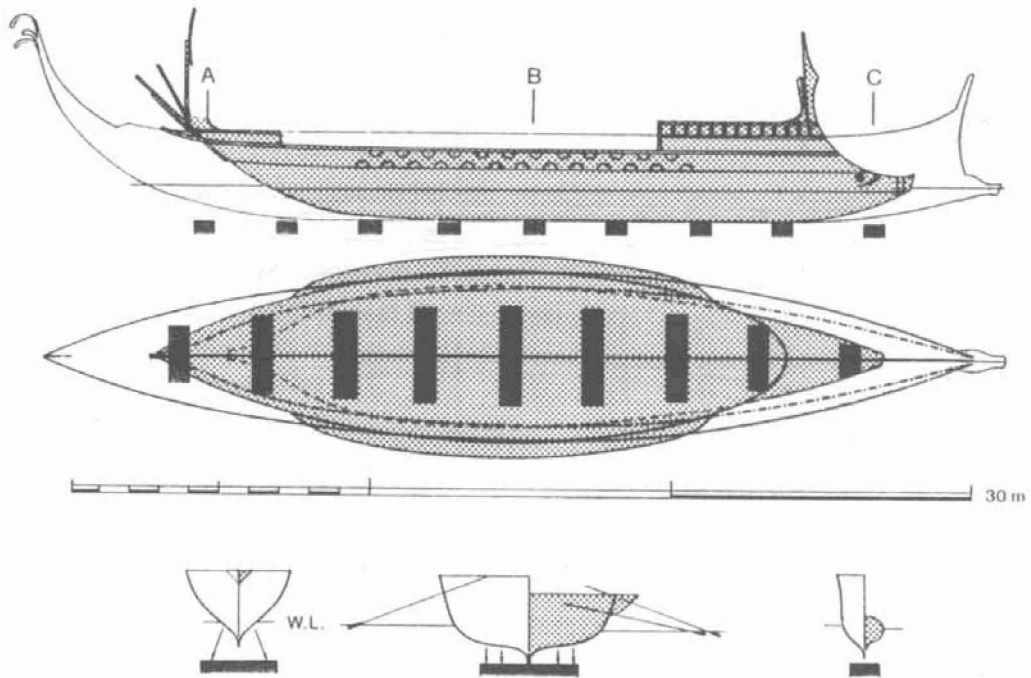


Fig. 1



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g. 2

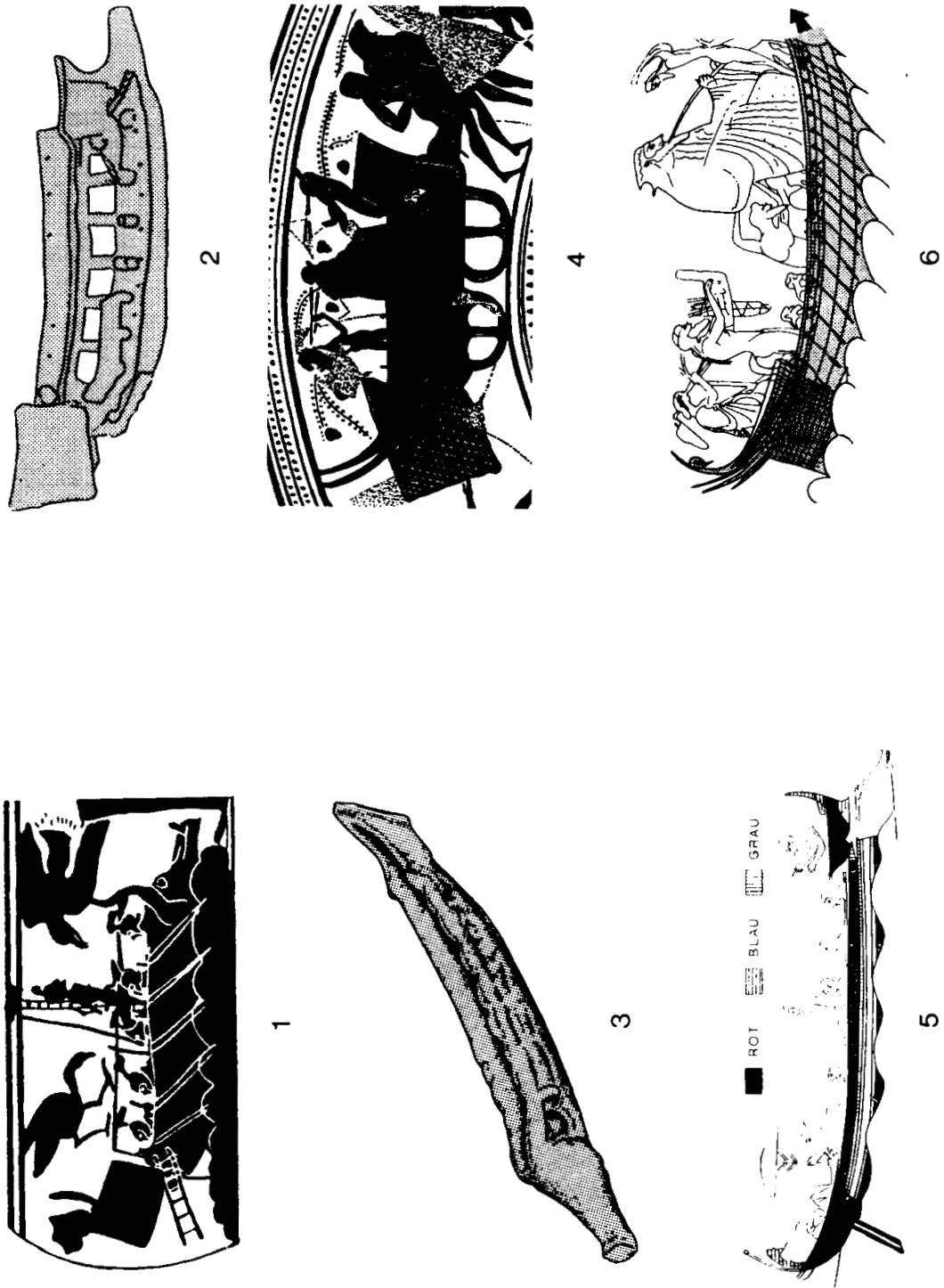
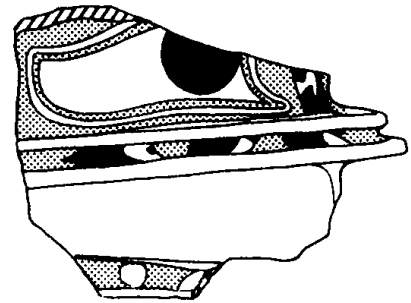
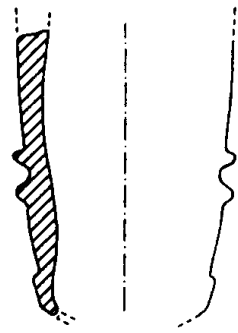


Fig. 3



5 cm

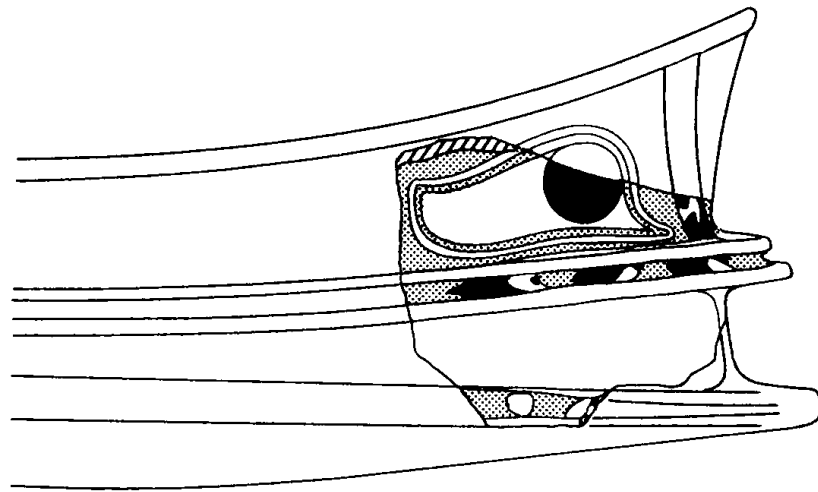
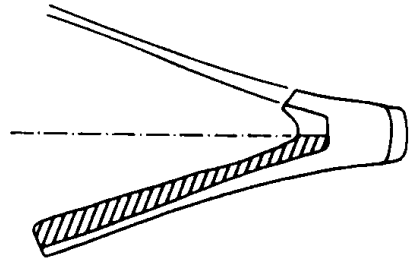


Fig. 4

THE ORIGIN OF THE EARLY MEDITERRANEAN PLANK BOAT ADDITIONS

1. Reply to a critique of my first paper

A report on the last Symposium at Delphi mentions my paper as follows:

“Gerhard Kapitän produced a novel argument that early Mediterranean ships were developed from log rafts rather than edge-joined extended dugouts, but undermined his case by suggesting that such a vessel would not be watertight, which explains why Egyptian reliefs show advanced ships with cargoes clearly visibly on decks rather than in wet holds. A simpler explanation is that the artist wished to show what the cargo was and therefore placed it on deck”. (Illsley, 1987:261).

The famous egyptologist Gaston Maspero writes “Merchant ships had no hold, and the load was piled on deck”. (Maspero, 1910:392). The same opinion is expressed by experts in ancient Egyptian water craft, as e. g. by Landström¹, Göttlicher and Werner² and recently by Cheryl Haldane³.

What is behind the old cliché that cargo depicted on deck would be in the hold? Among the countless models and pictures of ships discovered in ancient Egyptian tombs and temples there are those illustrating types with a container-like, box-shaped structure on deck. In reliefs and wall paintings Egyptian artists depicted the cargo which actually was in the container on top of it in order to display it. In other pictures cargo is shown on deck, and it was concluded by analogy that this cargo was in the hold of the ship, also because one was convinced that this had been so at all times. However, this is a fallacy, and the counter-question “Where would the Egyptian artists have depicted the cargo, if it was indeed on deck?”, demonstrates that the mentioned deduction is not conclusive, but may be wrong. At any rate, the container-shaped structures on deck are an unmistakable proof that deck loads were practised on Egyptian ships.

Furthermore, from the archaeological evidence, although still scanty, it is obvious that the hulls of Egyptian vessels, independent from what their use was, were very low and therefore not suited for cargo stowage. This is the case in the reassembled Cheops ship (Jenkins, 1980:fig.83; Lipke, 1984: Fig.53)⁴ and in the frameless Dahshur boats, as can be seen from reconstructed midships cross sections (Fig. 1)⁵. A third find, the water craft which was found dismantled at el-Lisht, had a particular low hull. This is indicated by a single frame which was uncovered together with the planks. (See Fig. 6c and the third part of this study).

This archaeological evidence is largely supported by hundreds of ancient pictures which almost exclusively depict vessels with low hulls. Some Egyptian boat models seem to be exceptions to this rule; however, this is due to a characteristic feature of almost all models. This is their flat bottom beneath the central part of the model which obviously is nothing else than a standing base which adds height to the hull. With few exceptions⁶, the vessels represented in these models had round hulls like the Dahshur boats. The rather trapezoidal cross sections of various flat-bottomed models had conveyed the impression of fairly large and deep hulls, however.

A third argument for deck loads are the deck beams of the vessels which in frameless constructions substitute the function of the frames and therefore could not be removed without endangering the stability of the hull. The archaeological evidence indicates that deck beams were normally spaced rather close to each other. The distances usually vary between 0.55 and 0.8 m⁸. Thus, they would have been a permanent obstacle for stowing goods in the hull.

2. Ancient pictorial and literary evidence for rafts

Early pictures of rafts and references to them in ancient literature are not rare. However, the depictions were usually interpreted as boats or dugouts. Nautical researchers who examined early Scandinavian rock carvings of water craft conclude that they represent rafts rather than boats (Köster, 1934; Halldin 1949 and 1950). There are also corresponding interpretations of early representations of Near East water craft, such as the Negadeh II pottery paintings (Landström, 1974: Figs 30-45; Heyerdahl, 1978:21, Fig.1). Landström (1974:13) mentions that papyrus rafts may be concerned, while Heyerdahl thinks that all these pictures show reed rafts (Heyerdahl, 1978:21 ff.). With his Tigris expedition, as previously with Ra I and II, Heyerdahl has indeed shown that large reed rafts can be seaworthy (Heyerdahl, 1980). In the marshes of Mesopotamia reed may

have been the most suitable material for the construction of water craft, but elsewhere trees existed and from these early man built log rafts for coastal fishing and for navigation on the open sea. Strangely enough, this possibility has not been considered, and I do not know of attempts to interpret the oldest pictures of Near East water craft as log rafts.

However that may be, there is hardly any doubt that rafts are concerned. They are sometimes shown with a single line only and in other cases with two lines closely parallel to each other. The enclosed space may depict the logs seen in side view. Bigger spaces may refer to reed bundles which on log rafts could have been used for side shelter. Common to almost all depictions, single-line drawings included, are the upward curved ends of these early water craft. These extremities were as yet normally interpreted as the upward-lashed ends of reed rafts, well known namely from Heyerdahl's replica constructions. We know, however, that subsequently plank boats, e.g. double-enders, also had such high-curving bow and stern posts, and presumably these were made of wood. Accordingly, such posts, could also have been affixed onto log rafts, no matter, whether they were made of wood, consisting e.g. of bending branches, or whether they were partly or entirely of reed or other rather soft material such as palm ribs. In other words, the curved ends do not preclude identifying these depictions as log rafts. But then, why do not present-day log rafts have such high-ranked stem and stern posts? The explanation is that raft fishermen in India and Sri Lanka consider them to be dangerous. It happens now and then that a *kattu-maram* or *teppam* capsizes in the surf, tilted over by a big tumbling wave. For this reason, before the surf girdles are passed, on departure as well as on return, the mast and sail are lowered, and the rowing rail, too, is taken off from its supporting board or post. We do not know, whether on prehistoric rafts towering-up parts had likewise been laid down during dangerous approaches to the coast. Because early man had certainly made the same experience, these parts were probably removable.

In the Aegean, there was in a much later period a sea-craft which, in my opinion, may have been a log raft rather than a boat. I refer to the 3rd millennium BC Cycladic vessels which are depicted in graffiti on so-called frying pans (Basch, 1987:figs.159 - 168). In September 1987, during a short stay on the island of Naxos, I saw in the mountains in a small museum at Apeiranthos, a flat stone with the hammered contours of this type of water craft; but this picture comprises the figures of two men standing on it (Basch, 1987: Fig.152). (Fig.2). I was struck by the similarity of this scene with that of Sri Lankan *teppam* fishermen standing on their rafts while they prepare or watch the net (Fig.3).

If this type of Cycladic craft were rafts, then the slightly raised end could be the fore end, as its angle is very similar to that of the prow pieces of *kattu-maram* which help the raft to pass through the surf. Consequently, the high post would be at the stern. On log rafts this is usually the largest and most stable part and therefore best suited for the erection of a post. I think, such a stern post could have been used as a look-out, needed in certain methods of fishing and for the navigation between islands. Islands may sometimes disappear under the skyline, but can be seen readily from a point a little bit higher up over the craft.

According to Pliny (Nat. Hist. 7. 57. 15), the ancestors of the Greeks "sailed on rafts" which had been "invented by King Erythras between islands in the Red Sea", and this refers to the time "before Danaos (the mythical progenitor of the Greeks) introduced the ship from Egypt". (cf. also Basch, 1987:76). These statements, expressed as a matter of course not needing references, testify for three events: the sea-craft of the prehistoric Greeks was the raft; this originated from the Red Sea, and the ships used subsequently by the Greeks were stimulated from Egyptian ship building techniques.

The last statement is already proved by evidence from marine archaeological discoveries obtained over the past thirty years. Like early Egyptian craft, Greek ships were built shell-first and assembled by means of mortise-and-tenon joints which originate from Egypt⁸. These two features, which down to Roman Imperial times remained the hallmarks of ancient Mediterranean ships, attest unequivocally Egyptian provenance.

The most complete list of references to ancient accounts and mentioning of seagoing rafts has probably been compiled by Köster (1934: 125 ff.). Of these I note here those referring to the Red Sea, as this, in my opinion, was the region, where predynastic inhabitants of Egypt could have met with a type of log raft with platform, from which they developed their earliest boat-shaped craft with deck structure which then was gradually improved to the true watertight plank boat.

Pliny (Nat. Hist. 12. 42) reports that goods were shipped on rafts over the Straits of Bab el-Mandeb (cf. also Peripl. mar. erythr. 7. and Strabo 16. 769). Strabo (16. 177) mentions raft-based pirate raids by the Island-Nabataens against ships sailing from Egypt in the northern part of the Red Sea. In this context it is interesting to read in Assman's treatise on the raft of the Odyssey that on the Red Sea log rafts had still been seen in the 19th century (Assman, 1904:25).

One of the cited reports refers to a hunting excursion to an island named Toalhut, near Massaua, where fishermen used a narrow lashed raft made from

three or four light tree trunks with slightly raised fore ends. In order to avoid capsizing, the raft was provided with outriggers on both sides⁹. The fisherman set astride on the raft centre, leaving his legs hanging in the water. For propulsion he used a paddle with blades affixed to both ends of the shaft. One of the Europeans had to employ such a raft for the recovery of the boat of the excursionists which had drifted away from the shore (Anon., 1860:1001 f.). Because of this last circumstance the report is certainly authentic.

Another short mentioning of rafts used by natives to reach the islands in front of their coast refers to a tribe named Biscarians, said to be the neighbours of the coastal Ababdhies - descendants of the ancient Ichthyophags described by Strabo - on the northwest coast of the Red Sea (Klunziger, 1877:253). This is probably somewhere between Quseir and Hurgade. Unfortunately, the type of raft is not reported.

I think it possible that still nowadays log rafts exist on some faraway shores and islands of the Red Sea; however, as yet I could not find evidence for this¹⁰. In prehistoric times and down to Antiquity or even later, log rafts were probably the most common sea-craft on the Red Sea. Presumably, a similar situation existed on the east coast of Arabia. In Oman, a 3-log raft called *ramath*, in shape and lashing similar to 3-log *kattu-maram* (now almost obsolete in India), was used for fishing still in our century (Anon., 1977: 153)¹¹. The *ramath* may be influenced from India; perhaps it originated there and may have reached Arabia already in early times as a result of involuntary drifts¹².

3. New archaeological evidence: the timbers from el-Lisht.

After the discovery of six boats at Dahshur and of two ships aside the Cheops pyramid, one of them still to be examined, timbers from an Egyptian water craft at el-Lisht are now known as the third nautical archaeological find in Egypt, thanks to a study published by Cheryl Haldane last year (Ward Haldane, 1988)¹³.

During excavations since 1902 by the New York Metropolitan Museum of Art in the sands which surround the pyramid of Sesostris I, about 50 km south of Cairo, a great number of dismantled planks and a single frame were uncovered. The planks, having lengths and scarfs similar to those of the Dahshur boats, lay buried in various distances from each other, but carefully laid down rather parallel, and this may point to a type of ship burial. The context with the pyramid dates the find to ca. 2000 BC. This means, it stands chronologically between the 450 years older Cheops ships and the one-and-a-half century younger Dahshur boats.

A re-examination of a part of the site in 1984-85 brought the known total of the planks to 76. On this occasion the dimensions of 10 planks were recorded, and when the timbers were reburied at the end of the 1985 campaign, three planks remained stored in the excavation house, where Mrs. Haldane examined them the year after. From this resulted the following details of their attachments to each other:

In rectangular mortises, cut into the adjoining sides of the planks, flat tenons are kept which are of double-trapezoidal shape, seen in plan. In contrast to the dovetail tenons of the Dahshur boats these tenons have the largest width in the centre which stands in the mortise where the planks join (Ward Haldane, 1988: Fig. 3). The tenons are generally less long and large than the mortises. Accordingly, they would not provide a very rigid connection, but only keep the planks sufficiently clipped in the positions of the intended assembly¹⁴.

The second joining system are lashings with webbing passed through mortises which meet at a 90°- angle inside the corners of the ends of the planks (Ward Haldane, 1988: Fig.4). In my opinion, these lashings were not only the original, but also still the basic mean from which the connection of strakes and single planks to each other depended. The mortise and-tenon joints would have pre-established the composition of the planks and thus facilitated the lashings. In the assembled construction they would keep the strakes in place. However, because the craft was found dismantled, I think that a permanent assemblage of this vessel was probably not yet intended by the Egyptian shipwrights. The planks should allow to be dismantled when required, like the logs of a lashed or pegged raft and the timbers of sewn plank boats, but unlike the Dahshur boats which obviously were already vessels of a durably assembled type.

If the evolution of Egyptian boat building developed in this manner, it indicates that mortise-and-tenon joints were at first only an auxiliary device for joining the planks, experimented in order to facilitate the lashing, but then would have become the main and only device for joining the planks. Indeed, the mortise-and-tenon joints were gradually improved, and later - we do not yet know when and where for the first time - treenails were vertically passed through them in order to keep the tenons definitely in the mortises, when the older tradition of dismantling the craft from time to time had been abandoned. Summing up: at el-Lisht we are not only dealing with a new carpentry joining technique, but also with a most interesting intermediate stage of the evolution from lashed to tenon-joined water craft.

Other features of the el-Lisht timbers testify to an evolutionary stage between advanced platform raft and true plank boat. First, there are the rather thick planks which measure 12 to 15 cms. This is more than the thickness of the Dahshur boat planks, but even more than is applied in the Cheops ship, if one also considers the ship's size. The stated over-all length of the Cheops ship is 43.63 m and the beam 5.66 m (Lipke, 1984:97), while the el-Lisht craft, according to calculations which I shall explain measured probably not more than about 15 m and its beam only slightly more than 3 m. Large ancient ships of the Classical period had planks which were at most half as big as those found at el-Lisht. On the other hand, the el-Lisht planks measure roughly 1/2 or about 3/5 of the thickness of shaped logs such as in present-day *kattu-maram* rafts in India (Figs 4, 5 and 6A and 6B). Indeed, the planks at el-Lisht (Fig. 6C) stand right in the middle between raft logs and planks of large ancient ships, though they are made for a rather small vessel. In other words, they are exactly the example for the conjectured intermediate stage of the development which from big raft logs conducted to comparatively thin boat and ship planks.

Furthermore, the hull of the el-Lisht craft was obviously very low, as revealed by the frame found in 1924 which as yet remained the only one discovered. The resulting cross section (Fig. 6C) is shallow-curving, similar to those of Indian *kattu-maram* at their after end lashings, near the maximum beam (Fig. 6A and B). It is true that we do not know in which part of the vessel this frame was, but it is very likely that it was affixed to the strakes (by means of three big treenails) not far from amidships on the fore end half of the vessel. Why?

On top, the curved frame timber is provided with two big beams between which a gap of 0.5 m width is left. This gap is also marked by a shallow notch of the same extension in the upper side of the curved timber. My explanation is that the gap could have been occupied by the bipod mast of the vessel, when laid down, as is shown in my preliminary reconstruction drawing (Fig. 7).

The elaboration of this drawing departed from the number of planks so far known, taking into account that a few may be missing. In this way I obtained a first idea of the possible size of the vessel and the probable distribution of strakes and planks (as shown in Fig. 7, in the small sketch above). Length and beam also depend on the position of the frame¹⁵. Because this is unknown, I examined the various mast positions shown in Egyptian works of art and decided to use the position illustrated in a relief of the temple of Sahure (Landström, 1974: Figs 187, 191), although the el-Lisht craft is some hundred years younger. Pictures from the Middle Kingdom usually show the mast either amidships or rather close to the

bow. From the last position an essentially larger vessel would result which need many more planks than the number as yet ascertained. On the other hand, with the mast amidships, the frame would be at maximum beam and the vessel somewhat smaller, i.e. about 12-13 m long. In this case, probably not all the ascertained planks would fit into the hull construction. However, a length between 13 and 15 m is probably also in the range of the possibilities, while an essentially larger size is only possible, if more planks exist ¹⁶.

Obviously, any reconstruction on the base of the present vague archaeological evidence remains a non-committal attempt. The essential purpose of my drawing is to show that the frame would have substituted the first deck beam behind the mast, and that this arrangement fits, even if the mast is stepped at the bottom of the hull (and not necessary higher up, as in Landström's reconstruction of Sahure's ship, Fig. 199). It also shows that the frame may indeed have been the only one in the vessel and that the vessel, apart from this one frame, may have been frameless. Moreover, this argument suggests that an indispensable elimination of a deck beam might have been one of the earliest motives for the use of a frame in frameless craft. In other words, we may deal here with one of the first steps of the development which led to constructions with inserted frames.

There is one more feature deserving attention; viz. the notches in the bottom side of the frame. These are almost triangular and unusually deep (Fig. 6C; cf. also the photo in Ward Haldane, 1988: Fig.7). Frames passing over the seams of sewn planks whose stitchings embrace strands of sealing material or, as in the Cheops ship, a wooden batten (Lipke, 1984: Fig.53), have always rounded notches. It is unknown whether the seams in the el-Lisht craft were closed in one or the other way; no stitching holes along the edges of the planks are reported. Accordingly, three main possibilities might be considered:

- a. The planks were finished so carefully that the seams would have got watertight when the wood was sufficiently waterlogged. (I don't think that this quality of execution had been already achieved at this time).
- b. Caulking material had been used in the seams; however, there is no evidence for this¹⁷.
- c. The seams may have allowed the penetration of water, and the hull filled up to the level at which the craft altogether would be buoyant. This situation would have been the same as in a raft.

The deep notches in the frame are a hint in favour of this last presumption or at least of a situation in which water penetrates from time to time. I have thought

over this question for a long time, from the moment that I saw the published photo of the frame for the first time, but I could not find another explanation. Indeed, limber holes would have been indispensable, if there was water in the hull; they had to allow the through-flow. Otherwise it could happen that the hull draws more water in one part than in the other, creating the risk that the craft tilts with one end. This had certainly to be avoided.

What were the conditions in the hull of the el-Lisht vessel? My feeling is that there could have been a stage inbetween the two mentioned possibilities a and c: the water would at first penetrate the hull, but when the timbers were waterlogged, the penetration would diminish, allowing the crew to bail the water out in order to obtain a minor draught and to navigate more efficiently. When bailing was stopped for some reason, e.g. because the voyage had ended, the water in the hull would again rise. Sometimes the hull would be filled with water and, when this had been bailed out, at least wet and unsuited for cargo storage. This situation would coincide with the limber holes in the frame, but these do not prove that this was the situation. There is the possibility that the frame was shaped according to a traditional design or for emergency situations, or that it was a reused piece from another older type of water craft.

Whatsoever might have been true, it is obvious that the el-Lisht vessel, even if it had a tight hull, derives from craft with a wash-through situation; that is to say, its roots were log rafts. This conclusion is supported by the following features:

- it was an (almost) frameless shell-first construction,
- it had very thick planks, presumably providing buoyancy to the vessel by mere floating¹⁸, and had no keel,
- its cross sections were very shallow and rather similar to those of side-sheltered hull-shaped log rafts, and, accordingly, the low hull beneath its deck was unsuited for cargo storage.

Concluding, I think that we are still very close to a type of boat-shaped freighter raft with deck structure, if not right in presence of one¹⁹.

4. The evolution from platform log raft to plank boat with deck.

The evolution from log rafts to plank boats was largely determined by the natural laws of gravity and buoyancy and by those of early man's social life. For this reason the development was inevitable, cogent and irresistible. It started, when log rafts with side shelter of hull-shaped cross sections were provided with a platform on top of cross beams set athwart the outer logs.

At least since the Neolithic migration voyages, platforms on rafts were needed for safer and more efficient sea transports of persons and goods. Load and platform and all the other structures above water level add weight to the raft, by which buoyancy diminish and draught increases. Early man had certainly noticed that the raft logs dipped deeper into the water and that the speed of the raft diminished. Experiments with loads of different weights taught him that the cargo had to be kept in reasonable limits. He certainly had learned this already on simple rafts. Accordingly, it did not surprise him that a platform also impaired buoyancy, and, therefore, a rather large raft sufficiently buoyant had to be chosen for the mounting of such an upper structure. At the same time, raftsmen would have concluded that cross beams and "deck" had to be made as light as possible, though of course strong enough.

This last perception which could not be gained from using simple rafts only, was the starting point for the development of a more refined carpentry work than had previously been practised with the stone adze used for shaping the big floating logs. A first important progress resulted when more sophisticated woodworking tools were applied. Indeed, as soon as metal instruments began to substitute those made of flint, obsidian and other hard polished stone, the carpenters building the platforms could increasingly produce suitable structures and, encouraged by the results, began to specialise in refined woodworking. This enabled some of them to gain a particular know-how and to be highly successful. These very carpenters held the highest rank among the shipwrights, and this gave rise to a new order: Refined carpentry work dominated and began to control the whole production of this water craft. This is to say, refined techniques were now also applied to the floating structures. Long raft logs were substituted by comparably short timbers scarfed for connection in length. This was indispensable when sufficiently long timbers were not available, but had its advantages also from various other points of view. First of all, there was need to complete the hull-shaped form of the raft over its entire length. This important development allowed the mounting of cross beams from stem to stern, thus essentially enlarging the surface of the platform. The result was a perfectly boat-shaped raft with a complete deck structure which could satisfy the increasing demand for transport surface both for passengers and cargo. At the same time this new shape of the craft presented decisive advantages in navigation. The hull of this vessel, however, was at first still through-flown by water and not suited to be used as hold for cargo.

Nevertheless, this problem, too, was gradually overcome by refined carpentry techniques which were further perfected. The adjoining sides of the timbers, after

the use of big logs had been abandoned in favour of thinner planks, were given smoother surfaces better matching each other, and, even more important, the original lashings and stitchings were gradually substituted by mortise-and-tenon joints. These had at first been an auxiliary device during the assemblage of the craft, but later increasingly became the standard type of joint, as is shown e.g. by the Dahshur boats.

The building of the replica *Kyrenia II* has demonstrated that the use of mortise-and-tenon joints of improved design in well fitting planks provide watertightness to the hull, as soon as the wood is waterlogged. I now believe - in revision of what I said on this argument in my first paper - that this may have been already achieved in ancient Egypt; we cannot, however, say yet, at which period. At all events, the development which led from the wash-through and, later, wet hull to a hold sufficiently dry for stowing cargo, probably took place at first in the Near East and in the Aegean, where it concluded during the early second millennium BC, and perhaps somewhat later in the central and western Mediterranean.

Might caulking also have played a role in this process? Perhaps it did not, but it may have been used to restore hulls when they began to leak. Only much later caulking became indispensable, at a time when the planks were nailed onto the frames of skeleton-first constructions, which began to develop during the Late Roman Empire.

I wish to emphasise still the following point in this conjectured evolution. Logic implies that the first step in improving platform log rafts was the development of a type of entirely boat-shaped raft with deck structure, then followed by the gradual transformation of this most advanced platform or freighter raft into the true watertight plank boat which in the beginning had no frames or only a few ones. Later, when the hull became the cargo hold, some deck structures were abandoned again, or were reduced. Shell-first construction continued, but frames became indispensable, since the walls of the hull increased in height and because of the necessity to omit some deck beams in order to obtain sufficient space for handling bulky cargo and, generally, for the loading and unloading operations.

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Summary

The following arguments supplement the paper given at Delphi:

1. A reply to a critique of the first paper presents the evidence and reasons for deck loads on early Egyptian ships.
2. Ancient pictorial and literary evidence for rafts in the Aegean and Red Seas and reports on rafts used in the Red Sea in recent times are stated as references for the conjectured evolution from log raft to plank boat in prehistoric Egypt.
3. Recent archaeological evidence from water-craft timbers found at el-Lisht suggests new interpretations for the development of early Egyptian planked craft. The discussion includes the mortise-and-tenon joints and the purpose for which they were originally intended, an interpretation of the thickness of the planks and explanations for two unusual features of one frame found among the planks. The illustrations comprise a preliminary reconstruction of the vessel showing the position of the frame related to a lowered bipod mast. Several features of the el-Lisht timbers point to a log raft origin.
4. A new idea explains how the evolution of log rafts with platform led to the construction of frameless plank boats with deck structures, and shows that this was an inevitable development determined by the natural laws of gravity and buoyancy and by the rules of early man's social life. Because the mounting of a platform onto a raft adds weight by which buoyancy diminish and draught increases, such addition must have given rise to the development of refined carpentry work. This stage evolved when metal tools became available. The new woodworking techniques were then also applied to the underwater structures of the craft. The big raft logs were replaced by thinner plank-shaped timbers which led to the construction of an advanced type of entirely boat-shaped raft with a complete deck structure, as was needed for satisfying the increasing demand of water transport capacity. As a result of the application and current improvement of mortise-and-tenon joints and of the subsequent abandonment of lashings and stitchings, the planked boat-raft would have transformed gradually into the true watertight plank boat which initially was without keel and frameless.

NOTES

- 1 "Egyptian vessels probably carried most of the cargo on deck" (Landström, 1974:60).
- 2 "The cargo as a rule was carried on deck, not in the hull". (Göttlicher and Werner, 1971:8).
- 3 In a letter of 19th May 1989 Mrs. Haldane, commenting shortly on my Delphi paper, agrees that the hull of early Egyptian boats was not used for stowing cargo.

4. Lipke (1984:97) states that his main drawings to scale on the fold-outs, i.e. fig. 52 included, refer to a 1:20 scale model of the ship and not to the reassembled original. Therefore, they do unfortunately not correspond to the dimensions of the reconstructed ship listed on pp. 79 ff. As to the sheer height, the difference in the cross section of fig. 52 is 17% too much. The corresponding section published by Göttlicher and Werner (1971:Tf. XLII, 3) seems to be closer to the facts. Moreover, I think that the angle at which the second and the third strakes join is rather exaggerated in Lipke's cross section of fig. 52.
5. My drawings to scale of the midships cross sections of two Dahshur boats are only informative; none does exactly correspond to the evidence, since I could base myself only on published data and on drawings which by their reproduction may have become slightly distorted. In fact, the stated measurements in no case correspond to those of the drawings; cfr. also the caption to my Fig. 1. Of two other Dahshur boats, Cairo 4926 and the one in Pittsburgh, the data published as yet is not sufficient for the elaboration of cross sections.
6. There are exceptions. Types of boats with transom ends, i.e. punt-shaped vessels, seem to have had a flat bottom not only in the centre but over their entire length (cfr. Göttlicher and Werner, 1971: Tf. XIV. 1 and XXXI; Landström, 1974: figs 105-107, 127-128, 140-142, 183-184). On the other hand there are some models with rather low hulls, but without a flat bottom beneath their central parts (cfr. Göttlicher and Werner, 1971: Tf. XV, 1; Landström, 1974: figs 147, 204, 322).
7. The measurements are those of the Dahshur boats and the rebuilt Cheops ship. On the latter, however, some deck beams are set at much larger intervals, between about 1.3 and 2.1 m., over two hull sections at certain distances from bow and stern (Lipke, 1984:fig. 52). For the large gap near the bow Lipke mentions (p. 107) an explanation, which would correspond to mine given for the frame among the el-Lisht timbers (cf. part 3 of this study).
8. I refer to the Kyrenia ship of c.300 BC. A much earlier example is the Bronze Age wreck of Ulu Burun near Kas, Turkey, probably dating to the 14th century BC. The home country of this ship is still uncertain. From the archaic period also sewn plank ships are known, as e.g. the Bon Porté wreck from the late 6th century BC and now a wreck of the same period at Gela, Sicily, on which a first excavation campaign has just been carried through by Dr. Alice Freschi. Mediterranean sewn plank ships obviously derive from a ship-building tradition not using mortise-and-tenon joints.
9. The anonymous writer used the word "Ausrecker" which may be either an outmoded German term unknown to me or a wrong translation of the English word "outrigger". Perhaps the device, instead of referring to a double-outrigger, was only a simple balance pole.
10. In this context, log rafts on the Nile may be of interest. Paul Johnstone mentions rafts made from ambach logs which were used still in this century in the Bari region of Uganda for crossing the river, and he describes shortly three other more advanced types of ambach rafts on the White Nile made by the Dekkas and the Chilluk peoples, including one with freeboards consisting of bundles (Johnstone, 1980:7). Ambach rafts are probably not very large, as the branches of this light wood are from shrubs growing during the Nile inundations and breaking off when the river falls to its low level (cfr. the catchword "ambach" in encyclopaedias). Whether ambach rafts may also have played a role in ancient Egypt is not known to me; this could have been possible, if ambach floats coming down the river after the inundation period remained buoyant until it arrived in Egypt.
11. For this reference I am obliged to Mr. Bill Davies who examines traditional water craft in Oman. A type of raft called *shashah* made of date palm sticks and other floating material is still used by Omani fishermen on the sandy coasts of the Batinah (Anon. 1977:152).
12. As to drifts over large distances, which in a certain way are proofs of the seaworthiness of the

craft in question, I cite here the following occurrences which obviously are common events on the oceans since earliest times:

"Not long ago one read in Indian newspapers about a bamboo raft that had drifted from Burma and landed south of Madras with a couple of Burmese fishermen on board. Likewise Indian fishermen have ended up in Burma and Bangladesh..." (Engvall, 1988:28).

Another interesting report results from a newspaper cutting which, together with others, illustrates the cover page of the No. 31 issue (Sept. 1988) of the *Bay of Bengal News*. An US Navy helicopter rescued four Indian fishermen who had spent three days floating in a large fishbox in the Arabian Gulf, after their boat broke up and sank.

13. I am most grateful to Mrs. Haldane for various additional information which she kindly communicated. She also supplied me with a xeroxed copy of the drawing to scale of the frame, which was recorded by the excavators when they had found it. Of this I have used the side view A-B for the reconstruction of the cross section of my Fig. 6C, and the measurements resulting from this, including two more hypothetical outer strakes beneath the outer ends of the timbers on top of the curved frame timber, determined my preliminary reconstruction drawing of the vessel Fig. 7.
14. In some mortises Mrs. Haldane has noticed remains of small square-shaped pegs aside the tenons; cfr. her fig. 3. These would have provided a more rigid connection. The pegs are obviously an improvisation demonstrating that the Egyptian shipwrights intended to improve the mortise-and-tenon joints and that they were just experimenting with these pegs.
15. For my reconstruction drawing I have also taken in consideration the proportions between length and width. These are about 1:4 or slightly more in the Dahshur boats, but 1:7.7 in the reconstructed Cheops ship. Accordingly, a proportion of nearly 1:5 may have been that of the el-Lisht vessel, if its length was about 15 m. An explanation for the essential differences could be that the lengths of the deck beams had to be kept within reasonable limits. This would mean that Egyptian frameless craft, the larger it was built in length, the more it had to be kept slender.
16. During the re-excavation campaign of 1988 no new finds of timbers seem to have turned up. According to Mrs. Haldane's communication, the planks and the frame uncovered in 1924 (her fig. 6) have not been found again, and it is unknown what was done with them at the end of that excavation. Mrs. Haldane believes that at least the frame has been preserved, possibly in magazines at Saqqara (letter of 29 May 1989).
17. In her letter of 29 May 1989 Mrs. Haldane emphasises that she has "never seen any indication of caulking on an Egyptian hull".
18. The water level in the hull, the vessel floating filled with water, can roughly be calculated from the estimated volume of the floating planks with due regard to the approximate weight of the structures above water level, such as the cross beams, deck boards, gunwales, mast and sailing gear. The argument suggests that a scale model should be built for trials.
19. Cfr. the arguments discussed in the following chapter. The term freighter raft refers to rafts used for all types of transports, of goods as well as of persons. Shapes and methods of joining, as met in the timbers of the el-Lisht vessel, would, in my opinion, just as well apply to craft on the sea.
20. I had intended to present in this paper also a discussion of James Hornell's ideas on the 'Origins of the plank-built boats' published fifty years ago (Hornell, 1939). Perhaps apart from what he has written on the junks of China, his statements require a careful revisal, some of his preconditions now being outdated. Because the time for this review is not sufficient here, I defer the discussion to another occasion, but should like to mention that I agree with Hornell's references to worldwide evidence of plank-built boats developed from dugouts. However, all these cases seem to date to relatively recent times, prevailing to the medieval period and to modern times, and none to prehistory, apart from the addition of washstrakes to a logboat (Ellmers, 1976: 10-11).

It is true that this is the first step of an evolution leading to plank boats, but no early complete examples of plank boats deriving from a dugout are known to me.

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ILLUSTRATIONS

- Fig. 1 Attempted reconstructions of the midships cross sections of two Dahshur boats (P = port side, S = starboard side).
I.A. Boat in the Chicago Field Museum, according to data in Ward Haldane, 1984: 8 ff
I.B. Boat in the Cairo Museum 4925, according to Landström, 1974: fig 275, basing on Reisner, 1913: fig. 312.
II.A. Boat in the Cairo Museum 4925, according to the drawings by de Morgan, 1895 Fig. 203, as reproduced in Göttlicher and Werner, 1971: Tf.XLIV.
II.B. Boat in the Chicago Field Museum, reconstruction in the proportion of Cairo 4925 as drawn in II.A.
- Fig. 2 Hammered graffiti on the smooth surface of a stone showing a Cycladic water craft of the same type as depicted on the so-called frying pans, but here with two men standing on it. Find from Kophi t'Arioniou in the Museum of Apeiranthos, Naxos, 3rd millennium BC (from Basch, 1987: fig. 152).
- Fig. 3 Tamil fishermen on their *teppam* rafts, watching and handling nets on the sea at Negombo Sri Lanka, Febr. 1989. Near the skyline a sailing *oruwa* (Tele-zoom photo).
- Fig. 4 Large 7-log *kattu-maram* raft on the beach of Madras, India, Febr. 1988. This raft used for shore seining is equipped with two rowing rails. a. Port side. b. After end. To a wooden pole kept in holes on top of the outer logs the lashing rope is repeatedly fastened in order to pull it under tension. The pole providing stiffening and, together with the lashing, a rigid connection of the raft logs, corresponds functionally to the cross beams of platform rafts and to deck beams of frameless plank boats.
- Fig. 5 Scale drawing of the 7-log *kattu-maram* of Fig.4, the dotted lines roughly reconstruct the original log ends. A. Plan. B. Port side with rowing rail raised onto its supporting board, and below, one of the rowing oars with blade stitched to the short oar pole. C. Cross section at the fore end lashing embracing the prow piece timbers. D. Cross section at the after end lashing.
- Fig. 6 A. After end cross section and lashing of the 7-log *kattu-maram* as in Fig. 5. D. B. Simplified after end cross section of a large sea-going 7-log *kattu-maram* rigged with crab claw sail (cfr. Bengtson, 1988; drawing in Menon, 1980: 16-17, reproduced by Wiebeck, 1987: Tf. 3). C. Reconstructed cross section of the el-Lisht water craft, as results from the single frame found with the planks. The dotted lines indicate a possibly missing outer end of one of the upper frame timbers and the big treenails with which the frame was affixed to three strakes. The thickness of the planks is drawn according to the statement in Ward Haldane, 1988:143, and their widths corresponding to the distances between the triangular notches in the frame which roughly mark the positions of the seams of the strakes. (Cfr. the statements in the text and in note 13).
- Fig. 7 Attempted reconstruction of the el-Lisht water craft as a frameless plank boat with deck structure over cross beams and with a single frame which substitutes a deck beam behind the bipod mast of the vessel allowing the mast to be laid down onto a forked support post erected at the fore end.

THE ORIGIN OF THE EARLY MEDITERRANEAN PLANK BOAT

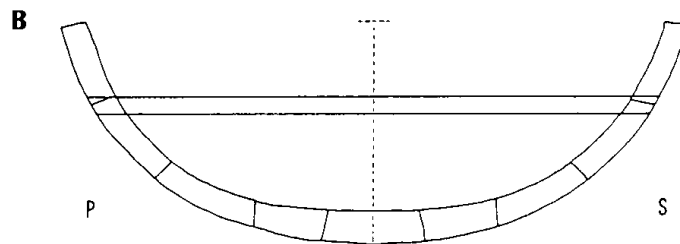
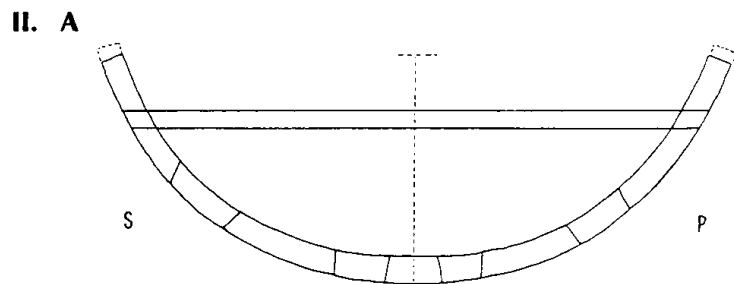
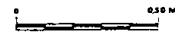
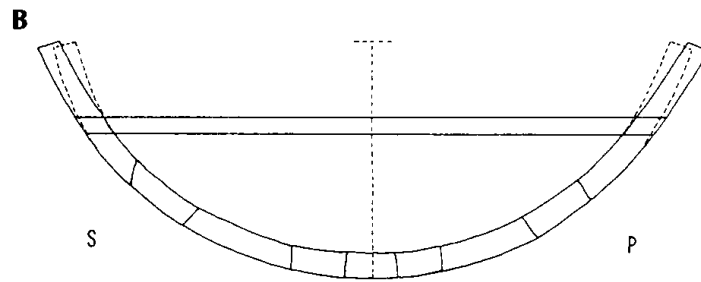
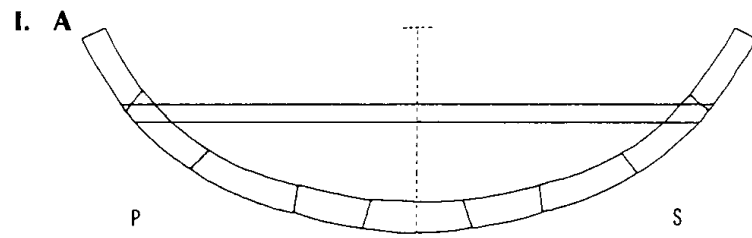


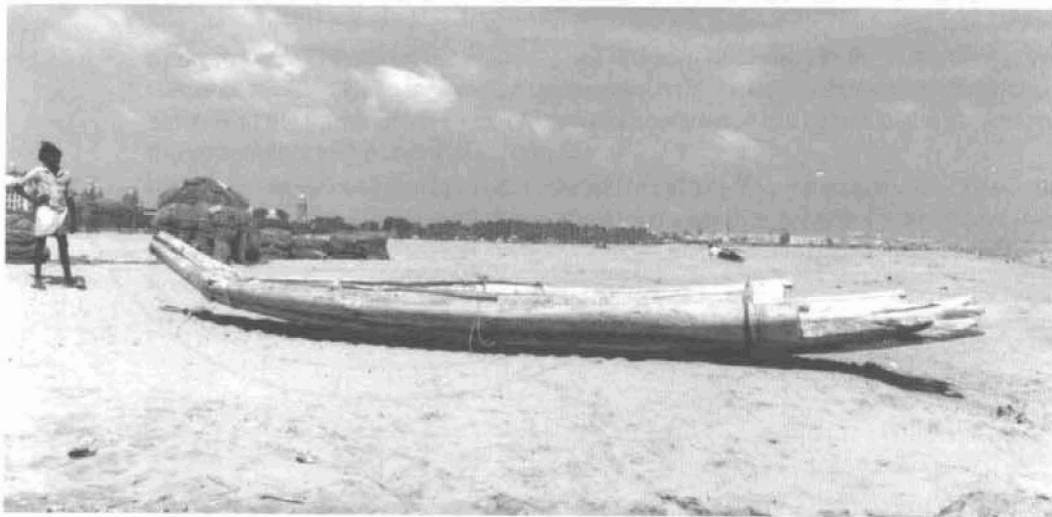
Fig.



fig. 2



ig. 3



l. 4a



Fig. 4

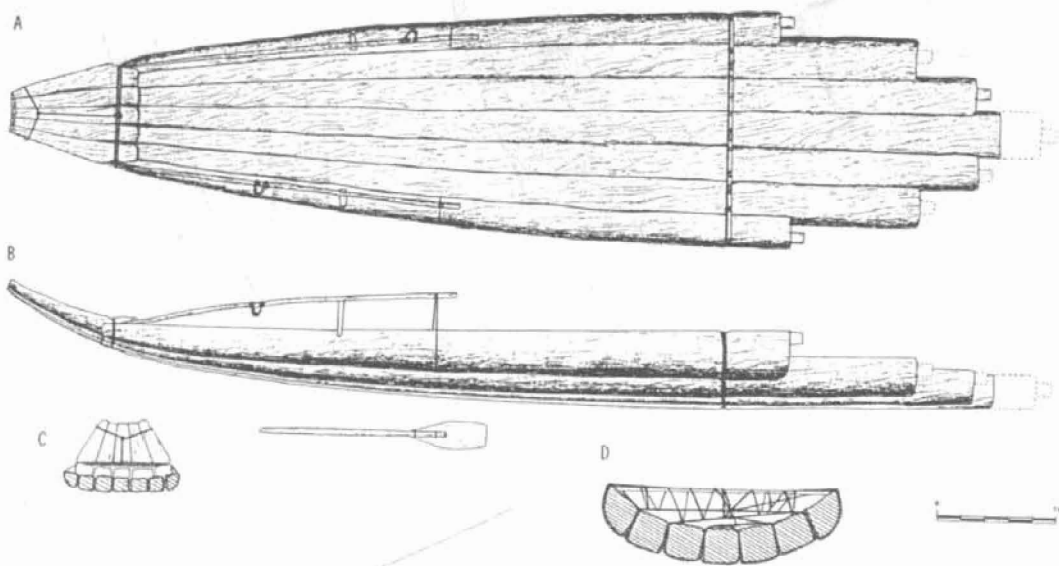


Fig. 5

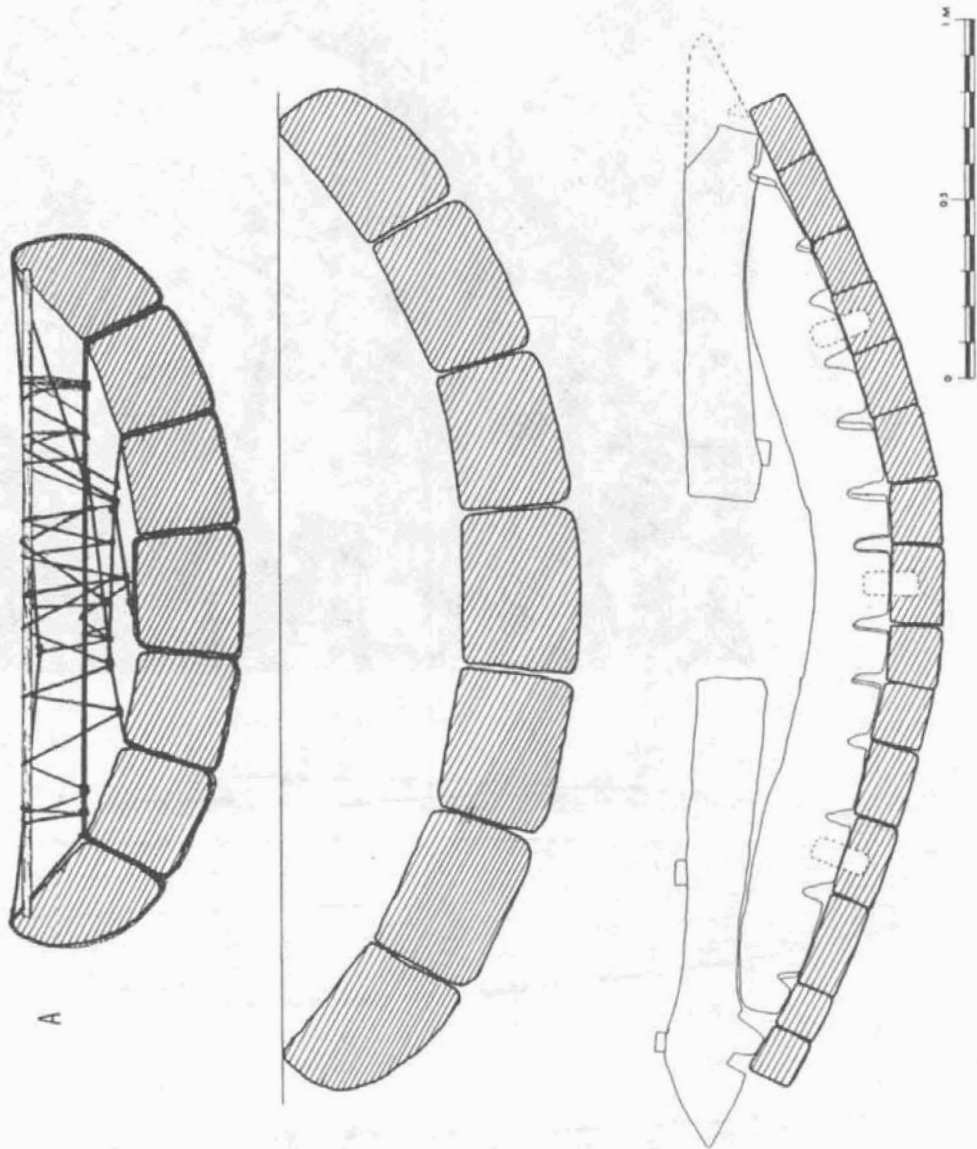


Fig. 6

THE ORIGIN OF THE EARLY MEDITERRANEAN PLANK BOAT

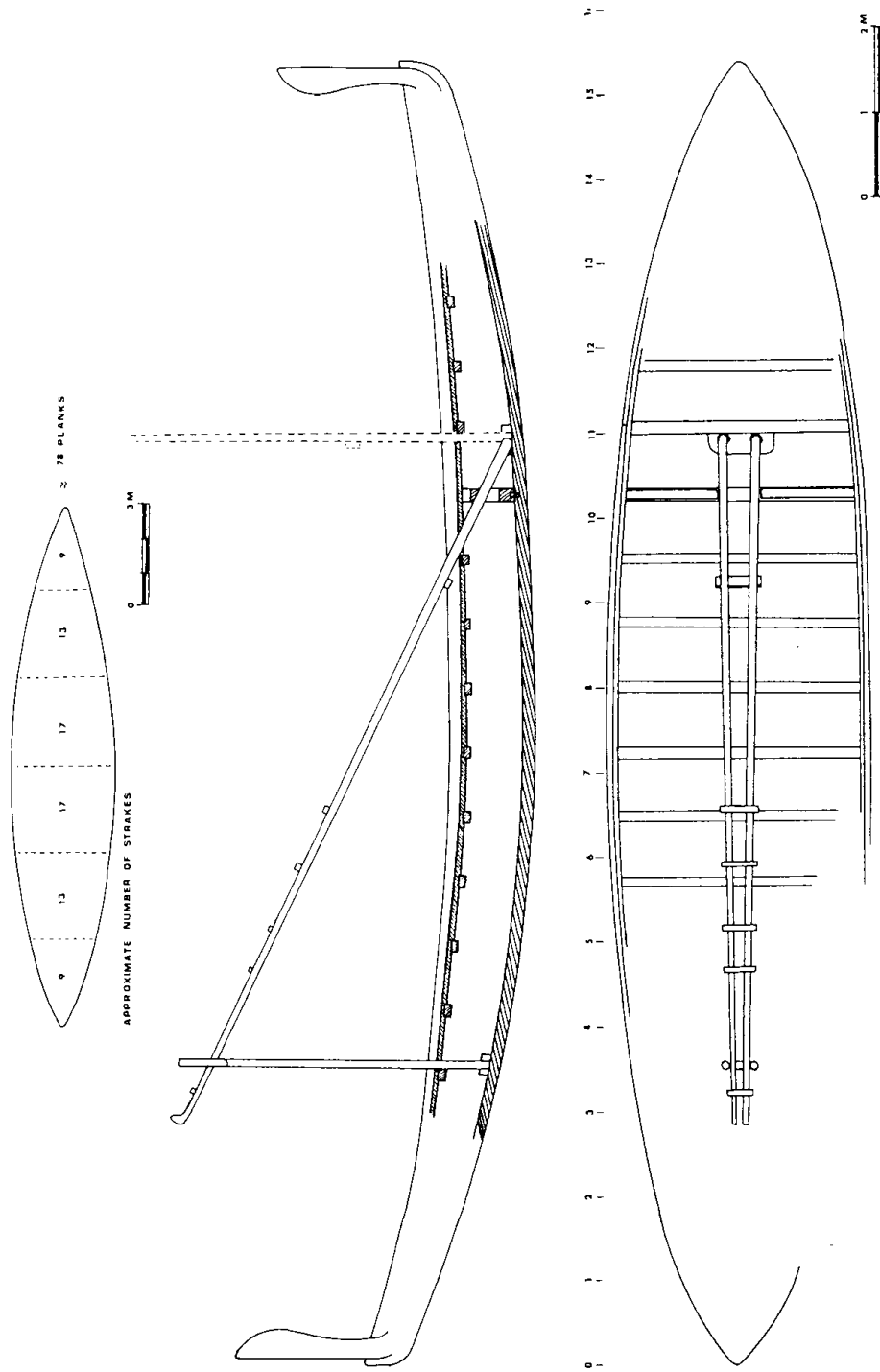


Fig. 7

SMITHS ON BOARD LATE BRONZE AGE SHIPS

The question of whether smiths were on board Late Bronze Age ships is not a recent one. As early as 1956, Hugo Mühlestein suggested that smiths appeared to be an indispensable part of military Bronze Age vessels (Mühlestein 1956; Bass 1967, n. 52). Basing himself solely on literary evidence, Mühlestein theorized that the *oka*-tablets from the Palace of Pylos refer to ships, saying that the word *oka* or *ὀκάς* designates a sailing vessel. If this is the case, then every military ship listed has as one of its leaders a man who is also a smith. In no case are two smiths on board one ship.

The evidence from the Cape Gelidonya shipwreck

Mühlestein's suggestion gained substantial support and a more generalized frame of reference from the discovery of the Cape Gelidonya shipwreck in the early 1960's (Bass 1967). This ancient wreck excavated by George Bass and his team on the sea-bed off the southern coast of Turkey, gives a vivid picture of the last voyage of a sort of tramp ship that had sailed from Syria to Cyprus about 1200 BC and there collected the ingots of copper and tin and the scrap metal which made up its cargo on its final trip westward. Only 11 meters long, this little ship carried a ton of metal cargo which, at the time it was found, was the largest hoard of pre-Classical copper and bronze implements ever found in the Aegean area. The information embodied in the items she carried gave a new picture of trade in the East Mediterranean and of the activities of Late Bronze Age seafarers.

On board the ship there appears to have been a merchant with his balance-pan weights prepared to trade in any Eastern Mediterranean port, and perhaps a smith with all the implements necessary for bronze-making. Beside the copper,

tin, bronze scraps and ingots for being recast, as well as many agricultural tools, all the basic implements of a prehistoric smith were in the area of the wreck: two stone maceheads which must have been part of perforated hammers used for forging, six stone rubbers and polishers, a whetstone for sharpening tools, a bronze swage block for shaping tools and three large, hard stones which would have served as anvils. In the cabin area were also a bronze chisel and a punch. All that was missing from a travelling smith's kit were molds, but these may have existed in the form of soft clay which must have been washed away by the currents after the ship sank (Bass 1967, 275). If only chisel and punch were aboard the ship, one would assume that these were part of the cargo, since such tools often appear in contemporary founder's hoards. But the existence of stone implements such as maceheads, rubbers, polishers and a whetstone, makes this unlikely. However, only hammering, sharpening and polishing must have been done on board. Furnaces would have been quickly made of stone and clay at various stops along the route (Bass 1967, 80).

The evidence from the Ugarit maritime texts

The idea of a travelling smith was also suggested by Elisha Linder in 1970 concerning a text from the city of Ugarit on the northern coast of Syria (Linder 1970). This tablet is part of a number of texts which cover the maritime activities of the kingdom of Ugarit from ca. 1380 to 1195 BC. In an analysis of text 2056, Linder compared the inventory of an Alasia ship at one of the harbours of Ugarit, with the items hauled from the Cape Gelidonya wreck. The similarities were striking. Both ships carried copper and bronze ingots, agricultural tools such as shovels and picks, a number of bronze weapons and smith's tools such as adzes and chisels (Linder 1970, 26-7, 216-7).

The evidence from the Ulu Burun (KAS) shipwreck

The finds of another Late Bronze Age shipwreck, the excavations of which began in 1984 by the Institute of Nautical Archaeology (Bass 1986), also hinted at the possible presence of a smith aboard the ship. This 16 meter vessel laden with valuable commodities from around the Mediterranean, sank near the promontory of Ulu Burun in southern Turkey around the 14th century BC. The wreck's preserved metal cargo included more than six tons of copper and tin ingots, and many bronze weapons. There were also cutting tools, a set of tongs, a stone mace head and a whetstone, all of which may have been part of a travelling smith's tools and utensils.

There is evidence and a strong argument why at least some of the tools must belong to a smith and not a ship's carpenter as the excavation team suggests (Fred Hocker, personal communication, 26.VIII.1989). George Bass indicates that an Egyptian gold ring found with scrap gold "had been purposely cut in two with a chisel" (Bass 1987, 28). Is it really possible that a carpenter would have used a chisel to cut metal, even if it is soft metal? For here one sees the action of a smith, not a carpenter. Together with the fact that this cut ring was found with scrap gold, is proof of the presence of a goldsmith on board from activities actually witnessed (cutting of a ring, putting it together with other scrap from the same metal); the presence of a carpenter is just postulation for the time being, which in any case does not exclude the presence of a goldsmith.

The Smith in ancient societies

Since the first smiths started their craft in the Late Stone Age, this mysterious craft formed the center of abundant myths and legends and the smith grew to belong to a singular social type associated with religious rites and taboos. The smith of prehistoric times may be honoured or despised, but always held in awe. He is often identified with the magician or priest probably because of the complexities of the metallurgical processes he alone has mastered and his knowledge of the secret manipulations and necessary rites to purify the new, unclean metal (Robins 1953). The smiths's craft partook of the magician's rites, and until very recently in the rainforest regions of Cameroon and Gabon in West Africa, the witch doctor of the village was often also the smith (J. Phillipson, personal communication, 15.VI.1989).

Ancient Sumer in southern Mesopotamia provides an example of smiths who were not free craftsmen but were persons linked closely to the temple-state economy that characterizes one of the world's oldest societies, from about 3000-2000 BC (Limet 1960). However, later, during the reign of Hammurabi and his successors, from 1800 BC on, temple-guilds seem to have declined and although the smiths still had a certain religious prestige, they had a difficult time which grew worse in the Kassite period from about 1600 BC, when temple-guilds broke up into guilds of free craftsmen (Forbes 1964, 90).

Not much is known about the smiths of ancient Egypt, but there is evidence from Old Kingdom mural paintings that the Egyptians used many dwarfs as smiths (Montet 1952, 1ff.). Whereas bronze-workers do not seem to have been much respected, goldsmiths formed an exception. They were part of guilds that worked under the supervision of the temples with the high priest of Ptah in Memphis

presiding over as “high inspector of the artists” (Erman and Ranke 1923, 550; Forbes 1964, 84).

In the Aegean world, documents dated to about 1300 BC indicate different types of smiths living together in small closed communities (Ventris and Chadwick 1962). The smiths on most of the tablets from the Palace of Pylos seem to have been honored craftsmen who possessed slaves. But since the tablets do not call these smiths *δημιουργοί*, that is those who work for the demos or the city, it appears that these craftsmen were sent for or came from outside the local community (Forbes 1964, 95).

Still later, the dissolution of the Hittite Empire about 1200 BC seems to have accounted for the wondering of many smiths over the Near East (Forbes 1964, 91). These smiths possessed a mass of lore and knowledge quite different from that of the copper and bronze-smiths who had already been at home in the towns of the Near East and the Aegean, and their superiority must have been largely due to their knowledge of making iron. But the smiths from Asia Minor were not allowed to immigrate everywhere. As far as can be judged from the meagre data, states like Egypt, Assyria and Babylonia were officially closed against these immigrants. Therefore the earliest signs of these Hittite smiths are found in Syria and Palestine at the close of the Bronze Age. Otherwise the quick spread of the working and use of iron in the area would be less intelligible. Smiths appear to have remained valuable craftsmen in the area of the Levant for many years after that. The domination of Palestine by a handful of Philistines seems to have been credited to their excellent smiths (1 Sam. 13. 19), and Nebuchadnezzar of Babylon mentions expressly that he carried off the smiths of Jerusalem in 587 BC (Isa. 24.1; 29.2).

Late Bronze Age shipping and trade

By the time the Ulu Burun ship sank in the 14th century B.C., it appears that a vast trade network was well established between the Near East and the Aegean region. The Late Bronze Age ships plied the Eastern Mediterranean in a circular pattern, taking advantage of the westward currents along the shores of southern Turkey, when sailing from Syria-Palestine to Cyprus and to the Aegean, then back with the eastward currents of the North Africa shores to Egypt (Lambrou-Phillipson 1991, 11-19).

There is no longer much doubt that a large part of the cargoes of Late Bronze Age ships which sailed from the Levant westward consisted largely of new metals.

Some years ago W.F. Albright speculated that the Biblical Tarshish Ships were not ships from the city of Tarsus, as had been one of the earlier suggestions (Bass 1967, 16T n. 37). He believed that these were ships which carried metal acquiring their name from the Akkadian word "tarshish" meaning smelting plant or refinery (Albright 1965; Bass 1967, 16T n. 36). Although these references are from a slightly later period, the Cape Gelidonya and Ulu Burun wrecks prove that such ships, dealing almost exclusively in metals, did sail. Indeed, a text from Ugarit (UT 2110) indicates that one ship carried over one hundred units of copper talents to be distributed to various customers (Linder 1970, 29-30).

Conclusion

It would appear from the archaeological data that Late Bronze Age vessels are examples of a phenomenon of ancient shipping—that is ships, which not only carried the raw metals, but also the smiths to produce the finished articles.

Unfortunately, there is little evidence at present to help understand the factors and the conditions which could have prompted the smith to become an itinerant specialist aboard Late Bronze Age vessels. Is it external pressures such as social conditions and warfare which obliged smiths to ply their craft from merchant ships? Or could it be the case that the merchant and the smith of the Cape Gelidonya ship were one and the same person and therefore the trader's mentality made an itinerant smith out of a previously sedentary craftsman? Or is it perhaps in an age of non-standardized products, the high costs of metals might have justified such customized service in the production of metal items?

Much light could be thrown on these questions by an exhaustive study of the smiths of ancient societies. A few attempts have been made in the past (Napier 1856, Robins, 1953, Eliade 1962, Forbes 1964), but the abundant archaeological and historical testimony that exists is not collected. The few notes gathered here, no doubt, demonstrate that much awaits the researcher who will deal with this intricate subject.

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PRIVATE FINANCING AND SHIPBUILDING IN THE KINGDOM OF ARAGON AS SEEN THROUGH ITS LAWS

The union of Catalonia with Aragón at the beginning of the 12th. century created a power able to expand commerce and dominion over the Mediterranean Sea.

The Kings of Aragón soon considered the advantage of converting the customs which since ancient times had regulated shipbuilding and maritime trade in Catalonia into laws which would be observed all over their dominions. It was Peter the Great who initiated these proceedings in 1340. These laws, which are known as 'customs of the sea' (*costumes de la mar*), are the extension of the 'ordinances of the coast' (*ordinaciones de la ribera*) of Barcelona of 1258 and confirm ancient systems of financing private shipbuilding and regulating the relations of all who were in the maritime trade. The central person of all these laws was the shipowner, (*senyor de la nau*).

Here we are only interested in private financing and ship building. Therefore we shall not consider the relations of the shipowner with the mariners, the merchants who hired the ship, or the pilgrims who went in it. We have extracted from these laws the paragraphs referring to shipbuilding and the means of financing it through the partnership of several people, who put their trust in the one designed as the shipowner (*senyor de la nau*) who would manage the construction of the ship and conduct the freight business going in the ship. The translation of these paragraphs follows this paper as an appendix, the original style has been modernised to avoid the tiring repetitions of the ancient writing.

These laws went into great details on the rights and obligations of the partners who formed the company to build the ship to carry freight. The shipowner was the partner who promoted the business and always travelled in the ship as the representative of the society, something similar to the roll of manager or delegate of the partners. The Laws did not consider the case of a single proprietor of a ship, as there were no relations between to regulate.

The first sentence of these Laws said:

When the shipowner begins to build a ship and wishes to offer shares, he has to communicate to the partners how many shares he will offer and how big the ship will be.

We can see from it that it was the shipowner who promoted the business and sought partners whom he had to inform first of the number of shares he proposed and which we know from documents at the *Archiu de la Corona d'Aragón* (Barcelona) were usually 8 or 16, but with the possibility that two persons could buy one share. Further he had to tell them the size of the ship: We would say the value of each share.

The Law did not state who were the partners (*parçoners*) who, with the shipowner formed the company, but it seems that there were many persons interested in this business, which was therefore probably very profitable in spite of the dangers of the sea and the pirates.

Once the shipping company was established, the partners were obliged to fulfil what they had promised, and if someone did not want or could not pay what had been agreed, the shipowner could demand payment by legal action. But this obligation was so personal that it ceased if the partner died, and his heirs were not obliged to fulfil what had been agreed if the deceased had not ordered it in his will. In such a case the shipowner had to find another partner who would take this share and pay out the heirs. These Laws established, even in an indirect way of expression and by the example of the enlargement of the ship which was to be built, the rule of majority (1/2): If the shipowner wished to make the ship bigger than proposed at the beginning, he had to request the agreement of the partners, or, at least, of the majority, and the decision of the majority was an obligation on all of them.

All these conditions are the same, in meaning, as we have today with the joint stock companies. Even the juridical person is there, represented by the ship, which had to be sold, if necessary, to pay for damages or other demands, the

partners not being liable for any higher amount than the value of the ship. But in case the ship had to be sold, the wages of the mariners had to be paid first of all.

We see through these old laws opinions which we today consider very modern, but they existed in those times, even expressed in a different way. The difference of the nominal and the market value of a share was expressed in those old laws through the following example (I/2): If the shipowner enlarged the ship which was built without the agreement of the other partners, this did not oblige them to pay more for their shares. They continued to have 1/8 or 1/6 of the ship, but the value of the share was higher. The actual agreements which are usual in Catalonia limiting the free sale of shares to third persons, may be an old custom as the paragraph (III/5) which regulated the transmission of one share to a new partner, obliged the seller and buyer to inform the shipowner of their intention.

The shipowner could refuse the new partner until he returned from the present voyage. But in all cases, the seller had to give the shipowner an option to purchase. If he did not make use of this, the sale went through the shipowner, who bought from the seller and sold publicly to the buyer with the knowledge of the other partners.

In case the partners did not reach an agreement, the solution was simple: If, for example, the partners did not agree with a proposal of the shipowner to enlarge the ship, they could force each other to sell the shares, so either the shipowner sold his share and the other partners kept the ship and selected another shipowner, or the shipowner found other partners who bought the majority of the shares and agreed with him.

From these Laws we deduce that the enlargement of ships in use was usual as we can see from paragraphs I/91 and III/4 which refer to a situation from enlargement during construction, which is regulated by I/1.

I/91 repeats nearly literally what I/1 said about enlargement during constuctions: that the shipowner had to ask the partners if these agreed, but III/44 refers to the case of the ship being in a place where there were no partners, nor at least a majority of them. In these conditions the shipowner could enlarge the ship, but only in two cases: If he was expecting an important freight or a long voyage, and also if he could foresee an important benefit for the society. Then the partners were obliged to take into account the expenses for this enlargement; but if they could prove that he had enlarged the ship out of vanity, to be the owner of a larger ship, the case was to be put before two trustworthy men and what they decided had to be accepted by all of them, shipowner and partners. We have here the arbitrators.

The Law referred to enlargements of one quarter, one third and one half, which are important changes in the ship.

To enable the shipowner to settle accounts with the partners, he needed book-keeping and trustworthy documents. For that purpose the Law provided the clerk (1/4), a very important administrator, whose function was unique in those times. He had more power and responsibility under the Aragonese Law as his equals in other Mediterranean ships as we can see through the Codex Amalfi. His documents were to be believed, as if from a notary, for all matters related to the voyage, even if they were written with the prow of the ship on the beach, or written by the clerk on land.

The shipowner could hire a clerk with the consent of the partners, if he was not a relative of him. He had to make him swear before the mariners, merchants and, if these were present, the partners, that he would be civil and faithful to any person on the ship and that he would only note in his documents the truth and what, in case of dispute, both parts expressed, doing right by every one. This old wording tells us, that he registered also the different positions expressed in case of dispute.

He had a big responsibility, as he was the guardian of the case in which the documents were kept under lock and key, and the keys of which should never leave him, and which he should never leave open in a way that another person could have access to them. In these cases, and if he wrote something which was not true, the penalty was to lose the right hand, be branded with hot iron on the forehead and to lose all he had.

1/5 obliged the clerk to be present during the time the ship was loaded. The mariners could not load nor unload, nor move the cargo without his knowledge, as he was responsible for all wares taken on board. If something taken on board on his presence got lost, he had to pay compensation for it, and if he could not pay, the responsibility was on the ship, which had to be sold if necessary, but the wages of the mariners were to be paid first.

1/6 laid down that the clerk could buy all that was necessary, but if he had to buy sails or ropes, this he had to report to the shipowner and he to the partners who made the voyage with him, as this was equipment of the ship. It was also the clerk who paid wages and expenses from the ships account, even to the shipowner (1/7) and kept the corresponding books, which he had to show on request to the shipowner and the partners on board, so that they knew what he had got for freight and what expenses there had been. The expenses and wages of the clerk were

also on the ship account and included shoes, ink, paper and parchment. The clerk could even take merchandise from a merchant as guaranty of payment of the freight.

These Laws specified the different elements of the mercantile society and the function of each. The shipowner acting in a similar way to an actual representative of the partners, whose rights and obligations were comparable with those of today. There was also the administration of the society through the clerk, who kept a register of all commercial dealings and whose responsibility and importance was greater than provided by our present laws, even through they are result of those of the middle Ages or even earlier ones.

As we have seen, l/7 states that the clerk, on request, had to show his book-keeping to the shipowner and partners who were on board. This can help us to know something more about the partners, or, at least, some of them. We know, from the part of the Law which regulates the relations of the shipowner with the merchants, that these travelled with the ship and the merchandise. This makes us suppose, that some of the partners, if not all, were merchants who were interested in having preferential position for their wares in the ship and their rights as partners. We can even suppose, that the possibility of buying half a share was to permit a merchant to give half part to a son or confidential clerk, to enable him to make the voyage as a partner.

Before we comment on the relations of the shipowner with those who were to build the ship, we shall refer to some dispositions related to those times, but which could have some parallels to our present. (l/81) If the shipowner wished to contract for a freight to the countries of the Saracenes, or a dangerous place, he had to request in advance the agreement of the partners, or, at least, the majority of them, if he was in a place where the majority was present, but he could decide on his own if not enough partners were present.

(l/82) He was not obliged to consult them in advance if the voyage was to Christian countries, but if some partner asked for a guaranty, he had to give one, following the usage of the sea. Also the partners could not sell the ship if there was a freight contracted, and had to wait until it came back. The first sentence of this paragraph is not quite so clear as we read it today unless we reflect that in those times there was no quick way to communicate with the ship on voyage and therefore the voyage had to be planned before sailing. A partner could demand a guaranty that the voyage was not extended or changed, because perhaps this partner was waiting for the return of the ship to use his right to sell.

(I/90) This paragraph obliges the shipowner to settle accounts with the partners at the end of each voyage. If he does not do so, he has to give all the profit made to the partners.

This allows us to suppose constant changes in the composition of the society. Perhaps this changed for each voyage, if some merchants going to the same place were interested in buying the shares necessary to have the majority of the society, so to be able to decide anything during the voyage.

For the construction of the ship there were two possibilities provided by the Law: that the shipowner hired shipwrights and caulkers, or that he ordered the ship from a wharf.

In the first case (I/3) the shipowner was obliged to pay daily the expenses and wages, if there was no agreement to pay every week. It was not necessary to fix a wage, as if this was not fixed, he had to pay the wages customary at the locality.

The Law provided that, if the artisans made a mistake and the ship was bigger than ordered, they had to pay half of the resulting expenses, and lost also the wages for the added time of the work. Nothing is said if the ship was smaller, as this could be enlarged easily.

The artisans building the ship had to inform all the partners about the size contracted with the shipowner and whether the ship should be strong or light. In this way the law provided information for the partners which, at present, does not exist any more, as the suppliers are not obliged to inform all the partners about the extent and the quality of the materials. If the shipowner decided to build himself with shipwrights and caulkers he had to consider labour regulations which we find very modern in tone, even if expressed in ancient terms.

Supposing there was a fault during the construction of the ship (III/3). It made a difference whether or not the artisans were capable and of good repute. If they were capable the shipowner could not dismiss them and had to come to an agreement with them. Neither could he dismiss them, if others offered to do the work for a lower price. If the shipowner dismissed them, no other shipwright or caulker should work on the ship before he had come to an agreement with the former employees.

The problem was different if the artisans were not able to built the ship. In that case they could be dismissed and the new crew was not obliged to consult them. If he ordered the ship from a dockyard, prudence obliged him to inform the

artisans who worked there, that the ship was produced on order (III/4). If the shipowner did so, the artisans could not embargo the ship if the proprietor of the dockyard did not pay them.

In both of two possibilities, penalties could be fixed, if the ship was not delivered in time. If the penalty was fixed, the shipwrights had to pay as provided, but if there was no penalty agreed, they had to compensate the shipowner for losses. On the other hand, the shipowner also had to reimburse the artisans for damages or losses, if he delayed payments to them. The Law insisted that in that cases equity had to prevail.

These old laws of the Catalan coast, referring to the activity of shipping companies reveal ideas which we consider very modern, but which confirm the antique roots of all our laws. Most of the details of the regulations of relations of the shipowner with his partners, or with the artisans who build the ship would be accepted to-day.

Summarizing, we could say that the financing and shipbuilding in the Kingdom of Aragon was done through companies following ancient customs, resulting from the necessity of gathering the necessary capital in all those little towns or villages in the many coves of Catalonia which traded at sea. That these customs were unified first by the most important of the towns of Catalonia - Barcelona - and later confirmed as Laws of the Kingdom was logical. Further, the spirit of these laws lives today, not only in the regulations for joint stock companies, but also in those for labour relations.

Federico Foerster Laures †

CONSOLAT DE MAR

AS COLLECTED AND REVISED BY FERRAN VALLS Y TABERNER AND
EDITED BY "EDITORIAL BARCINO" 1930 BARCELONA
EXTRACT AND COMMENT OF VOLUME 1 "COSTUMES DE LA MAR"

Referring to
"The building of a *nao* or *lley*"
(*Nao* and *Lley* were Catalan merchantmen)

I

Extract of the Law, volume 1, "customs of the sea"
The financing and building of a ship

- 1/1 When a shipowner wants to build a ship with partners, he has to agree with them of how many shares are to be and how it shall be build; how large, how wide and of what draught, and the extent and depth of the hold.
- If his partners are convinced by him and promise to participate, what they have promised, they must fulfil. If a partner is unable or unwilling to do what he has agreed, the shipowner can force him to do it, or can be credited with the sum his partner was obliged to provide.
- 1/2 If the shipowner who begins to build the ship on a certain scale and then gives her more depth in draught, and in the hold, and greater extend of surface in the hold, and makes the ship larger by one third, one quarter or one half before giving information to his partners, then no partner is obliged to increase his contribution but only to give for what the information has been given at the beginning. If he enlarges the ship in any way, the partner's share will be as if he had contributed to the enlargement which has been made. But if the shipowner wishes to enlarge the ship, he must go to each partner and ask who wants it to be done and who is opposed, and even if two or three or four or five partners are in opposition, so long as they are in a minority, the objection to the enlargement shall not be valid, and all the partners must accede to the request.

- l/3 The shipowner is obliged to give each shipwright who works on the construction three *diners* (Catalan coin. 12 Catalan diners are 1 *sou*, 20 *sous* are one *lliura*, the Catalan pound) every day for bread and drink, and also the wages he has agreed with them, if the shipwrights do not wish to give him grace to wait for their wages from one Saturday to another. But if the shipwrights work with the shipowner at will and no wage is fixed, the shipowner is obliged to give them the same as other shipwrights have on other constructions, according to the times and the region of the country.
- l/4 The shipowner may hire a clerk for the ship with the consent of the partners, if he is not his relation. He has to make him swear before the mariners, merchants and the partners, if there are any in the place, that he will be civil and faithful as much to the merchants, as to the shipowner, mariners, pilgrims and to any person who goes in the ship, and that he will keep the documents case and write nothing in it but only what is true, and what he hears from each of the parts in a discussion, and that he will do right to every one.
- And if the documents have been held by someone other than the clerk, nothing written there shall be believed.
- And if the clerk writes what he should not, he shall lose his right fist and be branded with hot iron on the forehead, and shall lose all he has, whether he or an other has written it.
- Further, the shipowner has to make the clerk swear that he will not sleep on land without the keys of the case in which are the documents, and that he will never leave the case open under penalty mentioned above.
- l/5 The clerk has such authority, that the shipowner may not load anything into the ship, except in the presence of the clerk, and no mariner shall take goods on board, nor unload them on land, nor move them without the knowledge of the clerk. And if anything is lost in the ship, may it be bale or bundle, other goods or merchandises, which the clerk has noted or was present when it was loaded, the clerk has to pay for it, and if the clerk has nothing to pay with, the ship must pay for it, even if it has to be sold, saving the wages of the mariners.
- l/6 The clerk may buy and sell all things, that is to say, tools, food or nets without informing the shipowner, but for rigging he has to inform the shipowner and the shipowner the partners who go with him.

- I/7 All expenses, such as food and drink are to be paid from the ship account to the shipowner and the clerk and also the clerk has to be paid for shoes, ink and parchment.
- I/8 The shipowner has the same wages as any of the other pilots who go in the ship ... And the clerk has to pay this to him and to note it down as well as payments to any of the others who are mariners ...
- I/10 The documents in the case are to be believed and regarded more than any other documents, even if the ship has the prow on land, or the clerk was on land when writing in them.
- I/66 If a shipowner rents rigging for a voyage and the rigging is lost through no fault of his, he is not obliged to compensate the person who rented it to him, but to pay only the rent which both had fixed. But if the rigging is lost by the fault of the shipowner, he is obliged to pay compensation for as much as the rigging was worth at the moment he took or rented it, or to return as much rigging as he took.
- I/81 A shipowner who contracts his ship to go to the countries of the Saracens, or to dangerous places, if he is in a place where there are his partners, must ask their consent before he confirms the contract for the voyage.

And if he consults them and the partners agree, he may make the contract, and no partner can continue to oppose him. And if he makes the contract without consulting them, the partners can oppose it and can make him buy their shares, since he had not asked them. If he had asked them, the partners can not make him buy their shares, nor put them on sale under any circumstances, before he is back from the voyage.

And if the partners buy out the shipowner who has contracted to carry cargo without their knowledge, and he disposes of the ship by sale or other means, and the partners keep the ship, it has to continue the voyage for the merchant who had made the cargo contract, for the price or freight for which the merchant had agreed with the shipowner with whom he had made the contract. But if the shipowner is in a place where there are no partners, he can make a contract for cargo and go to any place he wishes, and if the ship suffers any damage nobody can demand compensation for this action. But if he took any risk or chance, or the ship was lost by any act for which he was responsible, the partners can demand redress from him.

- I/82 A shipowner who contracts for cargo to go to Christian countries is not obliged to ask the agreement of any partner, if he does not wish to do so. No partner can sell out after he has contracted for the cargo until the ship is back from the voyage. But the shipowner has to give guaranty to his partners if any ask for it, that he will not change the voyage until he has returned the ship into the possession of the partners. The guaranty he gives need not be official, but only in the usual form following the customs of the sea.
- I/100 Every shipwright or caulker who promises to work for any shipowner is obliged to do the work, whether or not the wage has been agreed, since he has promised to do it. And if he will not do it, he is obliged to answer for any loss or damage which the shipowner for whom he had promised to work, can show that he has suffered, and also expects to suffer, except if the said artisan had been prevented by Act of God or by the Authority.
- And every shipowner who promises to give work to one or several of the said artisans and does not do so, is obliged to pay them the wages he had fixed with them. And if per chance no wage was fixed, the shipowner who failed them, is obliged to give all the equivalent of what other artisans get in the construction on which they work, considering the worth and reputation of the said artisans.

III

- III/1 If any person promises to join in the construction of a ship and he dies before the ship in whose construction he has promised to participate is constructed and completed, the heirs of those who hold the goods of the man who has died, are not obliged to do anything for the shipowner to whom he who had died had promised partnership if he had lived, if this matter had not been ordered or instructed to be introduced in his will. And if the one who died had given some money as part of the share in the partnership which he had promised to bring, and if this money is so much as to amount to the whole share he had promised to contribute, this share has to be sold before the ship sails out of the place where it has been built. And if per chance the money he gave was not enough to complete his share, the shipowner must look for some one else to provide the amount which the one who died had promised to contribute.

- III/2 If any shipwright makes the ship larger than had been agreed with the shipowner, he has to pay half of all the cost of the enlargement and lose the wages of as many days as he had worked on it. Further the shipwright is obliged to inform each one of the partners of the dimensions he has agreed with the shipowner, and also is obliged to state the type of construction, strong or light.
- III/3 If any shipwrights or caulkers work with any shipowner, they are obliged to do good solid work at which they are masters, and are able to carry out the construction, or even one better and greater, and the shipowner had given them the management of the construction, they had accepted and following his wishes had begun it, and while working there happens some misadventure to the said artisans, the said masters doing well and diligently all that the construction demands, and the shipowner wishes to dismiss them because of this misfortune, from which he will suffer through them, or if per chance he finds others who will do it for a better price, the shipowner can not dismiss them; neither can they leave it, since they have begun the work, until they have finished it, so far as these masters are good and able to carry out this construction and even one better and greater. And if the shipowner dismisses them, even though they are good and competent workers and doing well and diligently all that is necessary for the construction, no other shipwright or caulker shall participate in the construction, so long as the shipowner does not or had not come to an agreement with the artisans who had begun the work, and they shall not be discharged, on the word of the shipowner, but the newcomers shall be brotherly towards the artisans who had begun the work. But if the shipwrights and caulkers who begun the work had not sufficient knowledge how to do it, the shipowner can dismiss them and give the work to other shipwrights who know how to do the work. And those shipwrights who know how to do the work are not obliged to ask for information from the artisans who had begun the construction if these did not know how to do or finish it.
- III/4 If any shipwright or caulker agrees to carry out any construction on contract, he is obliged to pay all the other masters who work with him in the construction he has promised to carry out on contract which he has agreed. And if the artisans who work with him do not know that he is doing the work on contract, the shipowner must state it and tell them, because the shipwright may be a swindler or insolvent, and not have the wherewithal to pay the artisans who work for him, so that they will not be deceived, not knowing that he is doing the work on contract.

And if the shipowner does not tell them when they begin work on the construction and the shipwright who is doing the work on contract does not want to pay them or does not have the funds, the artisans who have worked on the construction may act and take over the construction they have made, and the construction has to be sequestered until the artisans are recompensed for all their injuries, damage and discomforts, and all expenses for food and drink which they have suffered.

But if the shipowner had stated and told them that the shipwright was working for him on contract and the shipwright might or might not pay them, they may not and shall not sequester the construction they have made, since the shipowner had told them at the beginning of the work, that he had given it on contract.

And if the shipwrights or caulkers who are building on contract agree with the shipowner for whom the construction is undertaken that they will deliver it finished on a fixed day or in a known time, and between them has been fixed and set down a set penalty, if the said artisans have not finished the construction as they had promised, the shipowner can demand the penalty from them, which was set between him and the artisans, and the said artisans are obliged to pay it without excuse. But if between them no penalty has been set or deposed, the said artisans are obliged to compensate the shipowner for any prejudice or damage he has suffered and all expenses for food and drink which he has had or will have, for the amount of which he is to be believed under his oath. But if the shipowner does not honour the payments he has agreed with the artisans and they have expenses for food and drink or suffer other losses, the shipowner is under the same obligations and compulsions to the artisans as they are to him, so that there is justice and equality between them.

- III/5 If any partner wishes to sell the share he has undertaken to pay for the construction of the ship, he has to inform the shipowner, and similarly has the buyer to inform the shipowner; but if the shipowner does not want a new partner, the buyer can not participate until the ship has made the voyage. And when the ship has completed the voyage, the partner can sell his share to the shipowner and this by shipowner to the buyer.

But the selling partner must give the shipowner the opportunity to surrender it or to acquire it, and the shipowner has the right to surrender his share or to buy from the partner, if there is no public sale.

III/4 If the shipowner is in a place where there are all of the majority of the partners, the shipowner has to ask them to agree to the enlargement of the said ship he wishes to make, and if the said partners, all or the majority of them do not wish it, the shipowner cannot force them to agree or carry it out. But the said shipowner can compel the said partners and these partners the shipowner to sell their respective interests. And if the shipowner should be in a place where there are none nor will be any of the said partners - none nor the majority of them and the shipowner wishes to enlarge the ship he can do it. But it is to be understood that the shipowner may enlarge it for only two reasons: In case he finds a great cargo or a long voyage, or he sees or expects there could be a great profit for himself and also for all the partners.

And if the shipowner enlarges the ship for either of these two reasons the partners are obliged to take into account all expenses for food and drink and other things which the shipowner had to pay for the enlargement, as long as the partners cannot show any reason for the contrary.

But if the partners can show a contrary reason to the shipowner, that the shipowner has not made the enlargement for the said reasons, but has done it by his authority or out of vanity, so that people will say he is owner of a great ship, then these expenses which have been incurred for the reasons given above, the partners are not obliged to take into account, unless they wish to, but those expenses which have been incurred as before are put before two good men of knowledge, perspicacy and prestige and what these decide to say should be accepted, the partners are obliged to take into account with the shipowner.

TIMBER CUTTING FOR SHIP CONSTRUCTION IN ANTIQUITY

SUMMARY

During the 18th century a revival of the ancient tradition of the Timber cutting for naval construction took place at the Arsenal of Venice.

This revival which gave us the opportunity to learn a lot about the principles of Timber cutting during the ancient time, was based on the information provided mainly by Vitruvius and Pliny.

These principles were abandoned after the 9th century AD when the Northern invaders arrived in Southern Europe.

After the Venetians made peace with the Turks in 1718, any activity of ship construction at the Arsenal of Venice ceased. The boats under construction were finished so slowly that one of them was launched after having spent fifty years at the docks.

Although the decline of the Venetian Republic continued, a vigorous expansion of commerce and ship construction took place due to important reforms in 1736. According to these, custom rights for the import and export of merchandise were considerably reduced, and the policy of the state favored the construction of the boats called “active boats” (*navi atte*), meaning vessels able to travel alone, without the escort of state convoys. The characteristics of these boats were quite consistent having a minimum overall length of 70ft and 24 cannons, and they were considered able to defend themselves from the pirates. To implement the reforms, adequate laws provided for a state subvention, which mainly meant the possibility of work at the Arsenal, where the technicians were available for three months and the materials for ship construction and their armament were offered at favorable prices.

Although the *riforma* did not revive Venice’s former merchant prosperity, the expansion of the fleet was considered as *felice*, so that in 1746, some Venetian ships sailed over to Petersburg and America via London.

In this period, Venice profited from the wars of the so-called “Spanish succession”, the French Revolution, the Russo-Turkish wars and developed the “neutral transport”, which only ceased with Napoleon’s intervention and the end of the Republic.

The start of this new era was also accompanied by two important events: first the updating of the old structures at the Arsenal, and secondly, the development of a high quality level of Venetian ship construction.

In 1738 a new building called *Palad alle seghe* was under construction, followed two years later by the construction of another building for storing and cutting public timber, called the *Tezzone alle seghe*. The reason for the latter that important construction was that for the first time, after the elimination of storing wood in piles or keeping it submerged in water, the patrons and supervisors of the Arsenal intended to use the scientific agronomic rules for the conservation of wood for naval carpentry.

As far as naval science is concerned, an experiment of historic value was the institution in April 1745 of the first chair for the study of Nautical theory and Naval Architecture at Padova. It should be noted that at the same period the general interest in Greek and Roman Architecture influenced a whole scientific approach. For example, the architect of the above mentioned building *Tezzone alle seghe*, Giovanni Scalfarotto, was known for his classical studies and his direct contact with Roman Architecture. This also became obvious in the architectural solutions he gave to the building, which maintains the structural principles of ancient Romans aqueducts.

On the other hand, regarding Naval studies, Nautical theory and ship construction, a very strong scientific preparation was guaranteed through the study of mathematics, mechanics, Hydrostatics, and general nautical theory. The study of the classical treatises of Vitruvius, Pliny, Serlio, etc, was the basic preparation and included most wellknown works of that period like the *Nouveau cours de mathématique* the *Architecture Hydraulique* of Bernard Forest de Belidor, and also the *Elements de Architecture navale* by Duhamel du Monceau and the *Traité du navire* by Pierre Bouguer.

During the final and more complex phase of reorganization of the naval force, a large number of decrees were approved, regarding the protection and the disposition of natural resources like wood, forests, etc. New institutions like supervisors and representatives for the forests were inaugurated among the local nobility, and following the proposals of the Agrarian Academy, a compilation of tables and statistics began to offer an overall view of the state of the forests and the wood supply.

Although one of these decrees was concerned with prescription of the lunar phases considered opportune for timber cutting, on the 16th of April 1758, a

Venetian citizen, Paolo Garbiza, presented to the supervisors and Patrons of the Venetian Arsenal a project regarding the way to preserve the proper element of any type of wood, describing all the preparation stages considered necessary before the final felling of the timber. According to his text, preserved in a manuscript in the state Archives of Venice, no one had previously considered the question of the perfect dryness of the wood before being used for ship construction.

With this project, Paolo Gradiza proposed to the patrons of the Arsenal his unique method for obtaining perfectly dry wood before storage. According to the manuscript, his method consisted of starting to cut the trees with some “preparatory cuts” some months before the final felling.

These cuts should take place at the base of the trees and not only at the exterior surface but also to a certain depth in the trunk. Leaving the trees in that condition for a certain amount of time, the plant would be kept alive, conserving all its natural strength but without the excess sap. This would happen, as he says, because the trees slowly lose most of their moisture, without cracks of termites.

He did not specify the time necessary for this operation, nor even how deep the “preparatory cuts” should be, because that mainly depends on the type of tree and on the quality and type of soil on which the tree was growing.

With his method (as he claims), the question of the time of year that the tree should be cut became negligible. For example, after a season of rains more time might be necessary for the tree to lose all the excess sap than in a “dry” season.

For a final demonstration of his project, Paolo Garbiza proposed to distinguish the timbers cut according to his method with a stamp. Later, when the timbers were assigned to the shipbuilders at the Arsenal, for the different parts of construction, the stamps would easily identify the difference between the timbers in use.

Before the end of his text, Garbiza proposed to the Patrons of the Arsenal to communicate his project to *professori naturalisti*, Mathematicians, and *Periti Publici*, so they can confirm whether his project agrees with what ..*Esimio Professore Vitruvio* wrote in his chapter nine part two about the use of materials.

The Patrons of the Arsenal communicated this project to Giovanni Poleni, who was professor *ad mathesim, nauticae teoriam, ed experimentalem philosophiam* at Padova, who was involved in Naval science, but mainly about *architecturae navalis principia*.

At the same time G. Poleni was a kind of consultant at the Venice Arsenal and had to supervise any scientific applications as for example the construction of replicas of the S. Carlo boat, purchased from the English.

On the 9th of November 1758, Poleni responded to the Arsenal's Patrons regarding the Garbiza project, with a twelve page text, which is also preserved at the state archives of Venice. He started with references mainly of historical interest followed by contemporary scientific explanations of each question. First he discussed Garbiza's reference to Vitruvius's theories, and analysed the relevant chapter using the 1567 edition of Daniel Barbaro.

According to that, and from Morgan's translation, "Timber should be felled between early Autumn and the time when Favonius begins to blow. For in spring all trees become pregnant, and they are all employing their natural vigour in the production of leaves and the fruits that return every year" (Poleni, f. 19v) and that "In felling a tree we should cut into the trunk of it to the very heart, and then leave it standing so that the sap may drain out drop by drop throughout the whole of it. In this way the useless liquid which is within will run out through the sapwood instead of having to die in a mass of decay, thus spoiling the quality of the timber. Then and not till then, the tree being drained dry and the sap no longer dripping, let it be felled and it will be in the highest state of usefulness". (Poleni, f. 20).

Then, his next reference is to the sixth book, chapter thirty, of Pliny's *Natural History*, edited by Harduino in 1723, which also confirms that "preparatory cuttings were in use in antiquity. (Poleni, f. 20r). A similar reference is to the Palladio Rutilio, who around the third century, writes that the trees should remain with the preparatory cuts until "drains away all the sap that the tree has".

At the end, Poleni makes similar reference to an anonymous source of about the ninth century AD called *Compendium Architecturae* (Poleni, 20v.), concluded in this first part of this text that the preparatory cuts were in use until the ninth century.

After that he has no other historical evidence, but according to him during the dark ages that intervened, in most of the countries that system was forgotten.

In the second part of his text, he addressed the scientific aspect of the problem, the *ragioni* as he says, with the use of a great number of texts which demonstrate also the level of science in the 18th century. Books like the *Institutiones Philosophicae* of Purchotius, the chapter of *Anatome Plantarum* in *Opera omnia*

by Marcelli Malpighi, the entry for *Pianta* in Chambers's dictionary, the *Philosophia* of Du Hamel, the *Oeuvres* of Mariotte and of Claude Perault, The *La Statique des Vegetaux* of Hales and at the end with the *Histoire* of Renceaume. All these sources were used to analyse scientifically the problem of circulation of liquids in timber, which Poleni applies to discuss the mechanism for their nutrition and their life.

After that, the proposed preparatory cuts, will stop the rise of new liquid from the roots to the leaves, and also will arrest the part of the liquids that descend.

According to his opinion, the application of that system will help to keep the trees dry, and in better condition for construction.

Before finishing his report, Poleni returns one more time to the argument about the period of the timber cutting. He consider that the two most important things that the supervisors should take into consideration are: first the phase of the moon and second the month of the year.

For the first question, he refers to the common belief that changes of the moon have a big influence on the trees. This happens because as was assumed, the full moon gives to the trees plenty of sap, so they are less durable when cut. So according to his opinion, the cut should take place with the old moon, which means from the 18th to the 3rd of the next moon.

About the second question, he considers that the sun also has a great influence on the plants. Thus it is better that the cut take place during the months with minimum sunshine to minimize the flow of liquids.

He concludes it that, the ideal time for cutting new timber should be during the winter time. Among those months special interest should be given to December which approaches springtime.

Conclusions

The proposal of P. Garbiza, shows the revival during the 18th century of the ancient tradition of timber preparation before felling.

This technique was commonly used until the 9th century AD. With the beginning of the northern invasions and of the dark ages, this method was forgotten.

The revival of that ancient technique, observing the month of the year, the phase of the moon, and making preparatory cuts, took place in connection with the 18th century interest in classical Architecture. Both contributed to the high quality naval construction technique developed during that century at the most famous European arsenal.

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APPENDIX

All' I. Illustrissimi ed Eccellentissimi Signori Proveditori e Patroni all' Arsenal Poleni.

9 Novembre 1758.

1. Il fine, cui spetta la ricerca fattami per una venerata Commissione dell' Ecc:ze vostre, é un tale taglio degli Alberi, quale faccia si, che gli Alberi tagliati riescano di maggior durata ed all' uso perfetti. Confacente a questo fine fu Loro presentato dal Sig. e Paolo Garbiza un suggerimento, intorno al quale io, ubbedendo Loro, esporró il parer mio.
2. A questo fine molto contribuisce l' asciugare gli Alberi; ed il sig. r Garbiza si dichiara, che su questo solo ed unico punto versa il suggerimento suo: che per maggior lume alle cose da dirsi io cui trascrivo.
3. Qualche, scriss' Egli, Mese prima di gittar a terra l' albero di qualunque genere siasi reputo necessario far nel piede alcuni tagli attorno la pianta, li quali tagli nonsolo abbiano da intaccar la Corteccia, ma da penetrare ancora in una parte del (19v) vivo legno. Lasciato cosí per alcun tempo discreto a proporzione del bisogno, si conserverà viva la Pianta, ma discendendo la sua umidità superflua resterà il legno perfetto nella naturale sua forza, perché lentamente scolando si renderrá asciuto. Fin cui Egli.
4. Verso il fine poi del suo Suggerimento lo stesso Sig. Garbiza, con una commendevole ingenuità, scrive, uniformarsi 'l progetto suo alla Dotrina da Vitruvio in questo proposito esposta. Io ebbi in altri tempi occasione di considerare il luogo di Vitruvio, che a quest' affare appartiene: ed è esso luogo nel Capo nono del secondo Libro dell' Architettura di quell' esimio Autore, che fiorí ai tempi d' Augusto. Le parole di Vitruvio (volgarizzate dal dottissimo Monsignor Daniel Barbaro) sono le seguenti¹. La materia si deve tagliare il principio dello Autunno, che sará fin a quel tempo avanti che

Favonio cominci a spirare (cioè innanzi la primavera) perchè da Primavera gli Alberi, sono pregni et tutti mandano la virtù della loro proprietá nelle fondi, et nei frutti.....² Et però se con quella ragione, et a quel tempo, che detto ho di sopra, si taglieranno gli Alberi, sarà utile et opportuna (20r) cosa. Ma così bisogna tagliarli, che ci vadi fin a mezzo la midolla, et lasciato sia il taglio, fino che stillando per esso si secchi l' umore, per il che quello inutile liguore, che in essi si trova, uscendo per lo suo tuorlo, non lascerà in quelli morire la putredine, nè guastarsi la qualità della materia: ma quando poi l' Albero sarà seccato, nè stillerà più, bisognerà gettando a terra. Et a questo modo si troverà perfetto all' uso.

5. All' autoritá di Vitruvio aggiungere si potrebbe quella di Plinio, il quale nel trentanovesimo Capo del Libro sesto della Natural istoria sua (composta circa al tempo di Vespasiano) narró, che³ alcuni non inutilmente lasciano gli Alberi tagliati all' intorno sino alla midolla (non però tanto che non restino in piedi) acciocchè, stando essi ancora in piedi, tutto l' umore fluisca ed esca. Similmente Palladio Rutilio, Autore che circa il terzo secolo scrisse, nel suo Mese di Novembre insegnò, che⁴ gli Alberi da tagliarsi recidansi pria colle mannaie sino alla midolla, e che quando sono così recisi, si patienti che restino per alquanto tempo in piedi, acciocchè per quelle parti scorra l' umore (20v) se nelle vene dell' Albero se ne contenga. E l' Anonimo Autore dell' opera, intitolata Compendium Architecturae, il qual scrisse circa il nono secolo (come esser probabile mostrai nelle nie Vitruviane Esercitazioni) propose, nel suo duodecimo Capo⁵, che gli alberi da recidersi, siano prima mentre stanno in piedi tagliati sino alla midolla, ma non interamente recisi acciocchè in tal modo si scoli l' umore inutile, e la rarità delle vene seccata si consolidi. Ma dopo quel secolo essendo sopravvenuti li secoli barbari, non è da maravigliarsi, che nel corso del loro tempo, o in tutti, o in alcuni Paesi, possa esser andato (principalmente per l' uso) in dimenticanza quel precetto de suddetti Autori.
6. Ma dalle Autorità passerò alle ragioni. Delle quali io non saprei dire, se prima non esponessi com'è da riflettersi, che⁶ gli Alberi sono organizzati, e costano di molte parti che mirabilmente servono alla formazione de medesimi, ed alla loro nutrizione. Primo fu il celebre⁷. Malpighi, che diede alla sua Anatomia delle Piante; indi anche altri dotti uomini hanno nella stessa con industrie ed ingegnose ricerche (21r) versato: ed hanno pur concepito, che qualche analogia siavi tra il⁸ meccanismo intero degli Alberi, e quello degli animali. E ci resero noto, che gli Alberi sono formati e di sottilissimi

cannellini, e di vasi spirali, e di urticolì, e di altre solide parti. Ma non solo sono composti di solide parti, che da alcuni diconsi vasi, anche di fluide; conciossiacché crescono e si alimentano cogli umori (o diconsi succhi) che⁹ dalle radici ascendono ai rami ed alle foglie, e dagli estremi rami e dalle foglie sino alle radici ritornano; e circolando (per dir cosí) si concuocono, e si trasformano variamente; e non sono già senza i loro ¹⁰ sali, ed altro. Di più molti degli umori negli Alberi ad un cetro modo s' impinguano, ed hanno della spessezza; onde¹¹ sevo degli Alberi anche sono chiamati.

7. Si dee anche avvertire, che per quella circolazione degli umori nei vasi degli Alberi hanno molta influenza il calore, e l' aria; e questa pur ¹² riesce ben utile all' avanzamento della vegetazione degli Alberi medesimi; i quali sono anche dotati della facultá di traspirare. Traspirano¹³ alcuni insensibilmente, come molte sperienze hanno dimostrato; ed altri¹⁴ sensibilmente tramandano degli umori; alcuni de 'quali umori esciti all' aria aperta (21v) si condensano, come avviene (per esempio) nella produzione delle Resine, e delle Gomme. Ma, dopo queste or quì tre altre aggiungerne debbo pur importanti al proposito nostro.
8. La prima si è, che¹⁵ le foglie degli alberi contribuiscono alla perfezione del nutritivo succo. E ciò viene provato dal vedersi, che gli Alberi, i quali abbiano fiorito, ma immediate poi gli siano state dai Bruchi (da noi chiamati Rughe) corrose le foglie, non hanno, per dir cosí, che degli aborti.
9. L' altra si è, che¹⁶ del succo nutritivo degli Alberi una parte passa per i vasi della corteccia, nelli quali è ben probabile, che riceve una nuova digestione. Di fatto si osservano alle volte degli Alberi internamente scavati e guasti, che della parte legnosa non hanno se non se quanto basta per mantener la corteccia in piedi, e che non ostante e vivono, e danno delle produzioni: dal che si può dedurre, che la corteccia per la nutrizione degli Alberi sia importante più della parte legnosa.
10. La terza parte poi consiste nell' osservazione seguente. In alcuni Alberi, de 'quali sia stata tagliata all' intorno la corteccia, nel fine della tagliata parte superiore, dopo qualche tempo (22r) si osserva formato e prodotto un grosso labbro (a guisa di un anello) che rende ingrossata quella parte. Quindi egli è da agromentarsi che negli Alberi quantità d' umore per la loro corteccia all' in giù ritorni: onde nel proposto caso ne nasca, che quell' umore, il quale discende per la corteccia, se in parte non trovi de escire per il vasi d' essa tagliati, si fermi, e quell' ingrossamento produca. Il quale si

può considerare come sia pure un indicio della natura inclinata ad andare anche negli Alberi cicatrizzando le loro ferite: nè una tale considerazione dee pretermettersi.

11. Poste tutte le suddette notizie, dalle quali apparisce essere organizzati gli Alberi, ed essere ragionevolissimo il credere, che per entro essi nell' indicata guisa circoli l' umore che li nutrice e mantiene; ne segue, che stante que 'Tagli proposti dal sig.r Gardica, (li quali, comechè gli Alberi restano in piedi, si possono chiamare Tagli preparatori) ne segue, dico, che rimanga inutile quella parte d' umore, che principiando ad ascendere trova tagliati i vasi per cui dovrebbe progredire, e rimanga pur inutile la parte d' umore che discendendo sbocca per i vasi tagliati. E rimanendo inutili quelle parti, è da credersi, che al tempo dell' (22v) intera recisione degli Alberi debbano essi restare più asciuti, e per la durata in condizione migliore di quel che sarebbero di più favorevole il consenso di que 'dotti Antichi, egli è a mio credere lodevole il suggerimento d' esso sig.r Garbiza, e da parsi in uso.
12. Già suppongo, che il sig.r Garbica intenda di fare il taglio preparatorio andando fin a mezzo la midolla, come propose Vitruvio, Autore cui si rapporta esso sig.r Garbiza, che citandolo scrisse così: si uniforma il mio progetto all' Articolo secondo all' uso de Materiali prescritto dall' esimio Professore Vitruvio. E suppongo che, fatti li Tagli preparatori, se ne osserveranno con diligenza i loro effetti, per lo scarico de succhi per la durata di questo, per le cicatrici che in alcune parti si formassero, per le alterazioni che nella vegetazione degli Alberi nascessero, o per altro che apparisce: ed eziandio suppongo che delle osservazioni tenirassi chiaro registro. Onde ciò che si apprendesse possa somministra delle regole convenienti al Pubblico servizio. In verità (non ostante le favorevoli autorità e ragioni) mi sembra, che trattandosi d' un opera, i di cui effetti saranno in massima (23r) parte dipendenti dalla Natura, sia per giovare l' osservarla anche quanto che agisce.
13. E quì avend' io già espresso il sentimento mio sopra l' affare del Suggerimento, di cui l' esposizione sta nelle Carte, per ordine dell' Ecc: ze V. re trasmessemi, sembrerebbe ch' io avessi finito. Ma sia lecito all' attenzion mia riverente d' aggiungere qualche breve riflessione ad un altro affare, sì strettamente con quel primo congiunto, che assendosi detto dell' uno egli è affatto naturale il dire dell' altro.
14. Quest' altro affare spetta al tempo di recidere gli Alberi (ed in tale proposito dirò, che per recidere intendo il taglio, con cui gettarsi a terra) e di questo

pure (come però incidentalmente) nel secondo suo scritto¹⁷ qualche motto il sig.r Garbiza ne fece. Esporrò dunque, che due cose per la recesione degli Alberi vengono considerate: L' età della Luna, ed il Mese dell' Anno.

15. Ella è un antica opinione, che gl' influssi della Luna abbiano negli Alberi molto potere: e questa opinione non solo dagli Uomini Volgari, ma eziandio da molti dotti Uomini viene sostenuta e difesa. Suppongono questi, che la Piena Luna renda (23v) gli Alberi più abbondanti d' umori , onde meno durevoli se si taglino; ed al contrario che gli umori pel decrescere della luna decrescano, e gli Alberi in questo tempo tagliati più durino. Di questi tali effetti cagionati dalla Luna ini però sogliono addurre ragioni, ma piuttosto ricorrono ad occulte virtù. E se qualche¹⁸ Valentuomo ha voluto spiegarli, egli è ricorso al calore, che dalla Luna Scema.
16. Ciò una buona spiegazione ci avrebbe somministrata, se fosse stato ben provato, che dalla Luna si propaghi ne 'terresti corpi calore. Ma di un tale propagazione non sono state recate prove constanti. Il Montanari¹⁹ narra, che con uno Specchio ustorio grande, ed un Termometro assai delicato, s'era scoperto del calore proveniente dai raggi della Luna.²⁰ E Hooke, de la Hire, Vilette, Tschirnhausen, valenti nell' arte di spiare le opere della Natura, con esatte sperienze, praticate pure con grandi specchi ustori, Genti, e delicatissimi Termometri, hanno cercato il valor della forza Lunare, né hanno trovato indicio di calore proveniente da essa.
17. Comunque però siasi di quelle Sperienze (benchè io propenda alla parte dell' Hooke, (24r) e di quegli altri, ed ciò che in tale proposito il Padre Belgrado ne ha recentemente scritto) reputo, non essere nel nostro caso da trascurarsi l' età della Luna: se non altro, acciocchè difetti de 'legni provenienti da altre cagioni non si possano attribuire ai negletti riguardi per quel Pianeta. Secondo i quali riguardi parmi, che si possa seguire l' opinione de quelli, che²¹ propongono il taglio degli Alberi a Luna vecchia, cioè dalli 18 avrei d' un giorno o meno.
18. Passo dalla considerazione d' un Luminare alla considerazione dell' altro, e vengo all' importantissimo. Il sole è quegli de corpi celesti, che ne 'terrestri ha la grande influenza. Trovo che questa senza dubitazioni si dee riguardare: e ben conviene pel taglio degli Alberi scegliere que 'Mesi, in cui la minor forza del sole meno aiuti l' ingresso de 'fluidi nelle vene degli Alberi. Onde ne nasca, che minor quantità d' umori ricevano li Cannellini, e gli Urticoli, e gli altri vasi; e che compressi dal freddo abbiano evacuato molto d' umori;

e che le traspirazioni (delle quali di sopra s' è detto) abbiano prodotti li maggiori loro effetti.

19. Io certamente fo con quelli, che per questo importantissimo punto della scelta de'Mesi prediligono i Mesi dell' Inverno. Nei quali Mesi come da principio si può comprendere il Dicembre, così sul fine egli è ben guardarsi dal tempo, in cui gli Alberi principiano i moti della Primavera.
20. Così resta esposto all' Eccelleze Vostre il sentimento mio giusta le venerate loro Commissioni asprimenti, che da me fosse esibito quanto credessi nel proposito. Elle si degnino di gradire l' ubbidienza mia, ed il profondo ossequio, con cui sono.

Di Vostre Eccellenze

Padova 9 Novembre 1758

U.mo Div.mo Obbl.mo servitore
Giovanni Poleni.

NOTES

1. Editione del 1567, pag. 89 lin. 4 avanti il fine.
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4. Editione del Gesnero 1753. Tomus alter. pag. 1005, art.XV.
5. Poleni, *Exercitationes Vitruvianae Secundae*, pag. 191
6. Purchotius, *institutiones philosophicae*, tom. III, pag. 24, 25 Primo et Praeter.
7. Marcelli Malpighii. *Opera Omnia*. In Volumine Primo extat Anatome Plantarum.
8. Chambers. *Dizionario* alla parola PIANTA pag, 364 §Dalle osservazioni ...
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10. Mariotte, *Oeuvres*, Tom. premier, pag. 121. Ma Premier, Et du Hamel, *Mémoires de l' Académie Royale*, Année 1729, pag. 350, §*Cette Méchanique*.
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12. Hales. *La statique des Vegetaux*. pag. 276. lin. 16. v. opur paf. 274.
13. Hales. Lib. cit. dalla pag. 3. alla 50. V. la "Table" alla parola "Transpiration". E. Guettard. *Memoires de l' Academie Royale*. An 1748. pag. 569.
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15. Reneaume. Nella cit. *Histoire*. pag. 51. § II y a . lin. 10
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17. Garbizza. Scrittura seconda. §La necessitá
18. Montanari. *Astrologia convinta di falso*. pag. 9.10.11
19. *Astrologia* cit. pag. 5 § e per cominciare
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21. Montanari. *Astrologia* cit. pag. 9. §lo non lin. 12

THE MA'AGAN MICHAEL SHIPWRECK

Part 1: General description of the finds followed by reflection on life on board and trade patterns in the middle of the first mill. BCE.

The site is located apr. 75 m offshore the swimming beach of Ma'agan Michael, a Kibbutz situated 35 km south of Haifa, Israel. The shipwreck lies under a layer of fine sand, 1.5-2 metres thick, in less than one metre of water deep (in normal sea conditions). A chain of reefs and a small island line up parallel to the coast 200 metres westward in a north south direction. This last feature affects the currents and sedimentation process which bare on the coastal morphology and has to be counted on when analyzing the history of our ship's wreckage.

The story of the discovery, with its dramatic touch on the beginnings of Marine Archeology in Israel 30 years ago at Ma'agan Michael, has already been publicized before. Our excavation methods and all the difficulties encountered because of the shallow depth in a surge zone are a subject to be taken up while discussing techniques in under water excavations. I shall therefore confine myself to a brief description by category of the various finds discovered and retrieved during the past two seasons of excavation in 1988 and '89. Then add short comments on the significance of the finds for the study of ancient shipping when touching on topics like Life on Board or Trade Patterns in the Mediterranean.

The main cargo:

We still ponder what comprised the main bulk of cargo considering the fact that by now over five and a half tons of ballast stones were cleared off the ship's hull and at least the same weight awaits to be removed. Since the midship was not yet excavated, we may still find evidence for the characteristic commodity possibly hiding under the ballast, if the cargo was not salvaged in antiquity in its totality. *Or, we may have to look for another clue as will be suggested later.*

The ballast is a category in itself and required a close analysis which indeed was carried out by the Geological Survey of Israel which reached the preliminary conclusions: among the seven rock types examined, the 'blueschists facies rocks are predominant and considering the collective evidence from all the rock types analyzed, and based on the examination and review of the geology of the Mediterranean, the Tyrrhenian Sea coasts around Corsica or Calabria, are the most likely of origin for the ballast stones found on the MM ship.

The ceramic ware consists of a fair number of complete vessels in an excellent state of preservation and many sherds which later in the laboratory were restored into semi wholesome vessels. From the stern of the ship we retrieved a cooking pot, a large footed bowl, pinch nozzle lamps, rounded lipped jugs with high handles, bowls of different sizes, black glazed miniature cups, juglets, trefoil mouth jugs and large fragments of amphoras, some decorated with a palm tree motif.

The assemblage should be divided roughly into 3 categories for dating and parallels as to origin. Firstly, the usual wares one would expect on any ship plying the Eastern Mediterranean during the middle of the first milenium BCE which include the cooking and storage ware, lamps etc. These are easily dated to the 5th century BCE, more probably to its second half. Second, the high handled jugs which have their parallels in Cypriote tombs where they are defined as representing non local type; these are usually associated with typical Phoenician ware of the second half of the fifth century BCE. Third, the miniature glazed bowls, which originate from an area north west to our coast, possibly eastern Greece, where glazing was much in use already in the end of the fifth century BCE. The decorated amphora could well be of Cypriote provenance.

The organic materials represent a basket, several kinds of ropes ranging from 1-3.0cm in diametre, three ply left handed twist; Dunnage in fairly large quantities identified as pistachio branches. A variety of foods which were analyzed by archaeobotanical laboratories of Bar-Ilan University, consist of barley, grapes, olives and figs. A preliminary pollen examination pointed to the summer season of the sailing.

The wooden objects turned out to be the most exciting small finds. These are divided into two principal groups: The artistically carved palettes, one "heart" or "leaf" shaped with three circular chambers and a pivoting lid and the fiddle shaped palette of which two specimen were found. Whether these were used to hold cosmetics, or served other purposes cannot presently be defined because of lack of parallels.

The second group belongs to the carpenter's tools

During the first season of excavation in the Autumn of 1988, just before winding up the operations at sea, several wooden artifacts were discovered in one small area which turned out to belong to the carpenter's tool kit: a handle with iron traces on one edge, an awl, a deformed mallet, a bow drill, a whetstone. When returning several months later, the excavation was resumed around the same area and turned out more items which unquestionably belonged to the complex of the shipwrights tools like a perfectly preserved carpenter's square, spare tenons and treenails in hundreds!

Since the metal forming the tools disintegrated almost completely, we could not at first define their shapes and exact functions. However when examining closer some suspicious concrete lumps found around the wooden handles, the results of the x-ray 30 KV photography were astonishing. Almost every lump of concrete engulfed an object the out line of which is clearly visible. Once these lumps will be carefully dissected and the negative cavities recast, we shall be able to reconstruct several of the iron tools.

Another category of the finds, belongs to the metals. We discovered iron and cooper nails used in the construction of the hull, an iron object resembling a cultic scoop and a barshaped ingot, which after the analysis by atomic absorption method, was identified as tin of 95% purity.

When piecing together the evidence from a preliminary study of the small finds and after taking into consideration the results of the meticulous analysis of the hull construction by Jay Rosloff, we get the first glimpse into the ship's history, its possible route and trade patterns.

The wreckage may have occurred when the ship, which lies in a perpendicular position to the coast with its prow landward, missed an opening in the sand bar while heading to a lagoon behind it or trying to make the Crocodile River Estuary some 2 km to the south.

A natural calamity or hostile human interference are not discounted although presently no signs of any damage to the hull or fire traces were observed. The parts of the ship excavated were found in a perfect state of preservation, not damaged by marine bore, its tools and ropes almost unused, with fresh chips of carpenter waste found in its bilge, which suggested that the ship was possibly on its maiden voyage.

The heavy ballast load did not leave too much displacement for a large volume of cargo. Indeed, beside those single items characteristic to commercial transactions carried out by the crew, we have not found as yet any clues as to the identity of the major bulk of the cargo.

Is it possible that beside the usual functions of a merchantman, our ship was engaged in selling the expertise in woodwork craftsmanship and shipwright skills? In such a case it would follow the pattern of the seafaring Merchantsmith whose presence was attested by the Cape-Gelidonya Shipwreck cargo and supported by the interpretation of a maritime text from Ugarit.

Which was the home-port of our ship and what was its cultural affiliation? The ceramic ware points to Cyprus and Eastern Greece as probable stopovers. The ballast stones and their origin could serve as another criterion although we know little about the handling of ballast, its reuse and storing. However, the temptation is big in suggesting the Central Mediterranean as a possible area for the location of the ship's homebase. This could be supported by certain features in the hull construction but much is still left to conjecture. The forthcoming season of excavation in the Autumn may add important clues to our inquiry.

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 - Fig. 7 "Heart" shaped wooden box found at Ma'agan Michael
 - Fig. 8a The ship's carpenter tools
 - Fig. 8b A carpenter's square, found with other tools of the ship's carpenter still at perfect right angle
 - Fig. 9 A tin ingot

Photos: Danny Syon, David Evan, Steve Breitstein.

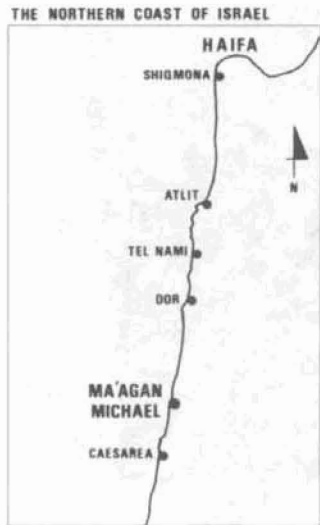


Fig. 1



Fig. 2



Fig. 3



Fig. 5



Fig. 6



Fig. 4a



Fig. 4b

Fig. 8a

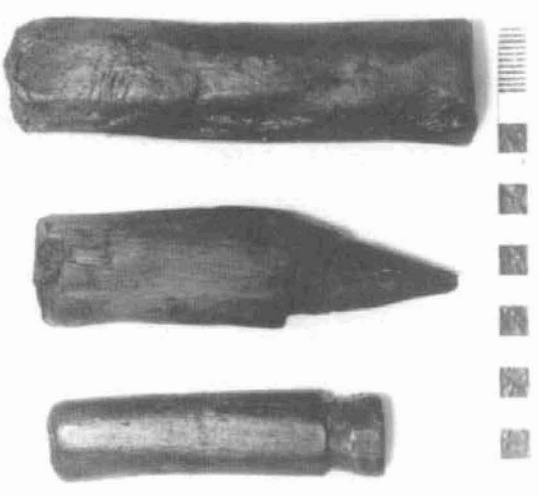


Fig. 8b

Fig. 7

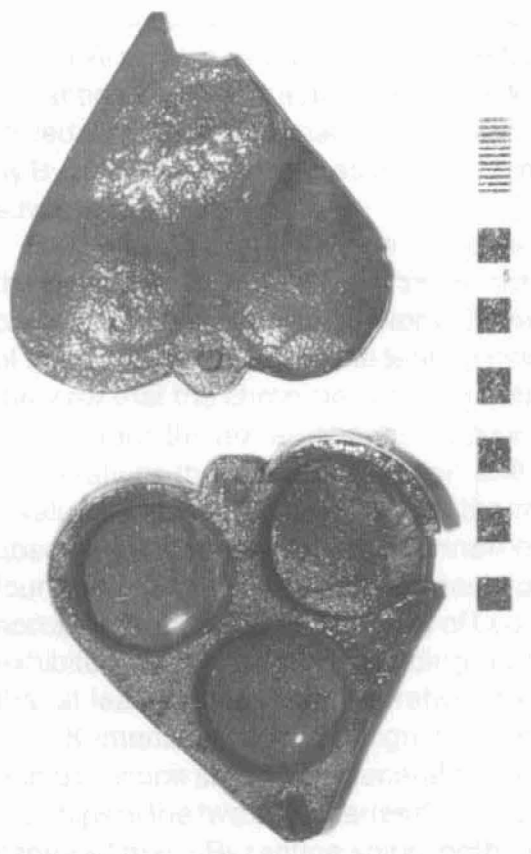


Fig. 9

SOME QUESTIONS OF MEDIEVAL NAUTICAL TECHNOLOGY IN KAMENIATES' "SACK OF THESSALONIKI" (904 AD)

The chronicle of Ioannis Kameniates which recounts the sack of Thessaloniki by the Arab fleet of Leo of Tripolis in 904 AD provides valuable information on Byzantine and Arab nautical technology of the early tenth century. The questions raised by Kameniates' narrative concern the type, size, and rig of the ships used by Byzantines and Arabs as well as the methods of warfare employed by the two adversaries.

The tenth century is one of the best documented periods in the history of the Byzantine navy and Kameniates' chronicle is on the whole a reliable guide on contemporary nautical technology. Some doubt has been cast on the authenticity of the chronicle as a genuine tenth century source.¹ However, even if we accept the view that the chronicle is a later (perhaps fifteenth-century) reworking of an earlier story, the text as it has come down to us contains a number of eye-witness observations that are unmistakably authentic tenth-century information and are invaluable as such. For example, the mention of the use of greek fire and the absence of any reference to cannon or gunpowder (both common since the fourteenth century), the detailed description of Arab and Sudanese warriors, the accurate reporting of the itinerary of Leo of Tripolis through the Aegean Sea, who exhibited particular care in avoiding confrontation with the Byzantine fleet, show that at least a core of the narrative must be an authentic tenth century work.²

Kameniates gives us significant information on the type and size of Arab and Byzantine ships. The general remark to be inferred from his narrative is that the ships of the two adversaries did not greatly differ. He informs us that the Arabs captured many Byzantine ships, both warships and merchant vessels, some of

which they hauled up from the bottom of the harbour by means of a winch-like machine³. Therefore, knowledge of both merchant ships and warships was shared between the two peoples. Kameniates himself was among those captured and along with other slaves boarded one of these ships, a Byzantine warship. He informs us that the ship had two “decks” (*καθέδραι*) and actually calls the ship a *dieres* (*διήρης*); the top deck (*τὴν ἄνω καθέδραν*) was occupied by the Arabs and the bottom one, which was “very dark and foul smelling”, was occupied by the slaves⁴.

This description of the Byzantine warship raises a few problems. It is certain that the ship had two “levels” or “banks”, since Kameniates calls it a *διήρης* which can only mean “a ship with two rowing levels”⁵; on the other hand, the term “deck” which Kameniates uses is misleading since it is highly improbable (and impractical for rowers in the hot Mediterranean conditions) that a ship would have closed decks, in the manner of later Western galleys. It is most probable, therefore, that by “bottom deck” Kameniates actually means the hold of the ship since only the hold fits the above description as being “very dark and foul smelling” and is an apt place for the prisoners to be hoarded on a long voyage⁶. In Kameniates’ terminology, the two banks (or “rowing levels”) of the ship could be designated by “top deck” and the hold by “bottom deck”. This is borne out by the fact that in a later passage he mentions that the Arabs spread hides over the ships thereby depriving the slaves of light;⁷ this could only be the case if the sunlight penetrated the place where the slaves were placed from above, and the hold of the ship which presumably had no side-openings fits this description best.

It is interesting, in connection with the above, that the thirteenth Arab author and official in Mamluk Egypt Ibn al-Manqalī states that the lower bank in Arab ships sometimes served as a hospital.⁸ It is doubtful here whether the lower bank or the hold of the ship is meant. Ibn al-Manqalī’s passage shows, however, that it was common practice among the Arabs to allocate the lower part of the ship to an auxiliary service, be that hospital facilities or slave-storage.

As for the size of Byzantine and Arab ships, Kameniates states that there were 200 Moslems and 800 Christian slaves in a Byzantine warship,⁹ and more than 1.000 (Moslems and slaves) on another ship, which however was nearly in danger of sinking from the weight (*ὡς τοσοῦτον ἀπέχειν βαπτισθῆναι τὴν ὀλκάδα ὅσον μιᾶς παλαιστῆς τὸ μέτρον ἐστίν*, “so that the ship was only one *palaiste* away from the water”¹⁰ - the measure *palaiste* is equivalent to four fingers’ breadth, or a little more than three inches). Unfortunately, in neither of the passages does Kameniates provide the information of how many rowers there were. It seems, however, that a complement of 200 men (rowers and soldiers) was almost standard in both Arab and Byzantine ships, a number which agrees with the Byzantine sources (Leo VI’s 10th-century *Naumachica* and Constantine Prophyrogennitus’ 12th-century *De cerimoniis*).

Kameniates' perceptive observations also shed some light on the rig of Byzantine and Arab warships. It was a characteristic of Arab and Byzantine warships that they were equipped with superstructures to enhance the fortification of the ships and the effective waging of battle from the deck. Leo VI mentions¹¹ that the forecastle (*ξυλόκαστρον*) was the wooden construction *περι τὸ μέσον τοῦ καταρτίου* (which is usually translated "half-way up the mast"¹² but is very improbable). It has been suggested that this should be corrected to *περι τὸ μέσον τῶν καταρτίων* ("half-way between the masts") or *περι τὸ μέσον κατάρτιον* ("around the middle mast")¹³. These readings, however, point to the fact that there must have been more than one mast. The second emendation of Leo's text (i.e. of a forecastle situated around the mast) is favoured by a thirteenth century arabic translation of Leo's guide by Ibn al-Manqalī who translates the same passage as: "in every ship there is a forecastle by the mast".¹⁴

The fact that there was indeed more than one mast is corroborated by Kameniates who speaks of *κατάρτια* ("masts"), in the plural, which are moreover *διὰ μέσου προβεβλημένα* ("projecting from the middle [of the ships])¹⁵. Furthermore, the fact that the foremast slings (*κατὰ πρόραν ἐξάρτια*) are specifically mentioned¹⁶ shows that a foremast existed which must have been placed as far forward as possible in the ship.

A celebrated passage in the narrative describes the way in which the Arabs joined the ships together and constructed a kind of makeshift wooden tower in each ship in order to reach the fortified walls of Thessaloniki which had been especially strengthened (and thus were higher) in anticipation of the Arab siege. The passage provides significant information on matters of nautical construction (e.g. that the ships possessed big and sturdy steering oars, that the mast amidships was the biggest, the foremast slings are specifically distinguished) all of which have been dealt with at some length by Dolley¹⁷. The passage also indicates, however, the tactical plan of the Arabs which was to approach the city walls with the stern of the ships and construct the towers well aft (this points to the fact that the ships were probably higher aft). It is very interesting that we find an exact parallel of the same tactical plan in the way the Crusaders took Constantinople after the siege of 1204. Villehardouin, one of the chroniclers of the siege, informs us that the Crusaders "devised further that the ships that carried the scaling ladders should be bound together, two and two, so that two ships should be in case to attack one tower"¹⁸ and Robert de Clari tells us of a similar method being employed, namely, that the Crusaders used bridges swinging from the masts of the ships to approach and fight the Byzantines on the city walls.¹⁹ Thus, this piece of evidence shows us that three hundred years after the sack of Thessaloniki by the Arabs the Crusaders used similar methods of fighting to capture Constantinople; in this way Kameniates' narration of the Arab plan acquires even greater credibility.

A point which should be particularly clarified, in itself remotely connected with nautical technology but clearly showing the nautical contact between Arabs and Byzantines, is Kameniates' use of the adjective "black" for Arab soldiers and the actual presence of blacks in the Arab army.

We know that the Egyptian army contained a large number of black Sudanese soldiers; indeed, the last ruler of the Ikhshidid Arabs of Egypt, Kafur, was black.²⁰ Sudanese soldiers were renowned for their skill in archery and their general fighting prowess and were regularly employed in military campaigns. Therefore, Kameniates mentions blacks in his narrative because he actually saw blacks among the Arab army and not because the Byzantines used the adjective "black" "proverbially, as a symbol of darkness" to characterize warriors that they particularly feared, as Kazhdan suggests.²¹ There is no doubt from Kameniates' narration and from contemporary historical evidence²² that the army of Leo of Tripolis actually numbered black Sudanese soldiers among its ranks; in fact Kameniates' narrative is a corroborating source for the presence of such soldiers in the Arab army of Leo of Tripolis.

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- 3 Kameniates, 61. 3.
- 4 Kameniates, 73.12, 74.7.
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- 6 Kameniates, 60.7.
- 7 Kameniates, 69.3.
- 8 Ibn al-Manqalī, *Al-Aḥkām*, p. 22, n. 2. This piece of information if found in Christides (1984b), 143.
- 9 Kameniates, 67. 1.
- 10 Kameniates, 76.6.
- 11 *Naumachica* 7.
- 12 Dolley (1948), 51.
- 13 *ibid.*
- 14 Ibn al-Manqalī, *Al-Aḥkām*, ed. M. 'Abd al-Raim (typescript), Cairo, n.d., 21. The translation of this passage appears in Christides (1984a), 44. See also Christides (1984b), 138 ff.
- 15 Kameniates, 32.5.
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*SOME QUESTIONS OF MEDIEVAL NAUTICAL TECHNOLOGY
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- 17 Dolley (1949), (1950).
- 18 Villehardouin & de Joinville, *Memoirs of the Crusades Villehardouin & de Joinville* (transl. Sir Frank Marzials), Westport CT: Greenwood, 1983 (repr.; first ed. London: Dent, 1908), 60-1.
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- 20 Christides (1984a), 189-90; see also the same author's article "milāḥā" in *EI*².
- 21 Kazhdan (1978), 308.
- 22 For example, in the Egyptian army, and it is a fact that Crete had normal trade relations with Egypt in the tenth century. Especially for Fatimid-Byzantine relations see Goitein (1967), (1973); van Doorninck (1991).

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είδώς γάρ ὡς ἄπαν περικλύζεται τὸ κατὰ νότον μέρος τῆς πόλεως ἀπὸ τῶν θαλασσίων ὑδάτων, ἐκείθεν δὲ προσπίπτοντος τοῦ πολέμου εὐχερῶς ἔχειν τοὺς βαρβάρους πᾶν ὅτιοῦν βούλουιτ' ἂν ἐν αὐτῷ διαπράξασθαι, μηδενος κωλύοντος | αὐτοὺς ὑπεράνω τῆς οἰκοδομῆς γενέσθαι τοῦ τείχους διὰ τὸ πρόσγειον καὶ χθαμαλωτάτην εἶναι τὰς τε νῆας μᾶλλον ὑπερανέχειν ἐκ τοῦ κατὰ πρῦμναν μέρος, καὶ ἀπὸ μετώρου δύνασθαι τοὺς ἐν ταῖς ἐπάλξεσιν ὄντας καταπιτρώσκειν, ἐβουλευσατο φραγαμὸν τινα καὶ τετεχνημένην ἐνέδραν ἐν αὐτοῖς ἐγκρύψαι τοῖς ὕδασι.

ὑφάψαντες γάρ πανταχοῦ φῶτα, καὶ πάσας αὐτῶν τὰς νῆας κατὰ δύο συζεύξαντες ἑτέραν τῆς ἑτέρας ἐχομένην, καὶ τισι κάλοις στιβαροῖς καὶ σιδηραῖς ἀλύσει τὰς ἑκατέρων πλευράς ἐν ἀλλήλαις συσφιγνάντες πρὸς τὸ μὴ ῥαδίως ἀφίστασθαι, ἀνέλικυσαν διὰ τῶν κατὰ πρῶραν ἀπηωρημένων ξαρτίων τὰ διὰ μέσου προβεβλημένα ξύλα, ἃ τοῖς ναυπιλλομένοις κατάρτια καλεῖν ἔθος. εἶτα τοὺς τῶν ἑκατέρων νηῶν αὐχένας ἐν τούτοις διὰ τῶν εἰς τὴν κεφαλίδα στρεφόμενων σχοινίων μέσον που τοῦ ἀέρος μετεωρήσαντες, τὰς τε σπάθας αὐτῶν ἐκ τοῦ κατὰ πρῶραν μέρος καὶ πέρα τῆς τῶν νηῶν διαμέτρου προβεβληκότες, ξένον τι καὶ παρηλλαγμένον παουργέυμα διὰ τοῦ τοιοῦτου τεχνάσματος ἐτεκτήναντο. ὕψου γάρ, ὡς ἔφη, τῶν αὐχένων μετεωρηθέντων, ἐβαλλον ἐν αὐτοῖς ἐπιθέτες μακρὰ τινα ξύλα στιχηδὸν ἄλλο κατ' ἄλλο, καὶ τὸν διὰ μέσου τόπον γεώσαντες τῇ σεσοφισμένη ταύτῃ μηχανῇ, τὰ πέρατά τε πάντοθεν σανίσι καταφραζόμενοι, καὶ τὰ ἄκρα τῶν αὐχένων ἐν τοῖς κατὰ πρῦμναν μέρεσιν ἄλλοις στιβαρωτάτοις δεσμοῖς ἐνασφαλισάμενοι, πύργους τινὰς τῶν εἰς τὴν χέρσον ἐν τῷ τείχει καθισταμένων χρεωδεστέρους τῇ ἐπινοίᾳ ταύτῃ κατετεχνάσαντο, ἐν οἷς ἐνόηλους τινὰς βαρβάρους ἐπανεβίβασαν, βώμη σωμάτων καὶ τολμηρὰ φύσεως ἀνεσταλαμένους, πῆ καθ' ἡμῶν ὑστάτην καὶ τελευταίαν ἐπιβουλήν ἐνεργήσαντας. ἐπέτρεπον γάρ τοὺς μὲν αὐτῶν βάλλειν τοῖς τόξοις κατὰ τῶν ἐνδοτέρων τοῦ τείχους ἐστῶτων, τοὺς δὲ τοῖς χειροπληθέσι λίθοις· ἄλλους πυρὶ τι, καὶ αὐτῷ τετεχνημένῳ καὶ τισιν ὄστρακίνοις σκεῦσι προηυτρεπισμένῳ, καθοπλίσαντες κατὰ τῶν ἀντιπρόσωπων αὐτῶν ἐρχομένων προσέταττον ἀκοντίζειν. ταῦτα δὲ πάντα ἦν αὐτοῖς ἐνεργῆ τε καὶ ἐπιτηδεῖα διὰ τὸ μῆκετι περὶ γῆν αὐτοῖς εἶναι ποιεῖν, ἀλλὰ τῷ προλεχθέντι κακούργῳ τεχνάσματι ὑψηλοτέρους αὐτοὺς καὶ αὐτῆς τῆς οἰκοδομῆς γενέσθαι τοῦ τείχους

ἐκαστῇ γάρ αὐτῶν συζυγίᾳ ἐπεφέρετο τὴν σεσοφισμένην ἐκείνην τῶν ὕλοσυνθέτων πύργων κατασκευήν, πολλὰ τῷ μέτρῳ τὴν τοῦ τείχους οἰκοδομὴν ὑπερβαίνουσαν, ἀνωθεν τε τοὺς βαρβάρους ἐξαλλομένους καθάπερ τινὰς ἐξοιστημένους ταύρους, καὶ τὸν ὀλέθρον ἅπασιν ἐπισειόντας.

1. As he [Petronas] knew that the entire southern part of the city is surrounded by the sea and that if the battle were to start in that part it would be easy for the barbarians to do whatever they wished there, since no one would obstruct their climbing over the construction on the castle wall (for it is close to the shore and low in height) and as the ships' sterns would be much higher they, being at a certain height, would be able to lethally wound the men in the bulwarks, he decided to hide some kind of obstacle and well-prepared trap in the water.

(17, 4-5)

2. They lit lamps on every side, and yoked all their ships together in pairs, one alongside the other, binding the sides of each pair with stout hawsers and chains and so lashing them that they might not easily be parted. Then by means of the foremost slings they hoisted aloft those poles projecting from their middle which in nautical parlance are called yards. Next they used tackle to hoist to the masthead the steering-oars of the vessels, their blades running forward and outboard of the ships. In this way they acquired a new and different contrivance by this trick. Having, as I said, hoisted aloft the steering-oars, they laid across long planks side by side, placing them so as to bridge over the intervening space in this most ingenious contrivance. The ends [of the platform] were provided with a screen of planks, and the [inboard] extremities of the steering-oars were made fast by more very strong chains carried well aft. By this fabrication they constructed towers, more useful than the ones in land, on the castle walls. On those towers they mounted armed barbarians, distinguished for their bodily strength and natural audacity, to perpetrate the last and final attack against us. Some of them could thus hit with bows those who were inside the castle walls, and some with hand-held stones, while others with a kind of prepared fire which was placed within clay jars, and they ordered them to throw it on the face of anyone coming towards them. And all this was effective and well-suited, for they were not doing this being on the ground but, with the afore-mentioned evil trick, they were standing higher than even the construction on the castle wall itself.

(32, 5-11)

3. And each pair of those [ships] bore that pre-figured construction of towers made of wood, which exceeded by far the height of the construction on the walls, and on top the barbarians, in a frenzy like raging bulls, about to bring destruction to all.

(34, 2)

οι οὖν βάρβαροι συναγα-
γόντες τὰς νῆας τῆς πόλεως, αἷς ἐχρῶντό ποτε πρὸς τὸ τὸν σίτον ἐπι-
κομίζεῖν οἱ καθ' ἡμᾶς ἔμποροι, ἐτι δὲ καὶ δις ἤμεν βυθίσαντες κατὰ τοῦ
πορθμοῦ τοῦ λιμένος σοφισμασί τινα ἀνεκύσαντες (β καὶ ἐνήργησαν διὰ
τικῶν στροφίγγων τοῖς ἐκείσε προβόλοις ἐπιτετηθευμένων καὶ τὴν
ἐπίνοιαν ἐργῶδη δεικνύντων, ἐλισσομένων τινὶ τεχνάσματι καὶ διὰ τῶν
ἀπηωρημένων κάλων ἀνεκκυόντων τὸ ὑποκείμενον), οὕτως οὖν καὶ
ἄλλων νηῶν πληθῶν εὐπορήσαντες εἰσεκόμισαν ἅπαντας, ὡς μηδένα
πῶποτε τῶν εἰς τοῦτο τεταγμένων παραλειφθῆναι.

ἡμᾶς
δὲ πάντας τοὺς ἐν τῇ καταλλαγῇ τηρουμένους ἐτι διεσπαρμένους ὄντας
συναγαγόντες οἱ βάρβαροι καὶ τινα πολεμικῆ νηὶ τῶν ἐκ τοῦ λιμένος
ἀκασπασθειῶν ὑφ' ἐν εἰσενεγκόντες καθιέρξαν ἤμεν δὲ πάντες, ὡς
εἰρηται, ἐν μιᾷ νηὶ Ῥωμαῖα πολεμικῆ, ἣτις ἦν διήρης, ὧν τὴν μὲν ἄνω
καθέδραν οἱ λαχόντες εἶναι μεθ' ἡμῶν βάρβαροι ἑαυτοῖς ἐκληρώσαντο,
τὴν κάτω δὲ ἡμῖν ἐπαφῆκαν, σκότους πολλοῦ καὶ δυσωδίας πλήρη.

ὡς γὰρ βιαίως οὕτως ἐξ ἀλλήλων
δισαιρεθέντες φύρδην ταῖς δόκασιν εἰσῆχθησαν, εὐρείαις τε οὖσαις καὶ
ἱκαναῖς πλήθει πολλοὺς ἐξαρκεῖν, οὐ κατάστοιχα, οὐδ' ὡς ἂν τις εἴποι,
ἐν αὐτάρκει τόπῳ τοῦ σωματικοῦ ὄγκου τῶν εἰσελθόντων ἕκαστος τὴν
καθέδραν ἐλάβανεν, ἀλλ' ὡς ἔτυχεν ὅπασ' κατενεχθείς, τοῦτο μόνον
ἀπεκλήρωτο, μὴ δυνηθεὶς ἐν δόλαις ταῖς ἐφεξῆς ἡμέραις ἕως μιᾶς παλα-
στῆς τόπον ἐφευρεῖν, ἵν' ἀνακλιθεὶς ἀνάπαυσιν δῶ κἂν βραχέϊαν τῶ
σώματι.

θυλάκων ἀψύχων δίκην ταῖς σελίσιν ἀλλήλοις ἐπικαθήμενοι, καὶ τοῖς
ζύλοις, οἷς ἐνηρτήμεθα, τιτρωσκόμενοι τε καὶ συνθλιβόμενοι, ἀνεκδιή-
γητόν τινα καὶ ἀρηρτοῦν ὑφιστάμεθα τὴν ἀνάγκην, οὐδ' ὅπως οὖν
συστραφεῖναι ἢ τινας ἑαυτοῖς μεταδοῦναι σχολῆς συγχωρούμενοι, ἀλλ'
ἢ μόνον τὰς κεφαλὰς ὑψοῦντες μικρὸν, εἰ που κἂν ἐλευθέρου ἀέρα ταῖς
ρίσιν ἐφελκίσωμεν καὶ μὴ πρὸ παντός ἄλλου δεινοῦ τῆ τῶν παρόντων
ἀνοσθυμιάσει τὴν πνοὴν ἐπαφήσοιμεν.

ταῖς νυξίν ἐφήπλουσαν τὰς δερματίνιας δέρρεις διὰ πασῶν
τῶν νηῶν καὶ πάντας εἰσὼ τοὺς δυστυχεῖς ἡμᾶς ἐναπέκλειον, ὥσπερ
καὶ πᾶσι τοῖς ἄλλοις ἐπικαθήμενοις.

4. And the barbarians, having gathered the ships of the city which our merchants once used to carry the wheat, and having even heaved up, by some contraption they thought-out, those ships which we had sunk at the entrance to the port (which they did by turning-wheels set up on the wall bulwarks - showing a tedious effort - and which they turned by some means, lifting up the ship with its brails hanging out). Having in this way acquired many more ships they boarded everyone in, so as not to leave anyone who was destined for this purpose [slavery] outside. (61,3)
5. And all of us who they kept for exchange and who were still scattered, the barbarians gathered and imprisoned on a warship of the ones they had hoisted up from the port [...] and we were all, as was mentioned, in a Greek warship which was two-banked (dieres). The top deck the barbarians who happened to be with us chose for themselves while the bottom one, which was very dark and foul-smelling, they left to us. (73,12 / 74,7)
6. In this way having been violently separated from each other they [the prisoners] were thrown mixed up in the ships which were wide and could fit lots of people. Nor, as someone could imagine, did each one of those who were brought in take his place according to his bodily size and was allotted the appropriate space, but at random was every one thrown in and that was his only gain, for in all the days that were to come he could not find even a little space to lie down and give his body some, even a short, rest. (60, 7)
7. Like lifeless bags we were sitting one on top of the other on the seats and being squeezed and pricked by the wood on which we were tied, we suffered the unspeakable and indescribable hardship without being able to turn around or to stretch and rest, but only by lifting our heads a little could we, perhaps, breathe some free air so as not to let our last breath not from some other evil but from the present stink. (68, 9)
8. At nights they spread covers of hide over all the ships and shut - poor us - all of us inside, so as to deprive us of light, too, together with everything else.

ΙΩΑΝΝΟΥ ΤΟΥ ΚΑΜΙΝΙΑΤΟΥ ΕΙΣ ΤΗΝ ΑΛΩΣΙΝ ΤΗΣ ΘΕΣΣΑΛΟΝΙΚΗΣ

κατὰ μόνην τὴν ναῦν ἔνθα ἤμεν
ἡμεῖς ὀκτακοσίων αἰχμαλώτων | ψυχῶν ἀριθμὸς ἦν, δίχα τῶν ἐν αὐτῇ
βαρβάρων, διακοσίων καὶ αὐτῶν ὄντων

πολλῶ γὰρ πλείω χιλίων ψυχῶν
ἔφασκον εἶναι κατὰ τὴν ναῦν ἐκείνην, ἐκ τε τῶν βαρβάρων καὶ τῶν
αἰχμαλώτων τῶν ἐν τῇ Κρήτῃ κατ' αὐτὴν εἰσενεχθέντων καὶ τῶν ἐκ τῆς
ρήθειας προστεθέντων αἰτίας, ὡς τοσοῦτον ἀπέχειν βαπτισθῆναι τὴν
ὀκτάδα ὅσον μίᾳ παλαιστῆς τὸ μέτρον ἐστίν.

καὶ ταῖς ἀπὸ τῶν πετροβόλων
καταφοραῖς, ὧν καὶ αὐτὸς μόνος ὁ διὰ τοῦ ἀέρος ἐγγινόμενος βοῆζος
ἐκατασιν τοῖς βαρβάροις ἐναπειργάζετο.

οἱ μὲν γὰρ αὐτῶν τοῖς τόξοις, ἕτεροι δὲ χειρο-
ποιήτω βροντῇ τῶν λίθων ἐκέχηντο· ἄλλοι τοῖς πετροβόλοις ἐγκαθή-
μενοι τὰς ὑπερμεγέθεις ἐκείνας τῶν πετρῶν χαλάζας μετωρίζοντες ἐπεμ-
πον. | κατὰ μόνης τῆς ρηθείσης πύλης ἐπιτά παραέστησαν πετροβόλους
πάντοθεν περιπεφραγμένους, οὓς διερχόμενοι τὴν Θάσον πρὸς τὴν
τοιαύτην χρεῖαν προπαρεσκεύασαν. καὶ μὴν ξυλοσυνθέτους τινὰς
κλίμακας ἀντικρῶ τούτων τῶν τείχει προσπελάσαντες ἀνέναι δι' αὐτῶν
ἐπειρῶντο, τοῖς ἀπὸ τῶν πετροβόλων ἀφιεμένοις λίθοις τὸ ἀσφαλὲς ἑαυτοῖς
συντηρούμενοι

John Caminiates: On the Sack of Thessaloniki (A.D. 904) [3]

9. In the ship that we were, alone, the number of prisoners was eight hundred souls, without the barbarians on board who were two hundred in number.

(67, 1)

10. It was said that in that ship there were more than a thousand souls, both barbarians and prisoners who boarded her in Crete as well as those from the aforementioned cause [saving another ship] so that the ship was nearly in danger of sinking.

(76, 6)

11. And [the barbarians were hitting us] with hurls of stones from the stone-throwing machines (*petroboloi*), the whistling noise of which alone, carried by the air, drove the barbarians to a frenzy.

(26, 6)

12. Some of them [the barbarians] used bows while others a man-made roar of stones; others sitting on the stone-throwing machines (*petroboloi*) were throwing from above this great hail of stones [...] against the mentioned gate alone they set up seven stone-throwing machines covered all over, which they prepared for this use when they were passing from Thasos. Also, by bringing wooden ladders opposite them, they tried to climb up the castle walls, covering themselves safe from the stones hurled by the stone-throwers.

(29. 3-6)

NOTES ON SALAMINIAN HARBOURS

*Κατὰ τοῦτό ἐστι Σαλαμῖς νῆσος
καὶ πόλις καὶ λιμὴν.
SKYLAX*

Introduction

My contribution¹ to this Third International Symposium on “Ship Construction in Antiquity” aims at giving us the chance to visit some of the ancient harbours of Salamis, land of King Ajax and birthplace of Euripides, an island favoured by Geography to be *εὐλίμενος* (well-harboured), not *δύσορμος ναυσίν*, as the ancient Greeks would have said.

Among the bigger islands of the Saronic Gulf, Salamis, with an area of 93.5 km², lies nearest to Attica. Its fame derives mainly from the great sea-battle that took place in the historic Straits in 480 BC. Yet, that naval battle, however crucial for Greek History, was one of many events in a long and at times turbulent Salaminian history in which ships and seamanship, harbours and sea-communication played a major role.

The nautical tradition is still very much in evidence in Salamis today. A substantial part of the income of many of the modern Salaminians derives from activities associated with the functioning of the *Naustathmos* i.e. the Arsenal of the Greek Fleet in the northeastern part of the island and of a sizeable fleet of fishing boats harboured at Koulouri, the island’s capital; and also with the existence of a series of small and medium-size shipyards and ship-repair units around the Bay of Ambelaki in the eastern part of the island and at Perama on the opposite Attic coast, which is linked to Salamis by ferry.

As its title suggests, my paper is a compilation of working notes and observations on Salaminian harbours made during recent field research for a larger project concerning Prehistoric Salamis with particular reference to its southern part², a project on which I have been fortunate to embark in collaboration with Professor Demetrios I. Pallas, an indefatigable explorer of his native island's past.

I had originally wanted this paper to focus on the Prehistoric Period and examine, in particular, the relation of some prehistoric settlement sites to specific natural harbours in Salamis. Very recent field research, however, has shown it preferable to devote due space to the presentation of the evidence for Salaminian harbours in use in historical times and then move backwards to Salaminian harbours in prehistoric times. To the latter I shall refer only in summary fashion at the end of my communication and reserve for them a full treatment in a second paper in the future.

Let me say at the outset that I am not a harbour archaeologist. Here, I should only like to present to you and briefly comment on the relevant evidence identified in Salamis; I believe, however, that its full interpretation at some later stage will be seen to have a direct bearing on our inquiry into the internal Salaminian history and also on the study of the maritime history of a central part of the Greek World.

Ambelaki (Figs. 1-12)

Before we go to the southern coast of Salamis, let us consider the harbour of the Classical and Hellenistic city of Salamis. This harbour is located in the small bay of Ambelaki in the eastern part of the island (Fig. 4), the plausible point of assembly of the united Greek fleet in 480 BC.

An idea of how the landscape in this part of the island might have looked in Antiquity is given by a water-colour, a view of the village and bay of Ambelaki from west, executed by the German painter Carl Rottmann³ during his stay in Greece in 1834-1835 (Fig. 2). As in other parts of Salamis and Attica, the landscape has been changing rapidly as is shown by a photograph of the area of Ambelaki taken in 1989 from near where Rottmann was painting (Fig. 3).

Despite its proximity to Athens, this historic ancient harbour is not frequented by visitors today. For a period in recent years it served as a graveyard for ships, while its waters are today among the most polluted in Salamis.

The small bay of Ambelaki is a fine natural harbour, always calm, with its mouth measuring c.450 m. It is well protected from the north winds by the peninsula

of Kamatero or Pounta (the ancient Kolouris, site of historical Salamis), rising to a height of 39 m above the sea, and from the south winds and the waves of the Saronic by the long peninsula of Kynosoura whose highest points rise 60 m and 56 m above sea level (Figs 4, 5).

The inner bay of Ambelaki served as the harbour of Classical and Hellenistic Salamis, the city that emerged as the capital of the island following its annexation to Athens shortly after 600 BC. In Strabo's words "the city of to-day is situated on a gulf, on a peninsula-like place which borders on Attica" (... τὴν δὲ νῦν ἐν κόλπῳ κειμένην ἐπὶ χερρονησοειδοῦς τόπου συνάπτοντος πρὸς τὴν Ἀττικὴν)⁴.

Parts of the city of Salamis including a fortification wall with gates were brought to light in 1918 by Antonios Keramopoulos and more recently by members of the Greek Archaeological Service at various points on the peninsula of Kamatero and below it at Ambelaki.

The port of historical Salamis is referred to by Pausanias in his *Description of Greece: Attica*⁵ and also by Skylax, the geographer, in his work *Periplus*, who reserves a Laconic phrase for it: "Salamis is an island, a city and a port" (Κατὰ τοῦτό ἐστι Σαλαμὶς νῆσος καὶ πόλις καὶ λιμὴν)⁶.

Large parts of the port-installations in the bay of Ambelaki now lie underwater due to the rise of the water level in the Straits since Classical times and to subsequent changes in the shoreline in the bay.

The ancient harbour-works in the bay of Ambelaki have been reported or indicated on maps by several scholars of the 19th century and of the early 20th century including H. Schliemann (1875), H. Gerhard Lolling (1884), E. Curtius and J.A. Kaupert (1895), J.G. Frazer (1898), Usslar (1900), P. Rediadis (1902, 1911), H. Raase (1904) and C. Rados (1915).

Remnants of harbour-installations in the innermost part of the bay of Ambelaki, apparently more of what is visible today, are clearly marked on a rare map of Salamis⁷ prepared by German surveyors between 1889 and 1891 (Fig. 1); also on J.A. Kaupert's archaeological map (1:25.000) of Salamis published in 1893 (see *Karten von Attika*, Dietrich Reimer, Berlin, 1893, Bl. XXI; and here Fig. 5).

Remains of port-installations, represented by blocks of varying size, can be seen today on all three sides of the inner bay of Ambelaki, especially along the west (Fig. 6). They include moles, rectangular constructions and other works whose exact character, nevertheless, cannot be recognized without excavation and underwater exploration (Figs 7, 9).

Of particular interest and very probably of Classical/Hellenistic date is a long row of blocks on the west side of the bay, lying mostly underwater and running roughly W-E (Figs 6, 8, 9).

A mole, largely dismantled, is found on the south side, immediately below the Mamais House (Akti Themistokleous 17). It runs NE-SW and has a visible length of 37.30 m (Fig. 10).

A mole, arguably of much later date, in use today on the north side of the bay, just southeast of the old Kriezis House in Salamis Avenue, is built with ancient square blocks, the largest of which are 1.20 to 1.30 m long. It runs N-S and is traceable for roughly 54.50 m, with a width ranging from 1.40 to 1.60 m (Figs 11, 12).

At a short distance west of this mole and close to shore are the submerged stone foundations of an apparently rectangular construction oriented N-S and consisting of three walls measuring 20 m, 11.40 m and 3 m respectively. These foundations are seen only at certain times of the year when the water recedes.

Segments of stone-walls are preserved on land at various points in the northern and western parts of the shore of the bay, close to the shoreline or at short distances from it. Some of these are likely to belong to the port-installations or to constructions whose functions were linked to the port.

On the basis of the testimony of old people at Ambelaki there also exist underwater what seem to be stone-paved platforms or corridors on the western side of the inner bay. Could these represent remnants of dry docks for ship-maintenance? Shipheds perhaps?

Finally, evidence for the *floruit* of the port of Salamis is provided by the surface pottery which we have observed in the northern and western parts of the shore of the inner bay. It is mainly Classical and Hellenistic containing a high proportion of black-glazed sherds of the finest Attic quality.

Kolones (Figs 1,13-17)

Still in the historical period, we shall now move on to the southern coast of Salamis and stop at the small bay at Kolones, which has a mouth measuring c. 455 m and is a good anchorage for small boats (Fig. 13). The place-name Kolones may well refer to "columns" which stood here in the past; in fact two (column) capitals, a Doric one and an Early Christian Ionic one, have already been reported from this area by Prof. D.I. Pallas.

The visible ancient remains at the site of Kolones including a tower, a fortress and remnants of harbourworks were first reported by Edward Dodwell early in the 19th century⁸ and were later to be dealt with to varying degree by a number of Greek scholars including I. Rizos Rangavis (1854), S. Stouraitis (1901), I. Dragatsis (1920), and E. Vranopoulos (1972), and most recently by Prof. D.I. Pallas⁹.

While the harbour at Ambelaki is basically associated with a city and its commerce, the smaller harbour at Kolones gives access to an inhabited area of an arguably different character.

Here at Kolones, the probable existence of an ancient mole or quay is suggested by a number of worked blocks of stone ranging in length from c. 75 cm to 1.20 m, which are found scattered on the shore by the sea, at the western end of the main beach and further west (Fig. 14).

A large block, 1.05 m long, and still in situ, is seen a few meters east of a modern cement ramp used for hauling boats ashore. Eight other blocks, almost all of them apparently displaced, can be spotted at points along the shore up to a distance of c. 75 m west of the large block in situ. The ceramic material lying around in this part of the shore included fragments of tiles, among them three of Early Christian type, and a quantity of unpainted sherds, mostly ranging in date from Classical to Late Roman times¹⁰.

At a distance of c. 400 m north of the harbour is a small acropolis on which are preserved substantial remains of walls, defensive or otherwise. Certain of these walls have been incorporated into an old farmhouse, (e.g. Fig. 15) the Vassiliou House.

A stretch of wall, on the south side of the acropolis, built of large worked blocks, is impressive (Fig. 15). It runs for c. 15 m, with a maximum preserved height of 2.40 m. The few black-glazed sherds seen on the acropolis, immediately north of the Vassiliou House, point to a Classical/early Hellenistic date for our fortress.

To the northwest of the pebbly beach at Kolones, at the top of a hill rising to a height of c. 38 m and overlooking the harbour, are the remains of a round tower (Figs 16, 17). The tower, still preserving its entrance (width on the outside: 1.50 m) on the north side with its lintel (2 m long and 55 cm wide) still *in situ*, has a diameter of 10.70 m and is built of large blocks ranging in length from 80 cm to 1.50 m and exceeding 50 cm in height. As with the fortress, a number of fine black-glazed sherds from inside the tower are assignable to Classical/early Hellenistic times.

Towers similar to the one at Kolones are known from Attica, the Megarid, the Argolid and other areas and from several Aegean islands, notably Siphnos, Thasos and Ceos. The theories as to their purpose were discussed by John Young in 1956¹¹. These towers have been invariably interpreted as forts, watchtowers, lighthouses, beacon-towers, and refuges from pirates. It is possible, however, that in many cases they had more than one function.

Our example may have been a watchtower, backed by a fort. It may also have been a lighthouse, standing, as it does, at the highest point of the harbour and at one of the southernmost points of Salamis, a deliverance for ships and sailors. If so, what we have here is the predecessor of the modern stone-built lighthouse on the nearby Cape Kochi (Fig. 18).

Prehistoric harbours (Figs 1,19)

Still in the south, it is worth pondering for a while on the conditions in the southern part of the island in prehistoric times. The occurrence of natural harbours on the southern coast may help us to explain the presence of an impressive ring of settlement sites in Southern Salamis which on the evidence of surface pottery cover the period from at least as early as the beginning of the Early Bronze Age to the end of the Mycenaean.

Most of these sites have been identified by Prof. D.I. Pallas¹² and are currently under scrutiny jointly with the author. Of special interest, is a series of fortified sites including Satirli: Kastelli, Ginani: Kastro, Maliza: Aspri Rachi, Mikri Kiapha and Sklavos, found at varying distances from the southern coast of Salamis. All are fine acropolis sites, with remnants of substantial fortification walls or simpler peribolos walls, and having a commanding view towards the sea. Each one of them can be shown to have been associated with at least one natural harbour on the southern coast. Their strategic locations may well have been selected by the inhabitants to share in the control of sea-routes using the passage between Salamis and Aegina in the Saronic Gulf. The economy of these settlements must have depended to a considerable degree on fishing, sea-trade and other maritime activities possibly including piracy¹³. The special topography of the fortified sites identified and the locations of possible harbours on the southern coast of the island are bound to give rise to several questions concerning security, defence and contact in the Bronze Age Saronic. The role of piracy, an aspect of prehistoric economic life often neglected among the more conservative prehistorians, but which is plentifully documented in ancient sources for both historical as well as

prehistoric times, will inevitably have to be reappraised. Even Ajax, a figure of great size and strength, represented by Homer as the Ares of the Greeks, did not remain indifferent to the temptations of piracy, within the district of the Saronic and the Argolic Gulfs, to judge from a passage in Hesiod's *Catalogues of Women*¹⁴.

Having mentioned Ajax and the Mycenaeans of Salamis, let me finish, by saying that I very much look forward to explaining in a future paper, the following:

Firstly, why we expect three sites in Southern Salamis to form a major Mycenaean triangle: the harbour of Peristeria (with its two islets) east of Kolones, the finest anchorage in the southernmost part of the island, known for centuries (Fig. 19); the site of Ginani, at about a 45 minute walk (or c. 2 kms) north of the eastern beach at Peristeria, a habitation site of some size, where we have succeeded in identifying Late Mycenaean sherds, certainly including LH III C among the surface pottery; and the site of a rather extensive Mycenaean cemetery of chamber tombs in the area of Chalioti¹⁵ at a short distance northeast of Peristeria which included burials belonging to Late Helladic IIIA - III C1.

Secondly, I will attempt to demonstrate how Strabo's crucial phrase that the old capital of Salamis "faces towards Aegina and the south wind" (...ἔχει δ' ὁμῶ-
νυμον πόλιν, τὴν μὲν ἀρχαίαν ἔρημον πρὸς Αἴγιναν τετραμμένην καὶ πρὸς νό-
τον...) ¹⁶, seen against the new evidence emerging from Prof. D.I. Pallas's continuing work in Southern Salamis, now seems to assume a new meaning.

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NOTES

1. An extended version of this communication, with fuller bibliographical references, will be published in a larger work on Salamis that is being prepared by the author.
2. This project, entitled "Ajax: A Project on Salamis", has recently received substantial financial assistance from the Institute for Aegean Prehistory, New York (March 1990).
3. *Εικόνες του Ελληνικού χώρου μετά την Απελευθέρωση* (Aquarelles and drawings by C. Rottmann and L. Lange, Text by Marinos Kalligas), Commercial Bank of Greece, Athens, 1977, p. 56, Pl. 20.
4. The Geography, 9.1.9. See *The Geography of Strabo* (with an English translation by H.L. Jones), Vol. IV, London, 1954, pp. 250-253.
5. *The Description of Greece (Attica)*, I. 35.3. See N.D. Papachatzis, *Παυσανίου Ελλάδος Περιήγησις: Αττικά*, Athens, 1974, pp. 457-459.
6. *Scylacis Caryandensis Periplus*, 57. See C. Müller, *Geographi Graeci Minores*, Vol. I, Paris, 1861, p. 46.
7. *Karte von Attika in 1:100.000, Sect. Salamis (No 4)*, Verlag von Dietrich Reimer (Ernst Vohsen), Berlin S.W. Wilhelmstrasse 29.
8. Edward Dodwell, *A Classical and Topographical Tour Through Greece, During the Years 1801, 1805 and 1806*, London, 1819, pp. 576-577.
9. D.I. Pallas, "Αρχαιολογικές επισημάνσεις στη Σαλαμίνα", *Archaeologikon Deltion* 42 (1987) A (forthcoming).
10. A number of diagnostic surface potsherds and tiles found at Kolones have already been deposited in the Museum of Salamis.
11. See John H. Young, "Studies in South Attica: Country Estates at Sounion", *Hesperia* XXV (1956), pp. 131 ff.
12. See D.I. Pallas, *op. cit.* (n. 9, above); also relevant information contained in D.I. Pallas, "Βροκή < Βοϊκή> Σαλαμίνας τοπωνυμικά-τοπογραφικά-ιστορικά", *Athena*, Vol. 80 (1988), pp. 99-135.
13. See Y.G. Lolos, "Piracy in the Prehistoric Aegean: Some Evidence from South Salamis", *ΕΝΑΛΙΑ: Annual* 1989, Vol. I, 1990, p. 43.
14. *Catalogues of Women and Eoiae*, 68.55-62. See *Hesiod: The Homeric Hymns and Homeric* (with an English translation by H.G. Evelyn-White), William Heinemann Ltd., London, 1967, pp. 196-197:

"And from Salamis Αΐας blameless warrior (ἀμώμητος πολεμιστής) sought her to wife, and offered fitting gifts, even wonderful deeds; for he said that he would drive together and give the shambling oxen and strong sheep of all those who lived in Troezen and Epidaurus near the sea, and in the island of Aegina and in Mases, sons of Achaeans, and shadowy Megara and frowning Corinthus, and Hermione and Asine which lie along the sea: for he was famous with the long spear (ἔγχει μακρῶ)".
15. On the Late Mycenaean chamber tomb cemetery at Chalioti see: P. Parthenis, "Σαλαμίς" *Ἐλευθερουδάκη Σύγχρονος Εγκυκλοπαίδεια*, Vol. 11: Supplement, Athens, p. 738 (1126); D. Lazaridis, *Archaeologikon Deltion* 22 (1967) B, Pl. 110a; N.D. Papachatzis, *op. cit.* (see n.5, above), p. 457; W.G. Cavanagh, *Attic Burial Customs*, ca. 2000-700 BC, Ph. D. thesis, Bedford College, University of London, vol. II, 1977, p.94.
16. The Geography, 9.1.9. See also note 4, above.

ILLUSTRATIONS

- Fig. 1 Map of Salamis (1:100.000)
 1: Ambelaki;
 2: Kolones;
 3: Peristeria
- Fig. 2 Bay of Ambelaki, from W. Water-colour by Carl Rottmann (1834-1835). See n.3, above.
- Fig. 3 View of village and bay of Ambelaki, from W. (1989).
- Fig. 4 Map of the village and bay of Ambelaki, with the peninsula of Pounta (the ancient Kolouris) and part of the peninsula of Kynosoura. See *Ναύσταθμος Σαλαμίνος και Όρμος Κεραταινίου*: Map (1:10.000) prepared by E. Angelidis, A. Chrisanthis, P. Roussen and I. Bouboulis, Athens, 1916.
- Fig. 5 Bay of Ambelaki, with Kolouris and Kynosoura. See A. Ch. Chatzis, "Τα αρχαία ονόματα της νήσου Σαλαμίνος", *Archaeologike Ephemeris* 1930, p. 67, Fig. 1.
- Fig. 6 Ambelaki. Inner bay, from N. (1989).
- Fig. 7 Ambelaki. Ancient harbour-works on the west side of the inner bay, from N.W. (1989).
- Fig. 8 Ambelaki. Ancient harbour-works on the west side of the inner bay, from W. (1989).
- Fig. 9 Ambelaki. Ancient harbour-works on the west side of the inner bay, from S./S.W. (1989).
- Fig. 10 Ambelaki. Mole on the south side of the inner bay, from S./S.W. (1989).
- Fig. 11 Ambelaki. Mole on the north side of the inner bay, from N. (1989).
- Fig. 12 Ambelaki. Mole on the north side of the inner bay, from S. (1989).
- Fig. 13 Kolones. Inner bay, from W./N.W. (1989).
- Fig. 14 Kolones. Western end of beach, where several worked blocks of stone have been spotted (1989).
- Fig. 15 Kolones. Part of wall, incorporated into the Vassiliou House, from S. (1989).
- Fig. 16 Kolones. Round tower, from S./SE. (1989).
- Fig. 17 Kolones. Entrance of round tower, from N./N.E. (1989).
- Fig. 18 Point Kochi. Modern stone-built lighthouse (1989).
- Fig. 19 Peristeria. Mycenaean harbour, from N.E. (1989). An anchorage for Ajax?

(All photographs are by Mr. Nicholas Zervoglos)



Fig. 1

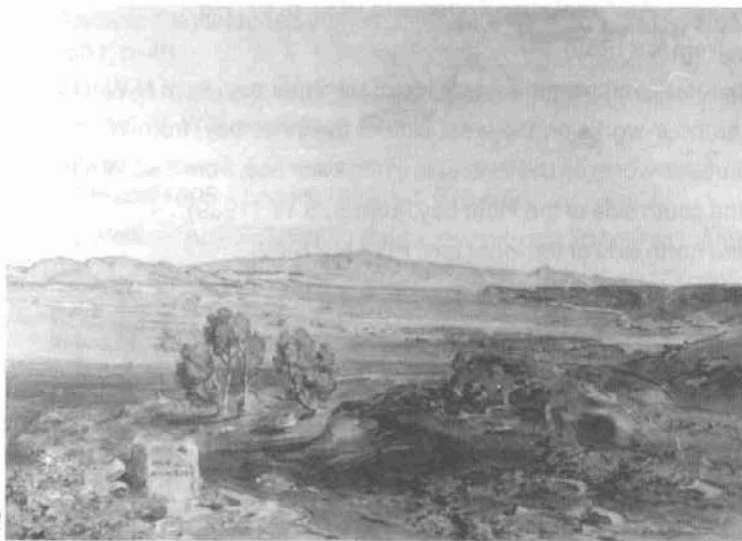


Fig. 2



Fig. 3

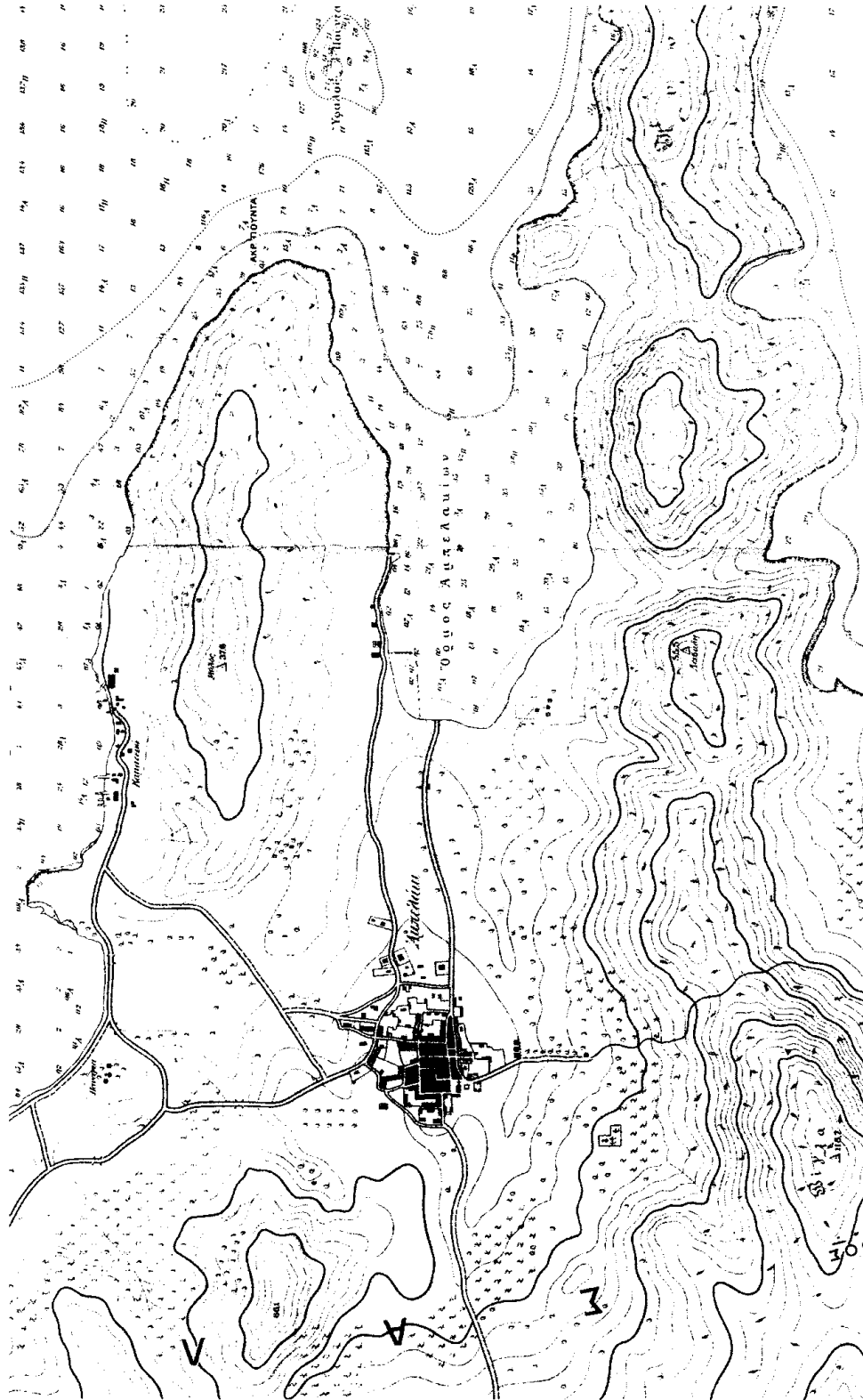


Fig. 4

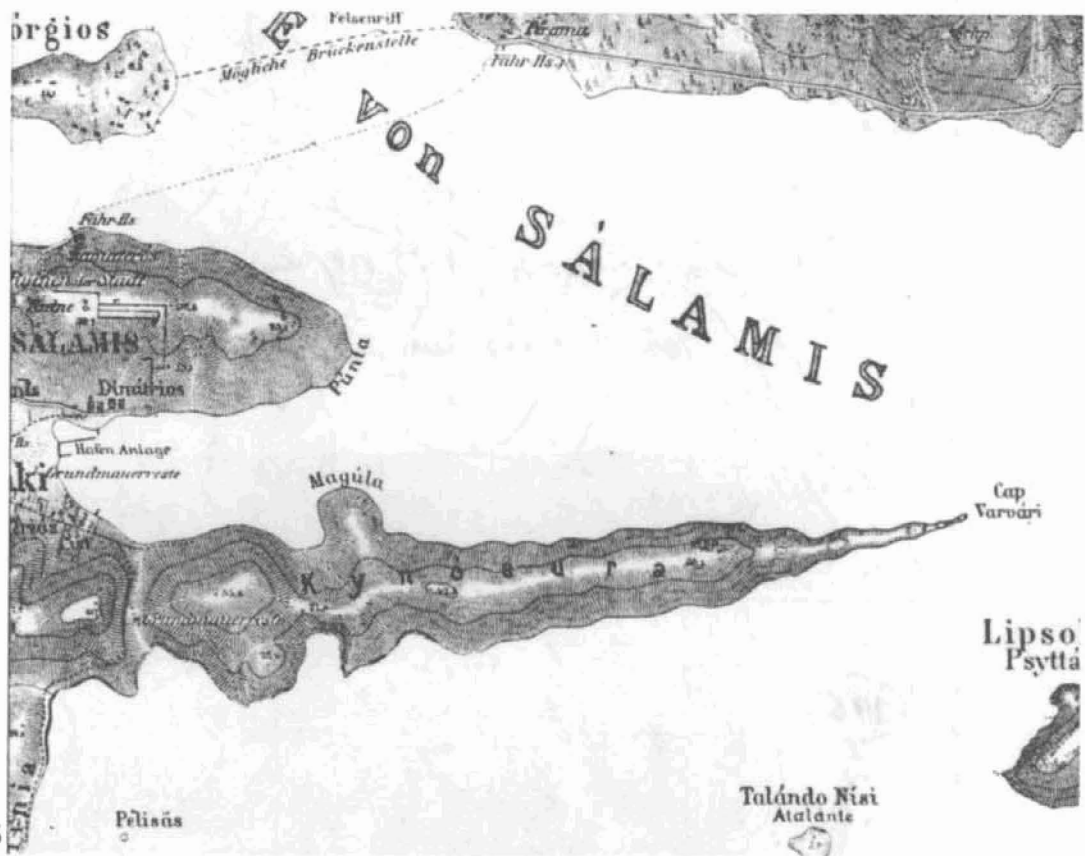


Fig. 5



Fig. 6



Fig. 7



Fig. 8

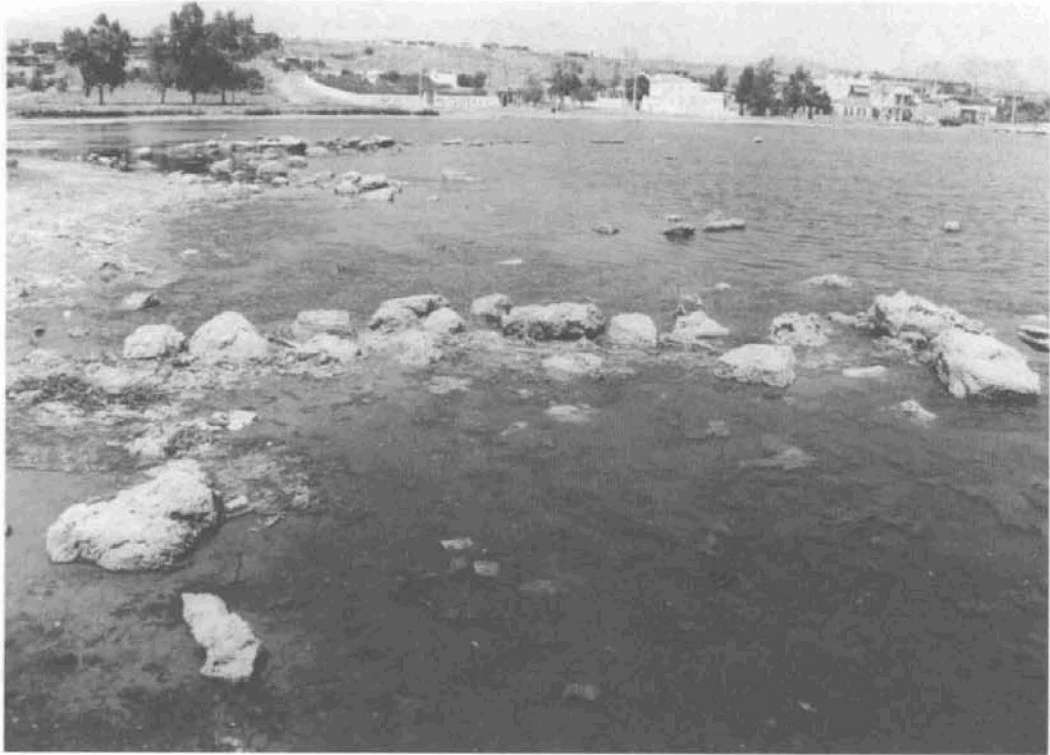
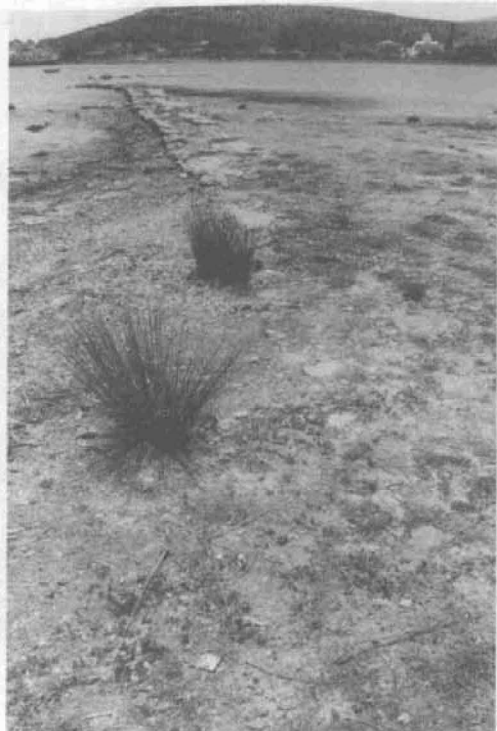


Fig. 9



Fig. 10



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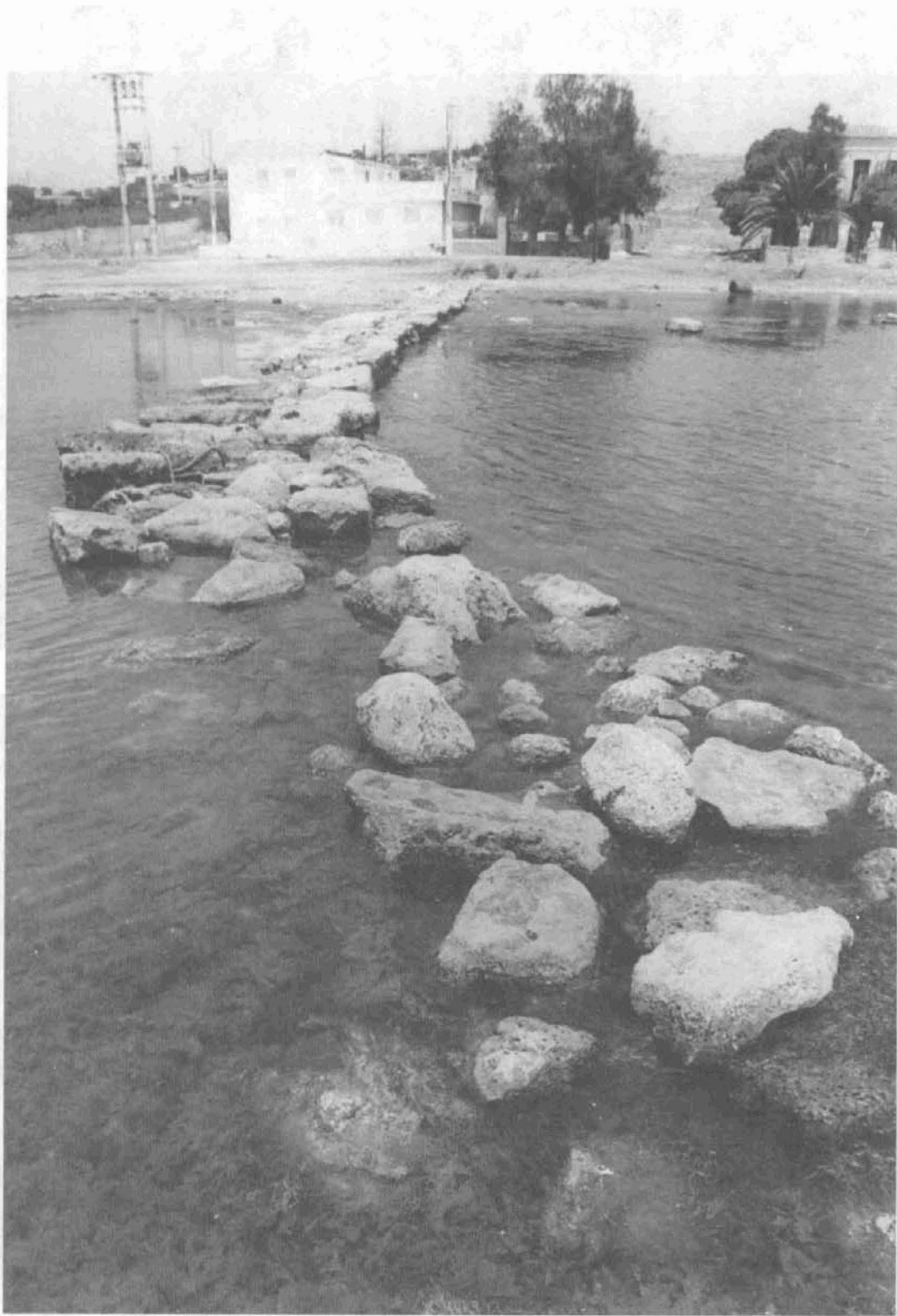


Fig. 12



Fig. 13



Fig. 14



Fig. 15



Fig. 16



Fig. 17



Fig. 18



Fig. 19

A ROCK ENGRAVING IN LEMNOS

(Preliminary study)

“Next they reached the slopes of Pallene, beyond the headland of Canastra, running all night with the wind. And at dawn before them as they journeyed rose Athos, the Thracian mountain, which with its topmost peak overshadows Lemnos, even as far as Myrina, though it lies as far off as the space that a well-trimmed merchantship would traverse up to mid-day¹. For them on that day, till darkness fell, the breeze blew exceedingly fresh, and the sails of the ship strained to it. But with the setting of the sun the wind left them, and it was by the oars that they reached Lemnos, the Sintian isle ... nor yet at dawn did they loose the ship’s hawsers to the breath of the north wind”².

“It was dark when we rounded Cape Mourtzephlo, the north-western point of Lemnos, and an hour before midnight we caught sight of the glimmering lights of Kastro, the chief town, which is situated near the middle of its western side. As soon as our vessel had cast anchor in the little harbour, and we were rowed ashore, we obtained practical evidence that Lemnos is but little visited, for we could hear of no inn, and a long-debate ensued among the officials at the landing-place as to where we could pass the night”³.

This is how Apollonius of Rhodes and Henry Fanshawe Tozer described arriving at the port of Myrina⁴ (Fig. 1), as it is known by its ancient and present name, or Stalimene, the Italian version⁵, or Kastro, as it was still called in the last

century, because of the fortified enclosure of its medieval castle. This is built on a rocky peninsula “which projects westward into the sea from the recesses of a bay, and rises steeply in its centre to a height of 400 feet. On either side of the narrow istmus which joins it to the mainland there is a rather exposed harbour⁶, and that which lies towards the north is flanked by the Greek, that towards the south by the Turkish, quarter...”⁷.

This rocky peninsula is probably Homer’s “well built town of Lemnos”⁸ where Apollonius’s Argonauts entered as guests of the Lemnian women and their queen Hypsipyle. In the XVIth century when Belon visited the island, Turkish guardians kept watching from the top of the castle in order to catch sight of approaching pirates in good time and prevent any Greek revolt⁹. Even in Tozer’s time “the approach to the fortifications was very striking, for the granite rocks of which the peninsula is composed rise steeply and stand out in the most fantastic forms, and in many places are stained bright yellow by patches of lichen... The isthmus between the two harbours forms a ridge where it abuts against the rocks, and at the back of this there is a conspicuous knoll, which falls abruptly on its eastern side toward the level ground where the Greek and Turkish quarters meet one another. Close to this ridge, and not far from the entrance gate (of the medieval walls), stand the only remains of the ancient city of Myrina - a splendid piece of cyclopean masonry, occupying a steep position on the hillside¹⁰.

Tozer did not notice that on the same side of the peninsula the rock has been carved in several places forming steps, concavities and right-angles (cf. Figs 4-5). A local historian, Pantelidis, described them in 1876. He also spoke about the port, situated on the south side of the peninsula, still called Emporio at this time and where there was also the bazar¹¹. Belon had already noticed that in both bays the wind blows and boats are not secured¹².

From this exact spot you can see on one of the rocks a kind of engraved drawing (Figs 2, 3). Unfortunately some meters higher someone has recently painted the initials of a football team on it. Beside the same rock is also carved on the rear side to form one of the right-angled structures mentioned above (Figs 4, 5). The face on which the drawing is engraved (Figs 6, 7) has a height of approximately 102 cms and a width of 190 cms. The surface is quite eroded and it is very difficult to tell which part of the incisions is artificial and which is not. However, it seems that its maximum visible length is 165 cm and its maximum height at least 70 cm. Underneath the drawing, about 23 cm from the last horizontal groove, the surface of the rock projects to form a kind of step. On the upper part

of the rock surface, at a distance of about 20 cm from the top of the upper visible incisions and at a distance of 19 cm between them, you can see two square cuttings¹³ of 8 and 9 cm; another one is situated to the right¹⁴. It is not known whether these cuttings are related to the rest of the engraving. The horizontal grooves which compose the drawing have been set with a distance of 4,5-6 cm between them. There are at least eight horizontal grooves and ten oblique ones on the lower part. The horizontal grooves curve upwards towards the right. It seems that on two or three from the bottom, there is a ripple before the curve.

At least three of the oblique grooves reach further up than the lower horizontal incision; At least two reach the third and one reaches the second parallel line. One of the horizontal incisions is only visible on the right half of the drawing and two of the oblique lines are not parallel with the others. There are more grooves and cavities but it is not sure yet whether they are accidental or not.

It is very tempting to interpret this sketch as an oared ship, stern and steering oar to the right. The horizontal grooves would represent the planking and the oars could suggest an oared boat, we could even imagine that they belong to a trieres. However there are a lot of problems which do not allow us to be dogmatic. First of all, the bad state of preservation of the rock surface¹⁵. Second, there are very serious problems concerning dates. The peninsula has never been investigated properly. Surface finds on the south side of it show an occupation from the geometric times up to Roman times¹⁶ and the entrance to the ancient acropolis is situated higher up to the same side of the peninsula, the medieval ones being on the northern and eastern sides. On the other hand, the nature of the representation, primitive as it is, could be compared either to some Delos ship graffiti or to XVIth century ones (church of Prophet Avvakoum in Paradissi, Rhodes)¹⁷.

Considering the various carvings on the rocks of the Myrina peninsula as a whole, despite the fact that as yet there is no proof that they are connected, it is possible to find possible parallels on similar heights, for instance in Syros¹⁸, a rocky acropolis in the bay of Galissas; or on several fairly inaccessible hills in the region of Western Thrace, at Roussa¹⁹, Monastiri Lofos, Aghios Georgios of Maronia, Aghios Georgios of Petrota²⁰. In all these cases however the rock engraving represent humans, animals and abstract "symbols". Similarities are found with the other indications of human action, that is cavities, "niches" and steps carved in the rock. Further rock engravings with human or animal representations do exist on the Pangaion Mount²¹, in Naxos, Euboia or Delphi and Crete²² as well as in the Bulgarian part of Thrace²³, in Albania, in Yougoslavia²⁴ and of course in

Italy or the Alps, to mention the more well-known examples. Some of them have been identified as ship representations²⁵. In most of these cases, the problem of dates remains unresolved for the moment, as scholars hesitate somewhere between the 12th century BC and the medieval period. All the same, in most places in Western Thrace the surface finds or small soundings have revealed Iron Age sherds²⁶.

It is true that Lemnos as an island has always been related to ships and sea travel: the Argonauts, Philoctetes, the Athenian expedition and conquest by Miltiades, even the Cabeirian mysteries: a ship had to go and bring back the holy flame once a year²⁷. The Cabeiroi were sea gods. The religious nautical community of the Lemniastai under the protection of the Lemnos and Samothrace gods, protectors from the dangers of the sea, existed up until the time of Christ. Venetians, Turks and Greeks or Russians have sieged the island many times and they came by ship. In any case, this actual port of Myrina was most probably the archaic, classic, roman and medieval one²⁸. A more ancient bronze age occupation is attested at another site in the surrounding area, near another peninsula separating two bays. It is therefore more probable that the ship engraving belonged to one of the occupations following the geometric age. It could be pre medieval occupation, since the latter is attested by surface finds as well as constructions (walls and buildings) on the other (the northern) side of the rocky peninsula.

Regardless of the problem of dates, ship graffiti on walls, particularly on sanctuary walls and house walls are well known: Malta Tarxien²⁹, Kition in Cyprus³⁰ and Delos³¹ but also several kinds of ship ex-votos from all periods need no further comment. It is true that the position of the Myrina engraving in the port, some meters higher than the spot where ships still moored at the beginning of the 20th century (Figs 8-10) and in a conspicuous position for people in the port, but not really visible from a great distance when you arrive or sail away (Fig. 11), could also indicate a kind of prayer or exhortation to non-human powers for protection against the dangers of the sea³², naufrages, pirates, etc. It seems that the original position of these structures and drawings might have been nearer to sea-level. A tectonic uplifting could be involved³³.

In any case, it is necessary to proceed with further investigations on this quite promising site, make an inventory³⁴ and drawings of all the engravings and structures and if possible trial soundings. A geological study is also needed. This would be the only way of acquiring more satisfactory results.

Finally, leaving the port of Myrina, where so many oared ships cast anchor through the centuries, we could recall, like Hypsipyle recalls the song she sang as mistress of the house at Lemnos *κερκίδος ίστοτόνου παραμύθια Λήμνια*³⁵, the Argonauts' departure from the port of Lemnos: "He (Jason) spoke and mounted the ship first of all; and so the rest of the chiefs followed, and, sitting in order, seized the oars; and Argus loosed for them the hawsers from under the sea-beaten rock. Whereupon they mightily smote the water with their long oars".³⁶

As the local saying goes in Lemnos: one experiences sorrow twice upon arrival and upon departure³⁷.

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NOTES

1. Cf. Belon 1578:58-59. Cf. Delage 1930:292 about geographical errors in the Apollonius's *Argonautica*.
2. Apollonius of Rhodes *Argonautica* A, 598-608, 651-652 (translation: Seaton 1921 2).
3. Tozer 1890:240. The description is of a trip to Lemnos in the spring of 1889.
4. Lemnos island, north-east Aegean. Some decades ago one still had to be rowed ashore, because of the shallowness of the water.
5. Belon 1578:57
6. Cf. Belon 1578:58
7. Tozer 1890:241
8. Homer θ283: "...Λήμνον, εύκτίμενον πτολιεθρον..."
9. Belon 1578:57
10. Tozer 1890:246
11. Pantelidis 1876:37
12. 120.1578:58
13. Width 3 and depth 4,5 and 5 cm. length 5, width 2, and depth 1 cm.
14. In any case it will anyway be necessary to carry further studies of all the grooves and marks. The architect of the K' Ephorate of Antiquities, Mrs. Meropi Frangou, is currently preparing a sketch of the engraving.
15. Oral information by Mr. Chr. Boulotis.
16. I am grateful to Mr. L. Basch (letter 2.7 1989) for suggesting these parallels: Delos: Basch 1987:376, nos 32. 34-36; 377, no 41; 378, no 45. Pr. Avvakoum: Karakatsani 1972, fig. 155.
17. Manthos 1979:39-40.

18. Triandaphyllos 1973, 1987.
19. Idem 1985.
20. Moutsopoulos 1969, Papoutsakis 1977.
21. Papoutsakis 1972 and 1977.
22. Ibidem:374. Cf. Dumas 1990, Mikov 1928/29.
23. Ibidem.
24. Crete, Asfendou (Sfakia); Papoutsakis 1972:113-114. Cf. ibidem n.32 on p. 114 about Spanish examples.
25. Triandaphyllos 1985:135, 137; Manthos 1979:42.
26. Cf. Moschidis 1907:115, 117, according to Philostratos, Her. 740.
27. Professor L. Basch, oral information (summer 1989).
28. Woolner 1957.
29. Basch and Artzy 1986.
30. Basch 1973.
31. Basch 1981.
32. Oral communication by Mrs. Olga Psychoyos.
33. There are several pictures of the engravings and other structures taken by Tr. Marangos between 1958 and 1980. He also made some sketches of the peninsula indicating their location and published several articles about the castle in the local newspaper "Η Λήμνος" and in "Καθημερινή"; in one of them he published the picture in fig. 7.
34. Euripides frgt. 11-13, Bond 1963.
35. Apollonius Arg. A,910-914, translation: Seaton 1921.
36. I am grateful to Mrs. Aglaia Archontidou, Ephor of Antiquities and to the Council of Monuments of the islands for kindly permitting me to publish this engraving, as well as to Miss. Honor Frost and Olga Psychoyos and Mss Lucien Basch, Luigi Beschi and Christos Boulotis for their invaluable help and advice. And finally, to Tryphon Marangos who identified a ship in this sketch more than thirty years ago.

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ILLUSTRATIONS

- Fig. 1 The actual port of Myrina in the early seventies (photo Tr. Marangos).
- Fig. 2 & 3 The rock engraving from the actual road (1989).
- Fig. 4 & 5 The engraving and connected(?) right-angled carvings (photo Tr. Marangos).
- Fig. 6 The rock engraving in 1989.
- Fig. 7 The rock engraving in the late fifties (photo Tr. Marangos).
- Fig. 8-10 View of the spot in the first decades of the 20th century (photo from the Tr. Marangos archive). Photo no 10: enlargement of no 9.
- Fig. 11 Actual view of the spot from the port (1989).

(photos by the author, except if otherwise stated)

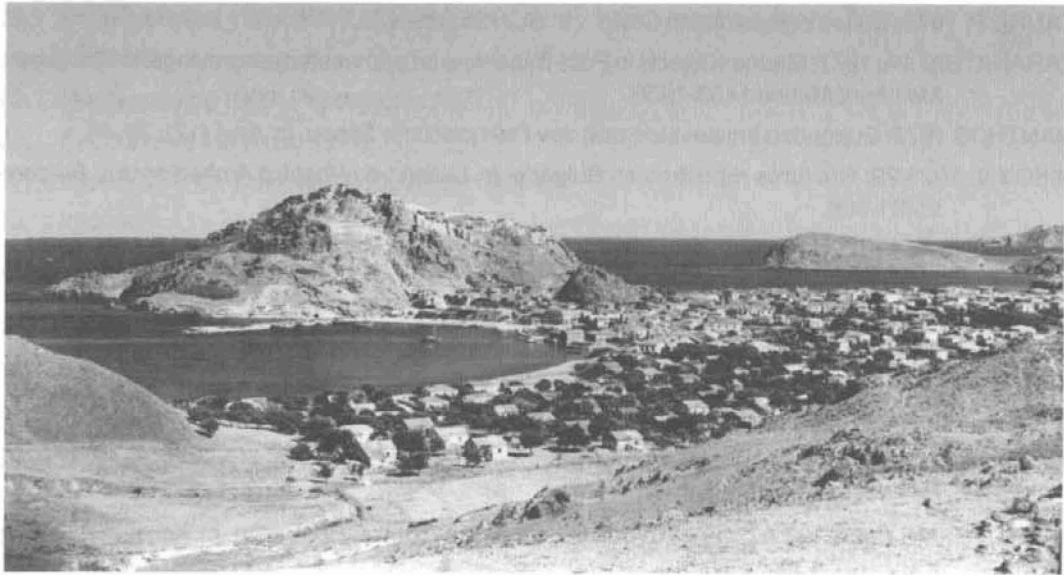


Fig. 1

Fig.2



Fig. 3



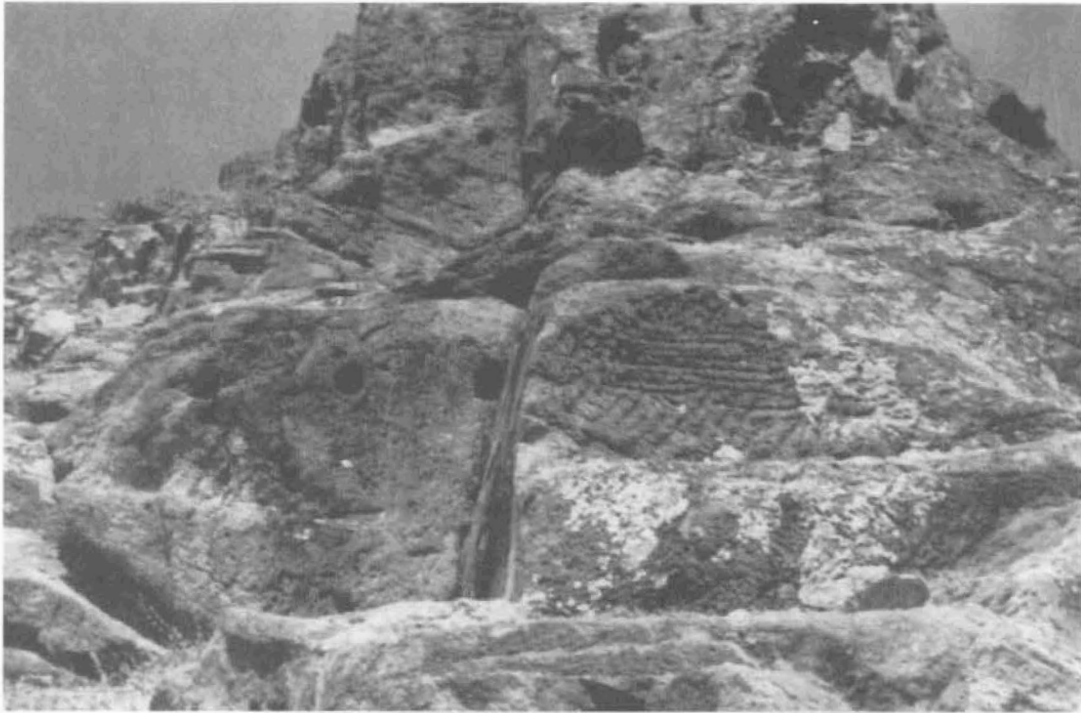


Fig. 4



Fig. 5

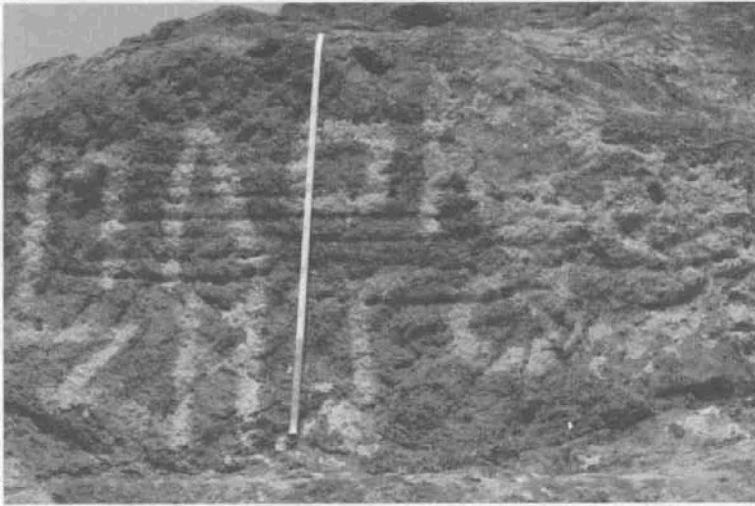


Fig. 6

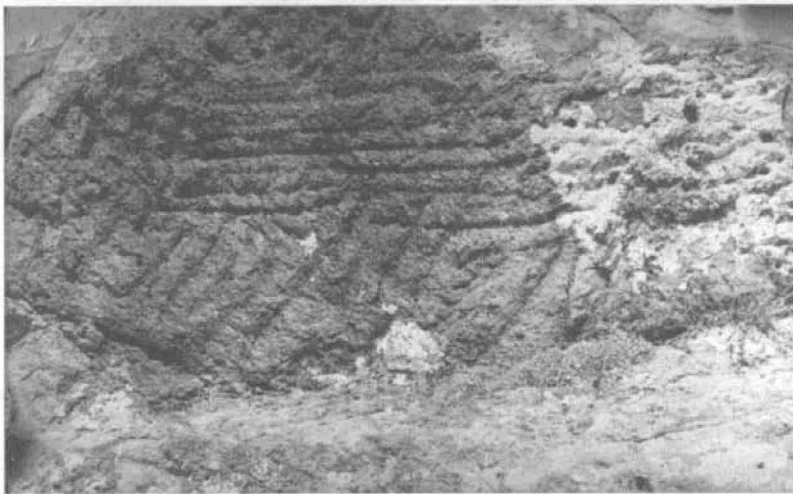


Fig. 7



Fig. 8



Fig. 9

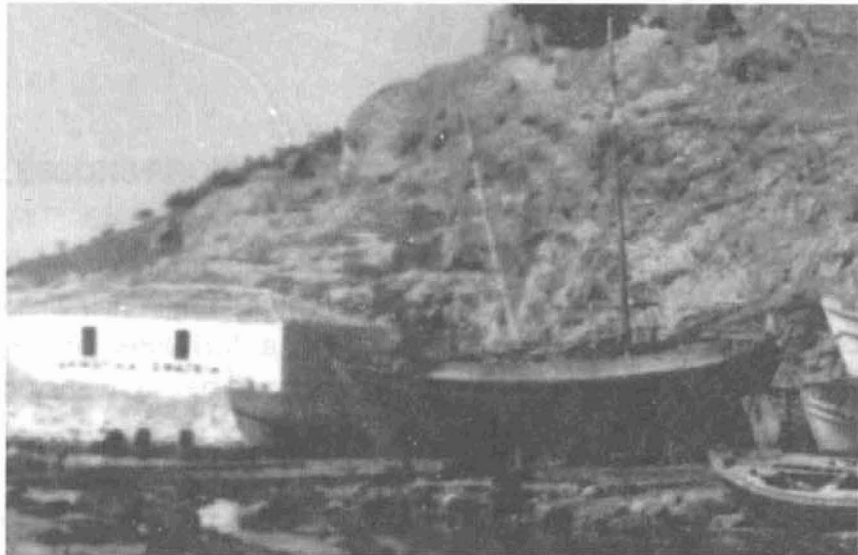


Fig. 10

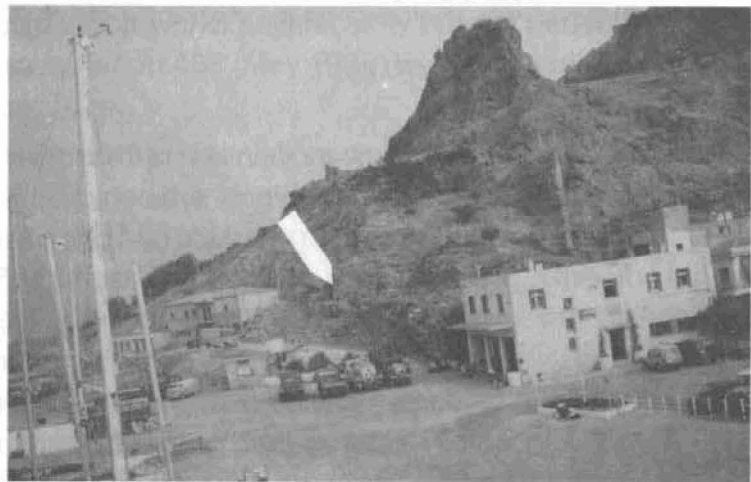


Fig. 11

LESSONS FROM THE TRIALS OF OLYMPIAS

When I submitted a summary of this paper I was intending to discuss a number of lessons which might be drawn from the Greek and British Trials of *Olympias* in 1987 and 1988. But, as the Mock Turtle in *Alice in Wonderland* observed, lessons are so called because they lessen every day. And so it has turned out.

It seems now to be accepted by nearly everyone that the trieres as reconstructed in *Olympias* is no Adventure Playground toy, as the 1987 article review in the *Mariner's Mirror* suggested it was, but a serious essay in experimental archaeology, an oared ship which works satisfactorily but not perfectly. And in the BAR International Series Report 486 (May 1989) we have made abundantly clear where the imperfections lie.

The 1987 *MM* reviewer made two reservations which may be briefly mentioned. The first was that we had assumed the length of the ship from the length of the Zea shipsheds whose lower end had not been properly surveyed. That is not the case. The length of the Zea shipsheds is a good rough guide, but the true length of the ship is determined by the length of the "engine room" ie. the fore-and-aft files of oarsmen, the longest of which is the thranite file of thirty-one oarsmen, and the basic unit of the file is the distance between one tholepin and the next, the "room" or *interscalmium* which I shall discuss later.

The second reservation which the reviewer made was that the oars were wrongly assumed to be of the same length in any one part of the ship. He argued that the oars are shown by epigraphical evidence to be distinguishable by sight, and that this must mean by length. The argument is plainly unacceptable, since there are several other ways by which they could be distinguished, e.g. marking, colour, and the shape of the blade. The last is actually required on practical grounds.

The most powerful, and at the same time the most elementary, argument for the oars of the trieres to be, where possible, of the same length is that the aim of the designer of the trieres must have been in antiquity, as it is now, to produce a ship which would make optimal use of the manpower available. Consequently the naval architect would take, at the outset of his design, oars of a length which fitted the physique of the average contemporary oarsman, and only depart from the length for very good reason. In the 4th century BC $9\frac{1}{2}$ cubits seems to have been adjudged the optimal length and all the oars were made of that length except those at bow and stern where there was a good reason, the converging hull, for a small reduction of the loom (for which in fact Aristotle and Galen provide evidence).

If we had had no epigraphical or literary evidence, we should have reached the same conclusion, starting with the oars of length suitable for the average human physique and only departing from that length in the parts of the ship where shorter looms were necessary.

More cogent perhaps than both the theoretical arguments for the oarsystem adopted in *Olympias* is the sight of her in action under oar, as the video will remind you. There is still a lot of fine tuning to be done if the high speeds and endurance attested in antiquity are to be achieved. But I do not think that there can be any doubt that the system itself, embodying equality of oarlength in any one part of the ship, is the one used (in the reviewer's words) by "the trireme that was the glory of Athens".

Two things are needed before a trieres reconstructed on the design of *Olympias* can reach the higher levels of performance attested in antiquity, both acceleration in battle conditions and endurance at a high average speed on voyage. They are:

- 1 lighter oars of an improved design and
- 2 a longer stroke. The former is achievable when funds are available, the latter needs further investigation to which I shall devote the rest of this paper, since it now appears to be the most important point to have emerged from the trials.

The long stroke, on which speed, and probably endurance as well, has in the trials been seen to depend, was there inhibited by various factors, in particular by the thalamians' lack of room between the thwart at the back of their heads as they lean backwards in the stroke and the thwart in front of their foreheads as they lean forward. The stroke of the other oarsmen can plainly be no longer than the stroke of the thalamians. So that this inhibition affects the stroke as a whole.

There seems to be no obvious remedy for this state of affairs. The thalamians' seats cannot be set more than a very little lower. The thwarts (*zuga*) cannot be removed or reduced in thickness since they are vital to the structure of a hull which has no real deck. Further, the zygiants' seats are on them (hence the name), so that they cannot be set significantly higher without upsetting the oarsystem and disturbing the equilibrium of the ship.

The distance between one thwart and the next, the shortness of which causes the trouble, is determined by the passage in Vitruvius. He wrote in Latin on architecture at the beginning of the last quarter of the first century BC in Rome. He says (1 2 4): [In] ships the working-out of harmonious designs (*symmetriarum ratiocinatio*) is found to derive [from] the *interscalmium* [i.e. the space between the tholepins (Gk. *skalmoi*)] which is called +*dipheciaca*+. In the same way the working out of the design of other manufactured things (*opera*) is found to depend on certain parts (*membra*).

In this passage the words (in) and (from) have to be supplied since the text is corrupt; and *dipheciaca* has been recognised as a corruption of a Greek word in Latin form which does not occur elsewhere, *dipechiaca* (Gk. *dipechiake* fem. sing. or *dipechiaka* neuter plural), with the meaning of "something (singular or plural) two cubits long". ("*Dipechus*" (of two cubits) occurs in Herodotus). Similar words of nautical slang are *thalamax*, *stuppax* in Aristophanes, and *tabiacha*, "the works" i.e. the ram, in Polybius.

That *interscalmium*, itself a mixture of Latin and Greek, should have a Greek equivalent is not surprising in view of the contemporary bilingual label of the Alba Fucentia graffito, *navis tetreris longa*. Most of Rome's *socii navales*, who manned her fleet, were probably Greek speaking, but the Greek word *dipechiake* is likely to derive not from them but from the shipbuilders, Sicilian or mainland Greek, from whom the Romans learnt how to build their oared warships. If that is the case, it is not surprising that the word does not turn up in Greek literature (the ship Odysseus is described as building in the Odyssey was a broad merchantman), since the shipbuilding tradition is otherwise entirely oral, and shipbuilding does not feature in comedy, our best source of maritime slang.

If *dipechiake* then belongs to the oral shipbuilding tradition, it may go back a very long way. There is no reason to connect it with triereis only, still less with the bigger ships the Romans used. It may originate with the first oared warships which had files of oarsmen one behind the other on each side of the ship, at the moment when the power/weight ratio became important with the development of the ram, and the minimum possible distance between one oarsman and the next began to be recognised as the crucial design feature and be given a name declaring that minimum distance...

This consideration suggests that we must look for the length in modern terms of the *dipechiake*, not in Rome or in Athens of the classical period but in archaic Greece, when the ships depicted on Geometric pottery and on the Dipylon vases, with their fore-and-aft files of oarsmen, were being built.

The length, in modern terms, of the cubit ($1\frac{1}{2}$ ft) is derived from excavation of buildings of various periods and from stadia. Doerpfeld's excavations on the Acropolis at Athens in the last century revealed the foundations of the earlier temple of Athena which epigraphy showed to have been called the Hecatompedon (i.e. the Hundred Foot Temple), and when the Parthenon was built the name was transferred to its eastern cella. The former was measured as accurately as possible and the length of 33 m established, while the latter measures 32.8 m. The foot accordingly at the early period is to be taken as measuring 33 cm (the Old Attic foot) and slightly less later. The cubit, which is always $1\frac{1}{2}$ ft, was accordingly 49.5-49.2 cm. The Old Attic foot is the same as that which lies at the basis of the Aeginetan (and Peloponnesian), and is identical with the Babylonian, measurements of length. From the stadion at Olympia (600 ft) is derived a foot of 32 cm and a cubit of 48 cm and from a stadion at Samos a longer foot of 35 cm and a cubit of 52.5 cm. It is an interesting fact that in the tables attributed to the Alexandrian mathematician Hero the Ionian cubit (52.5 cm) is called "the stonemason's or wood sawyer's cubit", (*lithikos, xylopristikos pechus*), indicating the sort of connection with a craft tradition which we have suggested that the term *dipechiake* had with the craft of ship-building.

There seem then to be two candidates for the cubit of the *dipechiake* either the Old Attic cubit of 49.5 cm or the Ionian, wood-sawyer's cubit of 52.5 cm. The first would give our cramped *thalamians* 10 cm, and the second give them 16.2 cm, more room. They would be grateful for either. A longer *dipechiake* would of course bring with it a longer "engine room" and hence a longer ship. In the case of the Old Attic cubit the additional length would be 3.1 m and in the case of the Ionian cubit 5.2 m. The overall length of a reconstruction on the lines of Olympias

in the former case would increase to about 40 m, making longitudinal bending strength an even more critical matter. In the latter case the length would increase by another two metres making it a more doubtful possibility both from a practical point of view (viz. the trieres' length) and in view of the Zea shipsheds).

The trials seem to have directed attention to a point no one would have been likely to think of without the direct experience of rowing *Olympias*. The logic is cogent. The ship cannot achieve her proper speed without a longer stroke at all levels, but that is not possible unless the thalamians are given room to swing their bodies a few inches further back and further forward. This additional room could only be provided by evaluating the two cubit "room" more generously. There is some ground for thinking that the term, *dipechiake*, expressing the basic element in the design of oared warships, may go back to the period of warship construction when the Old Attic foot was in use. Employment of the Old Attic foot would increase the "room" by 100 mm and the total length of the ship by about 3 m. The thalamians stroke would be 10 cm longer at the cost of making the longitudinal bending strength of the ship more critical. The measurements recorded there would have been certainly in the cubits employed in contemporary Athens. The uncertainty as to the precise length of the slipway of the Zea shipsheds removes any objection on their account to 3m of additional length for the ships they were built to house.

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LEGENDES ET RITES MARITIMES REFLETES DANS LES DESSINS GRAFFITI DES EGLISES DE NESSEBAR (XIV^e - XVIII^e S.)

L'énorme collection de dessins-graffiti médiévaux des églises de Nessebar (plus de 230 représentations) reflète de façon globale la vie des habitants du littoral pendant les "siècles obscurs". Ils démontrent un nombre de constructions navales typiques, étant souvent l'unique témoignage de ces types de bateaux. Les dessins possèdent un caractère votif - par ces représentations on visait à assurer la protection des forces divines dans les rudes conditions de la mer Noire. Ces croyances religieuses se manifestent de manière assez évidente dans quelques dessins - graffiti caractéristiques (Fig. 1-2).

L'un de ces graffiti présente le dessin d'un bateau médiéval sur la vergue duquel est placée l'icône d'un saint homme. Le reste des images intéressantes appartient aux personnages féminins. Ce sont deux figures en buste dessinées juste au-devant d'un bateau. Les femmes aux longs cheveux éparpillés sont démontrés maladroitement. L'une des figures est comme un allongement de la proue du bateau. Enfin nous pouvons mentionner aussi une figure féminine dessinée toute entière. Elle a un long habit, sur la tête porte une sorte de chapeau allongé et dans les mains - quelques objets imprécis.

L'image masculine représente sans doute un prêtre ce qui est confirmé par l'étole sur sa poitrine. En comparant ce détail avec les mains rangées devant le corps et le large front chauve il devient évident que sur le dessin est reproduit le buste de St Nicolas¹ (Fig.3).

Sa présence sur le bord du bateau n'est pas une surprise. Selon les données hagiographiques l'une des principales fonctions du Saint né en Lycie vers l'an 370 fut de secourir les pêcheurs et les marins. Dès sa tendre enfance Saint Nicolas fut l'exemple de la vertu et d'un tel ascétisme, qu'étant bébé il refusait le lait maternel mercredi et vendredi. Toute sa vie le Saint négligeait les biens matériels et les distribuait aux pauvres (même son propre héritage). Ses possibilités d'effectuer des actes vertueux accroissèrent après sa nomination pour évêque de la ville de Myre, située en Asie Mineure sud-occidentale, d'où provient son épithète la plus populaire - Saint Nicolas de Myre. Dans la tradition écrite il existe plusieurs épisodes reflétant l'activité de Saint Nicolas - le sauvetage de trois citoyens, qui bien qu'innocents furent condamnés, des trois généraux accusés injustement par l'empereur, etc. Ce n'est que plus tard qu'on commence à attribuer à Saint Nicolas des fonctions soterologiques plus générales et il devint le protecteur des paysans, guérisseur et sauveur des marins².

La vénération de Saint Nicolas comme protecteur des marins et des pêcheurs se propagea initialement parmi les marins grecs. Le saint acquiert son pouvoir sur les forces maritimes après le pèlerinage en Palestine. Ses facultés nouvelles devinrent le sujet de plusieurs épisodes. Au Moyen Âge elles furent souvent interprétées dans l'art surtout dans la région de la Méditerranée (des marins grecs le culte se répandit en Italie et en Espagne). Sur l'un des tableaux d'Ambrogio Lorenzetti (1319 - 1347) est représenté le miracle le plus important de St. Nicolas lié à la mer. L'action se déroule dans la ville de Myre qui fut dévorée par la faim. Saint Nicolas de Bari (c'est le nom sous lequel il devint célèbre à l'Ouest) supplia les marins d'un bateau byzantin de distribuer aux citoyens affamés leurs réserves de céréales. Les marins aidèrent les citoyens en leur laissant ses vivres. Arrivant à Constantinople ils découvrirent que leurs vivres furent restitués.

Un autre tableau d'un maître espagnol anonyme de XVe - XVe, démontre par quelle manière St. Nicolas secourit les marins au cours d'une tempête. Les rescapés de l'équipage sont déjà condamnés - le bateau est submergé par les vagues, le mât est cassé, les objets nagent tout autour. Alors intervint le Saint, il recolla deux parties du mât et sauva le bateau³.

Le culte envers Saint Nicolas comme protecteur des pêcheurs et des marins se répandit très vite dans les terres bulgares. Il vient de s'imposer la conception que le saint est le maître de la mer, le dompteur des tempêtes et des ouragans. On le représente sur un bateau d'or, navigant dans la mer. Le bateau est toujours à l'endroit où on avait besoin de lui. Les fonctions maritimes s'imposèrent vite

dans la tradition écrite et orale. Ce fait est confirmé par la chanson populaire dont le refrain est: "Le sort tomba à Saint Nicolas de marcher sur la mer, sur le Danube, les bateaux de secourir."⁴

Une enquête ethnographique contemporaine effectuée dans la partie orientale du littoral bulgare de la mer Noire offre quelques données intéressantes concernant l'état contemporain du culte. La légende qu'au cours de la construction d'une nouvelle barque on doit insérer une icône de Saint Nicolas, s'est conservée jusqu'à présent. L'icône consolidera la construction et gardera la barque des tempêtes maritimes. Une place particulière dans la vénération du saint appartient aux femmes des marins. Elles devaient prier devant son icône au cours des navigations de leurs époux. Dans le passé on n'allait pas à la pêche sans prier devant l'icône du saint⁵.

Il n'y a aucun doute qu'avec le dessin y présenté on avait cherché une telle protection. "L'icône" représentée est disposée sur l'une des places les plus importantes du bateau - le mât. Nous pouvons faire une analogie intéressante avec les fonctions de St. Christophe, considéré comme protecteur par les marins occidentaux. La légende dit que si l'on voit son image au cours d'un danger on peut se sauver de la mort. "Les feux de St. Christophe" devinrent célèbres - c'est la lumière particulière phosphorisante sur les extrémités des mâts juste avant la tempête.

Dans le cas concret les fonctions de Saint Nicolas sont renforcées par la protection du Christ, lui-même. La composition de la peinture murale où le Saint secoure les pêcheurs est dessinée juste au-dessus d'un dessin-graffito. Il s'agit d'un idéogramme-prière complexe qui est caractéristique pour le Moyen Age.⁶

D'autres données de l'enquête ethnographique effectuée se rapportent à la vénération du bateau lui-même. Cette vénération est une manifestation des croyances païennes fortes qui parfois s'entremêlent de manière bizarre avec le culte chrétien. Selon les enquêtés chaque barque est un être vivant et possède une âme. L'âme de la barque s'appelle *tchouni* ou bien *tsouni* et son cri perçant peut-être entendu dans le grincement du bateau au cours d'une tempête⁷. La représentation de plusieurs bateaux et d'un nombre restreint de gens sur les dessins-graffiti dans les églises de Nessebar s'explique par cette vénération du bateau. Pour les dessinateurs les bateaux étaient des êtres vivants de qui en plus dépendait la vie et le gagne-pain des hommes. Tandis que les grands bateaux occidentaux (y représentés de même) furent considérés comme des géants inconnus, arrivés de terres lointaines.

Les survivances des croyances païennes apparaissent le plus fortement dans les représentations féminines où la cohabitation du christianisme et du paganisme se manifeste de la façon la plus évidente. Deux Saintes chrétiennes sont considérées le plus étroitement liées à la mer - Sainte Pélagie et Sainte Agaline. Elles protègent encore les marins au cours de la tempête. Pourtant les habitants de Sozopol, Pomorie, Nessebar connaissent des légendes dans lesquelles il est question de belles jeunes filles habillées en blanc et aux longs cheveux - *nerajdes* ou *nérajdes*. Elles jouent au-dessus des vagues et protègent les vents et les ouragans⁸. On ne doit pas avoir une perspicacité particulière pour découvrir derrière ces personnages les néréides antiques, les filles de dieux marin Nérée et les océanides de Doris. Ce furent de même des femmes fôlatres bienveillantes envers les marins qui symbolisaient la profondeur, l'inconstance et les habitudes de la mer.

L'enquête ethnographique démontre aussi l'existence d'une déesse de la mer, nommée *Kyrie Thalassa* (Madame la Mer). Selon son aspect extérieur elle est semie-femme, semi-poisson aux longs cheveux. Les habitants des petites villes du littoral l'appellent encore "Mère de la Mer". Elle est la protectrice principale de la mer et de ces éléments. Les *nérajdes* sont ses subordonnées. Il n'y a pas longtemps que la tradition de mettre une figure féminine en bois sur la proue de chaque bateau, récemment construit, existait encore sur le littoral bulgare de la mer Noire⁹.

Ce n'est pas difficile de poursuivre le lien synchrétique entre cette déesse féminine et la mythologie grecque antique. Amphitrite, l'épouse du dieu marin tout puissant Poseidon, de même acquiert une grande puissance après son mariage. Ces dieux eurent plusieurs enfants, d'ordinaire ce furent des monstres. Pourtant l'un de leurs enfants se détacha des autres - ce fut Triton, le dieux des profondeurs maritimes, semi-homme, semi-poisson. Cette trinité est un phénomène assez caractéristique pour les mythologies anciennes exprimant la diversité de la nature et en même temps son intégralité, illustrée par les liens de parenté. Il devient évident que plus tard ces divinités furent unifiées dans un dieu synchrétique, possédant tous les traits principaux de ses composants. Ainsi des plusieurs êtres divins habitant selon les croyances des grecs la mer se furent conservées seulement les néréides et une divinité féminine synchrétique *Kyrie Thalassa*. Pourtant on devait faire un compromis avec les nouveaux personnages divins - les Saints chrétiens. C'est ainsi qu'apparaît un intéressant tableau hétéroclite des croyances sur le littoral bulgare de la mer Noire.

L'illustration indubitable de ces cultes est observée sur l'un des dessins situé au-dessous de la composition pittoresque "Le Christ aidant les pêcheurs" de l'église "St. Stéphane". Il n'y a aucun doute que l'une des images féminines en buste se rapporte à la proue du grand bateau y représenté (Fig.4). Comme il a été déjà mentionné à cet endroit on disposait la figure de *Kyrie Thalassa*. Au-dessous de l'image féminine nous pouvons déchiffrer une abréviation ou bien une fausse transcription du nom de Sainte Pélagie, c.-à-d. du nom de la Sainte-chrétienne protectrice des tempêtes et de la mer. En ce cas ce fut de même une divinité synchrétique unifiant les images de *Kyrie Thalassa* (cheveux longs et absence de la partie inférieure de corps), pourtant la dénomination est celle de la sainte chrétienne. Quant à autre image féminine il n'est pas exclu que ce soit l'image d'une *néraïda*.

En différence de ces deux images féminines, la troisième représentation de femme ne peut pas être liée de façon directe aux dessins des différents bateaux. Les habits de la femme sont complètement réels - l'habit est du type *saja* - serré à la taille, aux bords larges, la femme porte sur la tête un chapeau ou bien une couronne. Les bords de la *saja* sont décorés de dentelles¹⁰. Il est évident que le dessinateur avait représenté une femme réelle.

Avant le début de la saison de pêche et la sortie des bateaux en mer, on effectuait sur le littoral de différents rites. Les bateaux devaient être par exemple arrosés avec le sang du premier poisson attrapé. Un autre rite intéressant était exécuté par les femmes des pêcheurs. Parées et en habits de fête elles allaient sur le littoral avec une poêle et un long trépied, pour effectuer quelques rites particuliers¹¹. L'analyse attentive du dessin démontre que dans sa main droite la femme tient un objet rond à longue manche, et dans sa main gauche - un objet très long et courbé. On a déjà mentionné les habits de fête. Il est fort probable que sur le dessin eut été représentée l'exécution d'un rite féminin, effectué avant le commencement de la pêche.

Les exemples mentionnés sont suffisants pour qu'on puisse distinguer la diversité des croyances maritimes qui avaient existé dans le passé sur le littoral bulgare de la mer Noire. La profession même des pêcheurs et des marins créait des conditions favorables pour la diffusion de superstitions et de tabous différents. Les dangers incessants de la mer et la pêche incertaine favorisèrent la création de plusieurs croyances, ainsi que leur élargissement. De même la tradition de la profession accumule plusieurs couches religieuses. Les combinaisons obtenues s'avèrent extrêmement intéressantes et importantes quant à science. Ces

couches religieuses peuvent être découvertes dans toutes les mers européennes¹². La riche histoire de la mer Noire forma un véritable kaléidoscope de croyances.

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NOTES

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- 8 Ibidem, p. 109-110.
- 9 Ibidem, p. 110.
- 10 C' est la consultation compétente avec les spécialistes- ethnographes de BAN.
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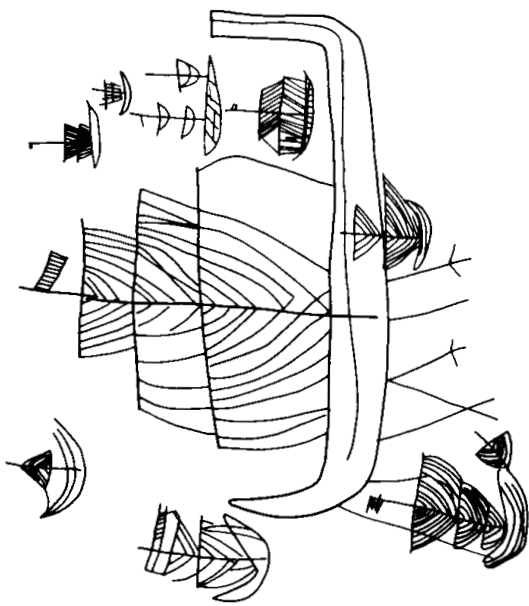


Fig. 1

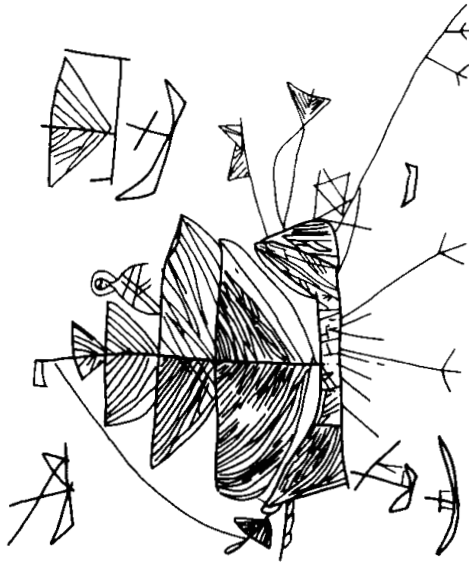


Fig. 3

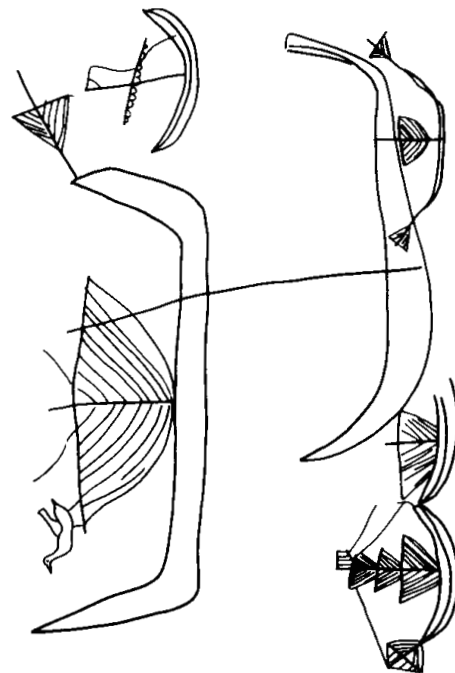


Fig. 2

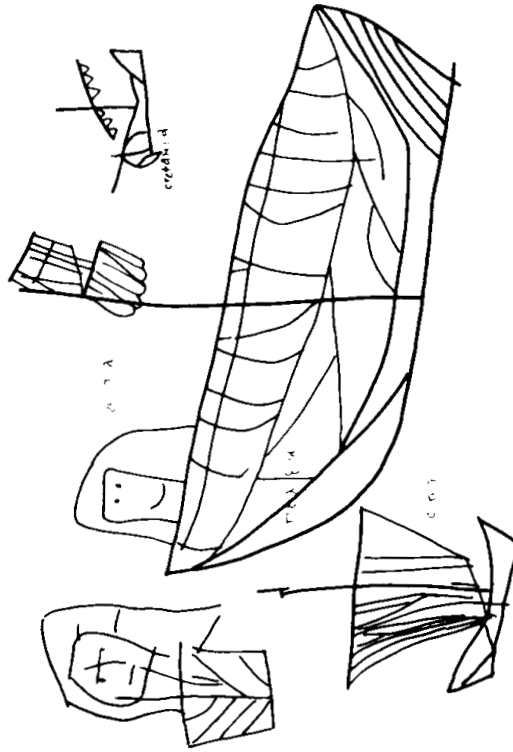


Fig. 4

THE GREEK CREW TRIALS WITH OLYMPIAS IN 1988

The second series of trials for OLYMPIAS started in the beginning of June 1988.

The ship was commanded by Lieutenant Demetrios Papadas and manned by a permanent deck crew of naval petty officers and ratings. The oarcrew were students of the petty officers academy at the ages of 18 and 19. These young men had never before been in the ship except of a short visit during the winter for educational purposes. Most of them were not familiar with rowing except of some lessons they had taken with the training "Sixteens" of their academy. Although the commanding officer and some men of the deck crew had participated in the trials of 1987 this new oarcrew mostly unfamiliar with rowing imposed the main difficulty for the planning of this second series of trials.

Until the 18th of July that the ship would be handed over to the oarcrew raised by the Trireme Trust we had one month and a half at our disposal excluding weekends and short vacation periods to train the crew, perform trials and take measurements for speed under oar, acceleration and manoeuvrability under oar, effectiveness of steering oars, various trials under sail and last but not least a voyage of 140 miles around various towns of the Saronic Gulf with festivities in each town which made our schedule on arrivals and departures rather tight. So it was decided that the crew would be training in the ship until June 17th and then one week of trials and measurements out of the harbour under construction in Neon Phaliron would follow. A short vacation would be given after that to the crew until the 2nd of July that the preparations for the Saronic Gulf voyage would start.

After one week of training a remarkable progress in the oarcrew performance was evident. Although during the first three days we were rather disappointed regarding the synchronizing of oarstroke and the endurance of the crew, at the end of the week they would row for one hour continuously at an average of 30 strokes per minute giving to OLYMPIAS a maximum speed of 4 knots in good weather conditions.

On the 17th of June that the trials with measurements began, 11 men out of 200 that originally was the number of the oarcrew were out of the team because of lacking the necessary strength, and fitness to handle the heavy oars. The remaining 190 continued, most of them with blisters in their palms and chaffed bottoms but rather proud of what they had achieved up to that time, expecting with great interest the adventure of the Saronic Gulf voyage.

The Manoeuverability - Speed and Acceleration Trials

For the accurate measurements of the speed under oar, and manoeuverability, the ship's course was tracked by a shore based measuring instrument called a Geodimeter using an infra-red laser beam reflected from the ship on which was mounted an omni-directional reflector. This instrument converted measured distances and angles into cartesian coordinates with great accuracy. The instruments and staff for the measurements were provided by the Hydrographic Service of the H.N. Except of the above mentioned instrumentation that was used for measurements, there had been installed in the ship during the winter of 1988 a digital log, a digital wind speed indicator and a wind direction indicator.

These trials took place for 5 consequent days from 17th to 21st of July in the hours between 8.00 and 15.00 in the area between the harbor of Neon Phaliron and the yaughts harbor in Paleon Phaliron. The trials began with the turning circles which is a fundamental ship trial manoeuvre that provides quantitative data on the ship's transient and steady state turning behavior. In all the tests initial speed was gained with the ship moving in a straight line and with equal numbers of rowers at work on each side; in some tests these rowers all continued working after the rudders had been applied but in others the rowers on the inside of the turn ceased work when the rudders were activated. Large protractors were used for measuring the rudder angles and to ensure that both rudders were applied equally.

Effect of rudder angle

The main yard was lowered for these tests. Angles of 22.5, 45 and 67.5 degrees were used, and the ship was propelled by the 62 oarsmen at the *thranite* level, although in the test with a 45 degrees angle they were men who normally rowed as *Zygians* or *Thalamians*. The diameters of the turning circles were 225m, 124m and 84m, i.e., they were inversely proportional to the rudder angle. The initial speeds were 4.5 knots, 3.8 knots and 3.8 knots and the loss of speed in the turns was 25%, and 20% respectively.

Effects of number and location of oarsmen during a turn

The main yard remained lowered for the first of these tests. By increasing the number of oarsmen in action from 62 to all 170 the initial speed was increased from 3.8 to 5.9 knots, and the diameter of the turn with a rudder angle of 67.5 degrees was increased from 84m to 110m. The loss of speed in turning was increased from 20% to 25% i.e. the speeds on leaving the turns were 3.0 knots and 4.4 knots respectively. After the main yard had been hoisted, the sail being brailled up to it, two tests were made to discover the effect of making the rowers on the inside of the turn (the port side) cease work when the rudders were put on, and the effect of increasing the number of rowers on the outside. In the first of these tests the 62 *Thranites* rowing at 29spm had attained a speed of 3.4 knots when the rudders were activated to an angle of 45 degrees and the port side *Thranites* stopped rowing. The diameter of the turn was 103m, whereas when all the *Thranites* had rowed throughout the turn it had been 124m. The comparison may not be quite fair because the yard had been hoisted and the initial speeds differed. In the second test the whole crew rowed at the outset to attain a speed of 5.3 knots before the rudders were activated and the port side rowers ceased rowing. The rudder angle was again 45 degrees and the diameter of the resulting turn was 105 m. The greater torque from having all the starboard oars rather than only the starboard *Thranite* oars in action during the turn evidently compensated for the greater resistance to turning that arose from the higher initial speed.

Several more turning circle trials were attempted at various speeds which confirmed the very good manoeuvrability of the ship although also several of them could not be considered as accurate and were discarded because of the severe drifting of the ship during the turn when the wind speed was above 8 knots.

The conclusion of these turning trials is that the rudders are very effective although they increase appreciably the resistance of the ship especially when they are working at angles above 30 degrees. The rudders are correctly balanced and easy to use. Their best position for a quick turn is at 67 degrees whereupon the rate of turning of the ship at a speed of 4 knots is 2.6 degrees per second.

One turning trial was performed with the port *Zygians* and *Thranite* files of oars backing water and the respective starboard files pulling ahead. It took several training turns in order to master the synchronisation of the port and starboard oars when the first were backing water and the second were pulling ahead. During this trial turn the ship turned at a rate of 3.5 degrees per second with 23 strokes per minute rowing rate staying virtually in the same place. In order to complete the

manoeuverability measurements we had planned zig-zag trials for the last two days of this phase.

The wind speed during these days exceeded the ten knots and the drift of the ship made it impossible to take the accurate measurements needed for this particular trial.

The results of the speed under oar trials can be summarized as following. The maximum speed attained by the ship in Phaliron measured by geodimeter regarding the course and distance and by stop-watches regarding the time was 7.2 knots. This speed was kept constant for a distance of 600 meters which was covered within 2 minutes and 42 seconds. The ship's log measured a speed of 8.02 knots during the last day's trials when the ship was in Poros which is questionable because of a + or -10% log's error. During these trials both rudders were fully immersed and the yards of both brailed with the sails furled. Given that the rudders increase the resistance of the bare hull of the ship in this high speed region by about 80%, one more knot in maximum attained speed with the rudders immersed by only 1/3 is reasonable to expect.

Maximum speed with only the *Thranites* file rowing was 5.8 knots with the *Zyggians* file 5 knots and with *Thalamians* file 4 knots.

Now some brief comments concerning the crews and ship's performance in the speed trials under oar. During the first two weeks of training of these novice oarsmen and the trials under oar impending, we concluded that they could reach a good synchronization but they rowed with little body swing with a short stroke (about 40-50 centimeters instead of the 80-90 cm available) using almost entirely their arms. Efforts to increase the body swing had adverse effects on synchronizaton because of lack of rowing experience.

Given that in propulsion by oars the power equals the force applied to the oar times the length of the stroke times the rate of stroke per minute ($P=F*S*spm$) and length of stroke could not be further increased, in order to increase P we decided to increase by practicing the force applied and the number of strokes per minute without loosing the synchronization. Of course with this technique we would loose in duration of the output since a significant part of the energy output of each oarsman per unit of time would be waisted in the efford to raise the heavy oar out of the water, make a backswing and start catching the water again.

The above were confirmed later by the speed measurements where the ship reached high values of speed but with the rather short duration of 2 min.

and 42 seconds at maximum instead of 6 or 7 minutes that an oarsmen physique makes possible. On the other hand these synchronized short and strong strokes with the oars should be the technique to achieve the highest values of acceleration in the ancient naval battles for ramming or avoiding the enemy ships in short distances.

It is also proven by statistical modelling that the synchronization of oars is better kept in the short crested and with short period waves of head seas that are met in Aegean and a *Trieres* can afford to sail, if shorter stroke is kept, because more oars are simultaneously in the water that with a longer stroke. So because of reasons of necessity so to speak OLYMPIAS was tested by the Greek Crew with the short stroke technique while later it was tested by the Trireme Trust's Crew with the long stroke technique.

As far as oars are concerned it was clear that although well balanced they were rather too heavy to handle especially for novice oarsmen. It took a lot of effort to deal with their high mass momentum during their pulling out of the water or at the sudden change of direction from backswing to the catch during each stroke. The beams at the height of the head of *Thalamians* seemed disturbing them psychologically rather than actually, since they were afraid to hit at the end of extreme body swings.

The rudders although very efficient seemed to induce an unnecessary drag at high speed because of turbulence caused by their bluff shaft cross section and their hydrodynamically poor blade shape which nevertheless is archaeologically justified. This makes it almost certain that in Antiquity at high speeds the rudders would be raised out of the water leaving immersed a percentage of the blade area which because of the increased speed would keep the maneuverability of the ship still at high standards.

The acceleration from stop was measured with all three rows of oars rowing and it took 32 seconds to reach a speed of 7 knots that gives an average value of acceleration of 0.1 m/sec. This value is greater if it is measured for smaller speeds from stop. The detailed results of the above mentioned trials as well as the results performed by the Trireme Trust crew in Poros will be given in detail in a report which is expected to be published until the end of this year.

I will now proceed with the trip of *Trieres* in the Saronic Gulf giving it as a summary of a diary together with the most important observations that can tell us a lot about the ship's performance and the crew's life not in so to say "laboratory conditions" but in actual and demanding voyages where the duration, the weather

conditions, the crew's level of training, the physique and stamina play their part which is not to be underestimated at all.

On Saturday June 9th at 7.50 in the morning, OLYMPIAS departed from Neon Phaliron with destination to Salamis where it was expected at 17.00 to begin the festivities of the farewell for the Saronic Gulf voyage.

There was a cross head breeze blowing with a speed of 4 knots. The rate of rowing was 32 strokes per minute and the ship's speed 3.2 knots. The speed remained constant at 3 knots for the next 4 hours. *Thalamian* oars men interchanged position with *Thranites* when OLYMPIAS had already covered 11.2 miles. There was an increased need for potable water and the two inflatable service boats brought new bottles from the landing ship of the Navy that was accompanying OLYMPIAS. At 12.00 the ship anchored at the Kanakia bay and the crew took its lunch.

At 12.30 and after a half hour lunch and rest the ship departed. The wind had turned Southward with a speed of 13 knots. The relative direction to the ship's course was 155 degrees and the main sail was unfurled giving to the ship a speed of 3.5 knots. This lasted only half an hour and afterwards the wind fell. The *thranites* file started rowing keeping the speed at 2.5 knots. The wind changed direction very often. We observed that the ship could sail when the apparent wind angle was above 75 degrees abeam. A short in duration South gentle breeze of 16 knots gave to the ship the speed of 6 knots and at 15.00 we arrived in Salamis having covered 21.5 miles.

OLYMPIAS sailed from Salamis with destination to Aegina on Monday July 11th on 7.40 in the morning for the part of the voyage which turned to be the most pleasant and easy because of the helpful wind. A breeze from north eastern direction with a speed of 12 knots was on the starboard beam of the ship. The sails were hoisted and brailed before casting off from the quay and proceeding clear under oars. After that both sails were unfurled and trimmed giving to the ship a speed of 3.5 knots.

The wind turned into gusty changing often direction within a range of 40 degrees and although the wind direction indicator was showing 90 degrees abeam the sails could not be regulated in a steady position going limp and frequently backing. These sudden gusts reaching sometimes the speed of 17 knots caused appreciable rolling of the ship. To reduce it the boat sail was furled leaving the mainsail to draw the ship at a speed of 6.5 knots. At 8.50 hours the ship tacked getting the wind which had weakened to a speed of 7 knots from the port beam and attaining a speed of 4.5 knots.

After one hour the boat sail was unfurled and *Zygians* and *Thranites* files started rowing increasing the ship's speed from 4.5 to 6.6 knots. This went on for 30 minutes.

Although the rowing efficiency was reduced because of the increased relative velocity of the water, it showed clearly that sails and oars could be used simultaneously in antiquity if the circumstances would call for that. During this leg of the voyage were present the archaeologist Mr. Spondilis and Mr. Timothy Shaw as observers. Only the port rudder was used during this part in order to reduce induced drag and observe the performance of the vessel under this condition. The ship sailed balanced and stiff behaving in the same way as if both rudders were used but with the speed increased by 9%.

At 11.30 after 3 hours and forty minutes OLYMPIAS arrived in Aegina covering the 16.18 miles distance from Salamis at an average speed of 4.6 knots. The conclusions of this leg of the voyage are very useful and confirmed the first impressions about sailing performance of the ship which we had from the previous year.

The leg from Aegina to Poros started the next day July the 12th at 6.40 in the morning. A light North-eastern breeze blowing with a speed of 7 knots from the port beam of OLYMPIAS gave hopes for an easy voyage. Professor Morrison and Mr. Timothy Shaw were aboard as observers. The ship attained with both sails unfurled and trimmed a speed of 5.5 knots and with the wind abeam at 90 degrees it crossed the Moni Straights.

At 8.20 hours the wind weakened to a speed of 2.2 knots being on the port quarter of the ship which sailed at a speed of 2 knots, indicating that the sailing efficiency of the sail rig was about 90% at this moment. A problem to the hauling halyard of the main yard on the masthead appeared at this time and one man of the deck crew was hauled using the halyard up to the top of the main mast to repair it. This repair work lasted 15 minutes.

The ship turned slightly its course having now the wind abeam at 70 degrees. The sail rig after the necessary trimming performed without any backing in this close angle to the wind defining its limits and capabilities. The ship's speed was 2.7 knots and the wind's velocity 4.7 knots. This course of the ship continued for three more hours with frequent changes to the wind direction which obliged the deck crew to deal very often with the trimming of the sails keeping an average speed of 3 knots.

As soon as the ship entered the Poros Straights both sails were furled and OLYMPIAS was rowed by *Thranites* and *Zyggians* at a speed of 4.3 knots with 32 strokes per minute. In a small bay close to the Poros harbour the ship anchored and a trial of quick abandoning of the ship with all crew jumping with order to the sea took place. The oarcrew jumped from the outriggers in an orderly way, by file *Thranites* first, then *Zyggians* and lastly the *Thalamians*. In this first trial it took 70 seconds for the oar crew to abandon the ship.

The ship remained at anchor for 6 hours and the crew rested and swam. After this trial the ship sailed again at 18.30 for its mooring in the quay of Naval School in Poros where it arrived at 19.20 hours.

The next day July the 13th at 6.30 the ship sailed with destination to Hydra. In the ship were present Prof. Morrison and Dr. Vichos as observers. At 7.10 hours both sails were unfurled in order to catch the morning breeze of speed 3.3 knots blowing from the starboard quarter which gave to the ship a speed of 2.9 knots. At 8.10 the ship approached the Tselevinia Straight with a speed of 4.0 knots. Some observations about the resistance of the rudders took place at this point with the port rudder pulled out of the water and then immersed again. At a speed of 4.0 knots each rudder contributed to a 10% decrease of the speed of the ship. At 9.15 the ship was 3.1 miles away from the harbour of Hydra. At this point the wind had gradually diminished to a speed of 1.0 knot so the sails were furled and the ship was rowed by all files of oars at a speed of 4.0 knots. A short sprint was attempted where the ship reached a speed of 7.8 knots as measured by ship's log. At 10.20 the ship arrived in Hydra having covered 13 miles in 3 hours and 50 minutes.

On Thursday 14th of July at 6.45 OLYMPIAS sailed for Poros. Getting a Nothern breeze of 3.3 knots ahead the ship was rowed by *Thranites* only reaching a speed of 3.3 knots. The pulling out of the rudder oars by 2/3 gave a small increase to the speed making it 3.7 knots indicating again that their drag in these low speeds is about 10% while it is greatly increased at higher speeds because of the wave making resistance of the rudder shaft. A short sprint with the *Thranites* oars gave to the ship a speed of 5.5 knots. After one hour of rowing the *Zyggians* took their turn to the *Thranites* oars. At 8.20 the breeze coming from ahead picked up to a velocity of 12 knots and the ship's speed dropped to 2.2 knots with only the *Thranites* rowing. After one hour the *Thalamians* who were resting up to that moment took their turn to the *Thranites* oars and the ship reached a speed of 3.2 knots with 32 strokes per minute. The ship arrived in Poros at 11.30 covering the distance of 13.3 miles in 4 hours and 45 minutes at an average speed of 2.8 knots by oars in a head wind of 12 knots.

The next morning at 6.30 the ship sailed with destination to Epidaurus. The relative velocity of the morning Northern breeze was 7 knots having a direction 10 degrees to the port of the ship's bow. Only the *Thranites* were pulling and the ship's speed was 3.2 knots. After two hours of rowing the morning breeze picked-up to a gentle breeze of velocity 13 knots steadily increasing and the ship's speed fell to 1.9 knots. The wave height increased to 0.6 meters. The ship was rowed now by *Thranites* and *Zyggians* reaching a speed of only 2.8 knots. At 10.00 and with OLYMPIAS sailing under the same conditions with a wind speed of 15 knots 18 degrees from the starboard side of the bow a drifting fo about 10 degrees was recorded. The files of oarsmen interchanged positions every hour with one file resting at a time. At 10.30 the course was altered westwards and having now the wind at the starboard beam both sails were unfurled and trimmed and the ship attained a speed of 3.5 knots. The OLYMPIAS arrived in Epidaurus at 15.00 covering a distance of 22 miles in 8 hours and 10 minutes at an average speed of 2.7 knots.

On Sunday the 17th of July at 6.30 the ship sailed for it's last length of the Saronic Gulf voyage from Epidaurus to Poros. The poor wind conditions prevailed in the greatest part of this leg where the ship was rowed by two files of oars for 4 hours reaching the average speed of 3.5 knots. At one part of this voyage we had a wave height of 0.8 meters from the bow and useful observations about the rowing conditions in rough water were made.

It was really difficult for the oarsmen to synchronize their stroke along the length of the ship since there were sections of the ship that the oars were catching water being at the crest of the wave while at others the oars were in the air being at the trough of the wave. The speed under these circumstances was reduced to about 2 knots. The part of the distance that was covered under sail was 7 miles at an average speed of 4.0 knots.

The total distance of this length which was 22 miles was covered in 7 hours at an average speed of 3.1 knots. The ship arrived at the bay next of the Poros harbour at 13.30 and stayed there at anchor for half an hour. New trials for quick abandoning of the ship took place there and the time was shortened to 24 seconds that took the whole oarcrew to abandon the ship in order.

With this arrival in Poros ended the first part of 1988 trials and with this occasion I want to express once again the thanks of the International Committee of Experimental Archaeology for OLYMPIAS and of me personally as the Trials Master to the crew of the ship and especially to the young oarsmen who made it possible to have all these results despite the difficulties.

After the voyage in Saronic Gulf we were able to draw useful conclusions about the performance of the ship's sailing rig. The observations of log speed and apparent wind speed and direction have been plotted after resolution into true wind speed and direction relative to ship's head on polar diagrams. These diagrams show, irrespective of wind speed the ratio of ship speed to true wind speed in various wind directions what is called the sailing efficiency. As we can see in the polar diagram the speed ratio is decreased with increasing wind's speed because sail is shortened in stronger winds and the resistance of the hull in the water increases as the cubic power of ship's speed. Maximum speed recorded was 8.5 knots in winds of 15 to 18 knots 30 to 40 degrees abaft the beam.

Ship's windward ability as observed showed that she can be sailed as close as 70 degrees into the apparent wind. Speeds of more than seven knots were often reached in quartering and following winds of around 15 knots apparent speed under full sail. In ideal conditions OLYMPIAS may exceed 10 knots under sail. Tacking and wearing can be carried out easily with little loss of speed owing to the ship's owing to the ship's responsiveness to the helm.

The lightning of the mainmast and main yard made for easier handling of the main sail although there is still some extra weight in the main yard that could be trimmed down. A view is also expressed that the main sail could safely be increased in area by increasing it's breadth and the length of the main yard.

The ship answered the helm well in all conditions of sailing yet met. The best combination of rudders and their degree of immersion when under sail has so far not been fully investigated. However during the trials good steering was experienced with only the leeward rudder in the water.

The excellent sailing performance strongly indicates that *triere* is made passages routinely under sail whenever the wind served and under oar only when pressed for time and worthwhile progress was possible by that means. That passages under oar were the exception rather than the rule could explain why explicit references in ancient literature are all to passages under oar while there are not to passages under sail. Such a predominant use of sail by fighting ships on passage would not in any way reduce the need for good performance under oar, essential to tactical mobility in combat before the invent of more efficient rigs and sailing warships. Until the fifteenth century AD ships needed to be equipped with both oars and sails to enable them to be deployed over appreciable distances while oars were equally important in minimising delays.

Behaviour in Waves

The behaviour of the ship in waves was very much what would be expected in a ship whose length was more than eight times the waterline breadth. The sense of pitching was especially felt among crew members stationed near the ends of the ship. No slamming of the bow to waves was experienced, presumably because whenever the forward part of the hull did emerge from the water when pitching, its sections were steep enough to prevent impact on reentry. When pitching, particularly on a head wind, longitudinal flexing of the hull was quite evident as waves passed under the vessel. In these trials the ship proved to be safe within the conditions for which it was designed, that is, in waves of up to about one meter in height.

In anchoring, the need was felt to put weights on the anchor ropes to obtain the same effects as those normally nowadays achieved by the use of chain in place of rope, mainly a horizontal pull on the anchor and “spring” in the cable which, hanging in a deep catenary would prevent sudden tightening should the ship pitch in waves while at anchor. Pulling the anchor by hand, proved slow and laborious owing to the limited working space and therefore the small number of men on the ropes. This needs further consideration in future operations with the reconstruction.

The main question that I had when we held the first discussions about the construction of OLYMPIAS in Greece came naturally to me once again after six years of common living experiences so to speak with her:

- Is it possible that such a ship could be seen sailing in Aegean 2500 years ago?

The answer now came unforced.

- Yes, OLYMPIAS is a *Trieres* that could be existing in Antiquity. Yes, there are areas that this ship can be improved as far as sailing rig-oars-internal arrangement are concerned and it is worthwhile to continue the trials and improvements in order to exploit and improve her limits, a process that without question was followed by ancient Greeks as well.

Commander Stavros Platis H.N.



SHIPS IN THRACE DURING THE BRONZE AGE

The Bronze Age in Thrace started at the end of the 4th millennium BC and ended at the end of the 2nd millennium BC¹. These two millennia in the history of Thrace have not been uniformly studied. This is particularly true of navigation and of the marine culture along the coasts of the Black Sea, the Sea of Marmara and the Aegean Sea, synthesized in the term Thracia Pontica. We have not excavated a ship from Thracia Pontica, but there exist other facts which may serve as a basis not only for the formulation of this problem, but also for its initial investigation.

Thus, for example, for the end of the 4th and throughout the entire 3rd millennium BC, i.e. during the Early Bronze Age, the Circumpontic cultural community² can be explained most logically in terms of the existence of active overseas contacts. The observed similarities of the archaeological cultures around the Black Sea cannot be due to mere coincidence, they must have resulted from contacts. It is quite another matter what the reasons for these assumed overseas voyages were. This problem will be discussed further below. These observations are even more valid for the cultures on both sides of the Sea of Marmara³. And if, nevertheless, the communications of Thrace by land were possible for part of the lands around the Black Sea, contacts with the northwestern part of Asia Minor were *par excellence* by sea. These two observations are supported by the predating of some of the stone anchors with holes found along the western Black Sea coast from the 2nd to the 3rd millennium BC, as proposed by Honor Frost⁴. These seem to have been the anchors of the ships that sailed at that time. However, these ships carrying many tons did not sail for the pleasure of their crews, as is the case with the yachtsmen of today. Navigation during the antiquity was for the needs of trade and was directly linked with production. In my opinion, one of the most

important reasons for navigation was the search for and the supply of copper ores or copper for the production of bronze. It should be pointed out that bronze was not used for making tools, because tools made of wood, bone, horn or stone were still effective, being at the same time much cheaper. Copper and its alloys were used for making weapons and cult objects (actually weapons were also objects). This can be accepted even after a cursory glance at the archaeological material. Then the search for copper as the basic product for the production of bronze becomes easily explainable. Whoever had copper could possess the modern weapons for that time, he could be victorious and he could rule over lands, wealth and people. Moreover, it is well known that the ancient Thracian lands were an extremely well developed metallurgical centre even from the Chalcolithic Age⁵. This suggests that copper was mined in the Thracian lands and was exported to lands where it was lacking. Ancient Thrace exported both to the Northern Black Sea coast and to the south.

In Bulgarian archaeology there is an attempt⁶ to see models of Early Bronze Age ships in some of the clay vessels found at Ezerovo II near the Varna Lake. In my opinion, these elongated plates are not sufficiently convincing evidence and we should wait patiently until a real model is discovered or - better still - an Early Bronze Age ship from Thracia Pontica. An indirect evidence about the use of navigation vessels - but for fishing - are the bones of dolphins and of belted bonito discovered during excavations of the Early Bronze Age settlement near Urdoviza⁷ because dolphins and belted bonito can be caught only by means of boats and ships.

Anyway, we still do not know what the ships of Thracia Pontica looked like in the 3rd millennium BC. However, on the basis of indirect evidence we may also assume the existence of ships both for fishing and for overseas contacts.

Data are considerably more abundant for the 2nd millennium BC, and especially for its second half. I shall start with the evidence found in the ancient authors concerning Thracian navigation. This evidence is the memory on which the archaeological data can be superimposed to come to life. Even Homer (II. XI, 220-230, Monro; Allen) told about the Thracian nobleman Iphidamas, son of Antenor, who sailed with a fleet of twelve ships during the Trojan War to fight on the side of Troy. According to (Pseudo-)Euripides (Rhesos I, 430-435, Ebener), it was again Homer who sang about the legendary Thracian king Rhesos who sailed with his ships in the aid of Troy. Another author to tell us again about the second half of the second millennium BC was Diodoros (VIII, frg. 11, Vogel), who reported

that after the Trojan War (13th century BC) the sea (i. e. the Aegean Sea - K.P.) was ruled over by Lydians and Maionians for 92 years, by Pelasgians for 85 years, by Thracians for 79 years, etc. Although Diodorus was a later author, he was known to have copied conscientiously earlier evidence that has been lost to us. This is why, the maritime supremacy of the Pelasgians and Thracians can be dated with much greater probability to the 12th and 11th century BC. Apollonius Rhodius (*Argonautica* I, 580-930, Merkel), who also adhered faithfully to the most ancient variants of the narratives, mentioned that the women on the island of Lemnos recognised the Argo ship as Thracian and were afraid of a piratic invasion. It is known that the myth about the “golden fleece” and the “voyage of the Argonauts” connected with it are dated approximately to the end of the 2nd and the beginning of the 1st millennium BC. Here I shall not dwell on the problem of the “golden fleece”, but nevertheless I shall mention in passing that such a “golden fleece” was discovered in the waters near the present-day cape of Kaliakra (the ancient Tirizis) along the present-day Bulgarian Black Sea coast. This was a metal ingot resembling a taut sheepskin or even oxhide, weighing nearly 1.5 kg and containing 32% gold, 18% silver, 43% copper, etc. The ingot is dated to the second half of the 2nd millennium BC, more specifically around the 14th century BC⁸.

Thus, according to the brief information of the written sources, it can be seen that the notion of Thracian navigation existed even in the most ancient myths. Consequently, we are faced with a fact: the Hellenic historical memory reflected the ancient maritime culture of the Thracians. Therefore, we are to expect some material confirmation.

The stone anchors with holes are among the most reliable arguments in this respect. They are from the Western Black Sea coast and the majority of them are dated to the 2nd millennium BC and especially to its second half⁹, another part - as I said earlier - is dated even to the 3rd millennium BC. Stone anchors number a total of 150. Petrographic studies have shown¹⁰ that 90% of them were locally produced, 10% came with foreign ships, for the time being it is not known where from. According to Honour Frost, their size and weight suggest beyond any doubt that they were used on ships of 200-300 tons, i.e. ships like the ones in the fleet of the Thracians from the Western Black Sea region. There are no grounds for ruling out the hypothesis that similar ships, made by the indigenous Thracian population, sailed in the Sea of Marmara and in the Aegean Sea. Quite on the contrary, the evidence of Diodorus and Apollonius Rhodius, cited above, concerns precisely the Thracians in the Aegean region.

Stone anchors from the Bulgarian Black Sea coast can give us yet another important notion about the Thracian ships from the 2nd millennium BC. Very important in this respect is the place where they have been found¹¹. Almost all of them have been discovered near anchorages which are usually localized in very calm bays, close to the land, unlike the stone and lead stocks which are usually found in the waters around the capes. In my opinion, this fact suggests indisputably that stone anchors were used for ships that navigated with oars or with sails, whereas stone and lead stocks were used on sailships. The ships with oars and sails with stone anchors could come in and go out of any bay using their oars only, approaching the shore and even reaching it. The sail was probably rather simple and was used only with suitable winds. According to the information available so far, such were the ships in Thrace during the Bronze Age. Sailing-craft began to be used later, during the Early Iron Age. It is the sail-craft that used wooden anchors with stone or lead stocks that anchored near the capes and did not enter deep into the bays. This was a common practice so that they could manoeuvre with their sails both in good and in bad weather. But this is quite a different topic.

In support of my conclusion I shall cite two more facts from the Late Bronze Age. These are the clay models of navigation vessels (boats) discovered in Northwestern Bulgaria in necropolises close to the Danube river¹² and the image of a ship on a stone plate from Southwestern Bulgaria (in the present-day town of Razlog), dated to the 14th-13th century and originating from a cult place¹³. In both regions this is indisputably an image of the "solar bark" which is associated with the religion of the ancient people. However, it is important for us that the navigation vessels were either boats or ships with oars. Although idealized, the notion of the "solar bark" apparently reflected to a great extent the actual navigation vessels used at that time.

In conclusion, the ships in Thracia Pontica were with oars, or rather with oars and sails, similar to the Late Bronze Age vessels found near Cape Gelydonia and Cape Kas on the western coast of Asia Minor. It seems that for two millennia they sailed in the waters of the Black Sea, the Sea of Marmara and the Aegean Sea. It is through these forms of navigation that Thracia Pontica performed the role of a contact zone for the Thracian civilization with the peoples in the rest of the Mediterranean world.

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THE SEA PEOPLES AND THERA SHIPS

The naval battle scene from Medinet Habu depicted on the north wall of the mortuary temple of Rameses III, is considered to be the earliest illustration of such an event of a true historical context (Nelson and Hoelscher 1929; Nelson et al 1930; Nelson 1943; Casson 1971: 36-8); Wachsmann 1981). Yet, one might reconsider this definition when carefully studying both the illustration, the text next to it, and the other historical source from Papyrus Harris I (c.f. ANET²:262a) one must come to the conclusion that in reality (or at least as the Ramesside historiographers would like it to be recorded) no real naval battle had ever been the case. The fact of the matter is that the "Sea Battle" of Rameses III 8th regnal year, against those people who were coming from the north, is to be matched with the Land Battle against the same invaders in the same year. As the illustration clearly depicted, on land the Egyptian army was fighting against a travelling mass of people, men, women and children, wandering with oxen carried heavy wagons and followed by their armed males (c.f. T. Dotlan 1982: 5-7). The Naval Battle is the other half of the same Egyptian attempt to stop the advancing invaders, in that case by ambushing and trapping their fleet of coaster vessels which were sailing down along the Levantine shore, toward Egypt (?), following the group which was travelling on land. The text from the mortuary temple which refers to these events claims:

"I organized my frontier in the Levant (Djahi), prepared before them, princes, commanders of garrisons and maryanu. I have the river mouths prepared like a strong wall, with warships, galleys (mḥ's) and coasters (br), fully equipped, for they were manned completely from bow to stern with valient warriors carrying their weapons". (Nelson et al.1930: Pl. 46; ANET²: 262b, translated by J.A. Wilson).

Further on in the same text:

"... Those who came together on the sea, the full flame was in front of them at the river-mouths, while a stockade of lances surrounded them on the shore. They were dragged in enclosed, and prostrated on the beach, killed and made into heaps from tail to head. Their ships and their goods were as if fallen into the water".

In another text from this temple, the claim is phrased:

"Those who entered the river mouths were like birds ensnated in the net..." (ANET²:263a).

The text next to the scene of the Naval Battle reads:

"... They are capsized and overwhelmed when they are... Their weapons are scattered upon (His (Rameses) arrow pierced whom of them he may have wished and the fugitive is become one fallen into the water" (ANET²:263b).

The scene (Fig. 1) verifies the general claim of the text. The overall picture is of an idle fleet of five vessels surrounded, attacked and capsized by four Egyptian ones, while being under bowmen raid from the nearby shore. The defeated Sea Peoples are picked by the Egyptian soldiers and captured either into their vessels, or being gathered on the shore. There is no naval battle as such, but rather a closing-in fleet coupled by garrisons on land, blocking a group of shipborne warriors, which are moored within a river mouth to be captured "like a bird in a net".

As for the Sea Peoples and their vessels much has been written about (Casson 1971:37; Wachsmann 1981; Basch 1987:66-9) and we do believe their boats were not of a type suited for naval battle. The tiny appendences at the base of their stemposts cannot be used as ramming device in any possible way (and see other opinions, Nelson and Hoelscher 1929; Fig. 24; Nelson 1943; Wachsmann 1981; Basch 1987: 68) and one might consider them to be mere coasters, similar to the oxen wagons on the matching Land Battle scene (Raban 1988: 264-272; 1989). In such a particular encounter, in which there were also other type of non-military vessels, involved on the Egyptian side, the one type which was chosen by the master artist was not operating in a regular naval manner. In fact, any kind of floating vessel with an ample room on deck for archers in as great a number as possible, "manned completely from bow to stern", would fit nicely for the Egyptian military tactics. At the right handside Rameses and his archers are raiding the helpless people on the enemy's vessels and so are doing the Egyptian seaborne

archers (c.f. Fig. 2: E.2, E.3). After causing maximum killing in that initial stage, the Egyptian oared vessels are closing in within a distance from the moored enemy suitable for throwing lances, slinged stones from the masts' topping crow nest and grapnels for tearing off enemy sails (in order to avoid escape), or in an attempt to capsize the enemy's vessel by pulling hard). The first aim is described on N.1 (Fig. 3), while the other is illustrated by the tumbling masts of N.4 and N.5 (partial success) and more clearly at the fully capsized Sea Peoples' vessel N.3. Only at the third stage of the battle, when most of the enemy's soldiers have been hurt, or forced into the water, the Egyptian vessels would come close enough for close range, face to face combat. This practise is most logical when one recalls the fact that by the time of Rameses III, the Sea People were known to the Egyptians for a century as superior close range warriors and to be equipped with better suited weapons for this type of fighting, furnishing with long straight iron swords (c.f. Sandars 1978: 49-50, 106-7). The Egyptians, on the other hand, were known as master archers and their composite bows were brought to a perfection already during their imperial wars of the 15th century BCE (Yadin 1963). With that in mind one would wonder whether the type of vessels depicted as representing Egypt in this Naval battle scene had been developed for such an occasion, or even for the general purpose of fighting the Egyptian maritime enemies of the period, namely - the Sea Peoples and their allies?

Studying the layout of the ships depicted at the Naval Battle scene, the most prominent fact is that the two types are furnished with the very same rig: A bulky mast crowned by a cup-like crow-nest and a loose-footed sail, bent upper yard and brails. Such a rig is unknown from either earlier or later Egyptian depictions and was undoubtedly a revolutionary innovation introduced from elsewhere (Casson 1971: 37f; Wachsmann 1981: 214-6; Raban 1989). The only parallels for that type of rig of somewhat earlier date are probably the Syrian (Canaanite) merchantmen depicted at the tomb of Nebamun at Thebes, Egypt, which dates to the 14th century BCE and a century younger depiction on a scaraboid seal from Ugarit (Wachsmann 1981: 214, Fig. 28). Another similarity between the two types of vessels is the high bulwark that protects the rowers, which is confined for and aft by castles or high platforms. The protecting bulwark is known of earlier depictions of Canaanite merchant galleys (c.f. Basch 1987: 64-5) and maybe also from much earlier (mid 3rd millennium BCE) depiction from the Aegean, such as Dorak knife and the Middle Helladic sherd from Tessaly (Basch 1987: 90-3, Figs 189-191). Yet they were unknown in Egypt (c.f. the depiction of Hatshapsuth's fleet on its Punt voyage, Casson 1971: Fig. 18). The fore and after castles, on the other hand,

can be traced back on Egyptian vessels to the Old Kingdom (Landstrom 1970) and also in the Aegean, during the late Minoan period (and see below). The differing part of the two types is the hull. While the angular shape of the ship's hull representing the Sea People have been studied and discussed in length by scholars, the one represents the Egyptians was less-thoroughly surveyed. Casson (1971: 37) writes:

"They are true fighting craft, apparently undecked... some sort of inner structure; indeed the whole general appearance gives the impression of a far sturdier hull than any attested from Egypt hitherto."

The sturdiness of the Egyptian hull may be compared with other 13th-12th centuries BCE depictions and models of ships and boats from both the Aegean (c.f. Basch 1987: figs. 273, 276, 299, 303, 308, 309) and the Levant (ibid., figs. 122, 131).

It has been suggested that such additional strengthening was a necessity when ramming became a common naval practice (Wachsmann 1981:217). The period in which this practice had been introduced is argued to be no earlier than the "Dark Ages" of Greek history, in the 9th-8th centuries BCE (Kirk 1949: 126f; Van Doorninck 1982:283-5) or even as late as the 7th century BCE (Casson 1971: 42, n.4; Wachsmann 1981: 216-7). As for the low, massive prow of the Egyptian hull from the depiction of Medinet Habu, earlier scholars considered it as a true ramming device (Landstrom 1969: 23; Yadin 1963: 253,342), but Casson has brought as argument *ex silencio* "...it was a weapon like a naval gun - once one fleet had it, all had to have it." (op. cit.)

It seems that Casson has missed "Reading the Battle" when suggesting that:

"The relief conforms that the only specifically naval weapon known was the grappling iron; the ram is conspicuously absent. A sea fight was still but a vesion of a land fight..." (Casson 1971:38)

As shown above this is the case for the particular encounter depicted at Medinet Habu, but far from being characteristic to what must be understood as true naval battle on high seas in which ships were destroyed, or plundered by acts of piracy (c.f. Linder 1973; Sandars 1978: 107, 184-6). The general shape of the hull and its upper structures fit a close range true naval combat. It seems as if a real deck was connecting the fore and after platforms almost to the entire width of the ships, enabling warriors to move freely back and forth port to starboard sides. This is clearly demonstrated by the Egyptian soldier who stabs a swimming

opponent at the starboard side of E.1 (Fig. 2). The absence of stempost would enable an easy boarding for the warriors, from the fighting deck and through the fore platform, to the opponent vessel. This practice would be typical for an act of piracy after the attacked vessel had been rammed. As for the claim that the ramming head is too high above the water level, there are plenty of parallels from later depictions of non-argued rams (Raban 1984: 17-18). An effective ramming must be above the waterline and a must in case of piracy, when the very goal is not to destroy the opponent vessel but to plunder her when still afloat (and see Steffy 1984: 240-3). So, there is a discrepancy between the characteristics of the Egyptian ship that was designed specially for fighting on high seas (Basch 1987: 68) and the manner with which it was used in the particular encounter depicted at Medinet Habu. Such a discrepancy, doubled by the non-Egyptian character of the ship, the rigging, the bulwark and the study hull, may lead to the conclusion that this type of vessel, though clearly part of the Egyptian fleet at the time, is an alien one to the traditional Pharaonic navy and most probably a recent addition, or a recent adaptation of a foreign type of vessel.

The best parallel to such addition to the Egyptian military units is undoubtedly to be found amongst the mercenaries of both Canaanite *taher* and *maryanu* and the Sea Peoples units of *Sherdanu* and *Philistines*(?) (Nelson et al 1930: Pl. 19). It seems as if the Egyptians had realized the military advantages of the long, straight iron swords of Sea People for close-range combat on land and of their swift ramming vessels on the sea.

The various new characteristics and technical innovations of what might be considered as the earliest true fighting ship, were undoubtedly the outcome of a century or more of naval encounters along the Levantine coast, or more precisely - the geographical sphere of southern Turkey, Cyprus and North Syria. There, since the El Amarna era of the 14th century, through events the Hittite archives referred to the acts of piracy and naval encounters which are mentioned in the texts of the Royal correspondence in Ugarit, an intensive sea-borne trade was to cope with ever intensified piracy and seaborne raid on coastal centers for almost 200 years. It seems as if a fleet of 150 ships the vassal king of Ugarit had, were not sufficient for the scope of these affecting activities (Linder 1973; Wachsmann 1981: 187-190). As far as the available scanty historical sources permit us to judge from, the intensity of naval encounters and piracy in that area, during the 13th century BCE exceeded by far the late one at the Dark Ages in the Aegean, or that of the earlier(?) piracy which Minos allegedly subdued (Thucydides I.4). Following the logical assumption that technical innovations might gain considerable

momentum when there is a time of crisis and urgent demand, this time period at that seaboard are the best candidates for the technical developments depicted on the type of the Egyptian fighting vessels from Medinet Habu.

Having that in mind, one might wonder from where each of the characters' prototypes had come? More so, one might search for an earlier, less specialized and technically inferior type of vessel which were fashioned for piracy or for fighting against it, as Minos did.

There are three possible sources to be considered: Egypt, Syria (the Canaanite coastal cities) and the Aegean (either Minoan, Mycenaean, or Western Anatolian = *Lukka*, or *Ahiyawa*). Of the types of earlier Egyptian sea going vessels we know much from written text, but somewhat less when it comes to iconographic depictions. The absence of good illustrations of Mediterranean sea going vessels of Egyptian character and of types other than the traditional Nilotic boats have caused scholars to come to all kinds of contradicting conclusions. One is that there was a Mediterranean fleet that was built in Egypt from Syrian timbers, but on Egyptian style all through the 18th dynasty's era (Säve Söderbergh 1946: 39-60), or even to the time of Ramesses III (Landström 1970). Others would argue in favor of types such as the *kbnt*, *keftiu* and *mḥs*, known from Egyptian texts of the New Kingdom, to be of foreign origin, even if they were constructed in Egyptian shipyards (Favier 1935; Basch 1987: 62-66), some consider them to be true Syrian (=Canaanite) merchantmen (Davies and Faulkner 1947); and some would claim that the Egyptians never actually built any kind of sea-going vessels (Lloyd 1975: 51-3; Nibbi 1975).

Facing this difficulty one must look for possible Egyptian elements in the layout of the Egyptian fighting galleys from Medinet Habu among the iconographic repertory of the riverine vessels of the Nile. There, only two relevant components might be traced: the fore and after platforms and the through going thwarts. Yet, even these two might be found outside Egypt. It has been mentioned above that the platforms or "castles" on both ends of the hull are common to the ships of both sides - the Egyptians and the Sea Peoples. Yet the Egyptian version differs from its counterpart by having them in asymmetric order: the fore one is depicted as a fighting platform at about deck-level and relatively low protecting bulk, while the one at the stern has two storeys, with the helmsman sitting on the flat top of the upper one (probably for gaining higher viewpoint for navigation). This concept was well in use in the Nile valley since the Old Kingdom period (c.f. Landstrom 1970: Figs. 137, 143, 146). Outside Egypt such an after cabin can be seen on

the dubious silver knife from Dorak in western Anatolia, which is also of an alleged Old Kingdom date (Basch 1987: Fig. 189) and on a Middle Minoan seal from Crete (Casson 1971: Fig. 39). Of about the same period as the depiction from Medinet Habu there is the Late Helladic III boat painted on a clay vessel from Tanagra in Greece (Basch 1987: Fig. 298) and the graffiti from near Dramesi, or Hyria, also in Greece, which was dated to the 13th century BCE (*ibid.*, Fig. 301), or to c. 15000 BCE (Cason 1971: Fig. 25). Similar cabins, or platforms, or castles are not to be found among the few iconographic depictions from the Levant, except maybe for the clay model from Byblos, which is tentatively dated to the 13th century BCE (Basch 1987: Fig. 122). This last parallel is a typically symmetric vessel with some resemblance to the Sea Peoples type of boats at the Sea Battle scene (and for the probable meaning of the symmetry of the hull on both see Raban 1984: 14-16; 1989: 165-7). The Byblos model is also the only non-Egyptian (?) parallel for cross planking thwarts, unless we consider the ships of Kenamun's tomb at Thebes to be a truly realistic depiction of a 14th century BCE. Canaanite merchantman (c.f. Basch 1987: Fig. 114). So, one might take these two elements as of genuine Egyptian origin. Yet, if we consider the ship to be a foreign product of a long amalgamating process that took place in the Levantine area, these elements could have been picked there as well (for the thwarts) or to be of a farther origin, both in time and geographical distance, such as the Aegean, or Crete (for the fore and after cabins).

A unique feature of the Egyptian ship is the low, almost horizontal prow with its metal(?) termination fashioned in a form of lioness head with an open mouth from which the head of a bearded enemy (Asiatic?) protrudes. Such a lioness head is known from other Egyptian depictions and it is almost a copy of a decoration on the Royal bow's case on Rameses II war chariot at the famous great battle against the Hittites at Qadesh, in Syria (Fig. 4). This parallel depicts a male lion, probably the Egyptian war God Montu, of which Rameses III refers to as "my father" (ANET²: 256a), while on the Egyptian ship of Rameses II it is clearly a lioness which might represent the Egyptian war goddess, Sechmet. Yet, the leaping gesture in the first and the feminine sex of the other are to be found coupled decorating the ends of the ships from the miniature fresco at Thera (c.f. Marinatos 1974: 54-5; Raban 1984: 17; Basch 1987: 121-3). There is no direct connection between the two, yet one might suggest some traditional and cultural continuation between the earlier Theran decorating image and the later Egyptian ones. It is also possible that the peoples who had designed the Egyptian boats were an ethnic and cultural offspring of the people of Thera and the selection of a lioness

head at the tip of the ramming(?) prow was for them as valid emblem as it was for their Egyptian patrons. Ramming is another probable connection between the earlier Thera boats and the later Egyptian ones. The arguments for considering the later as a true ram (although unlike the types that were developed later, in the first millennium BCE, both by the Phoenicians and by the Greeks) were presented above; the possibility that ramming was practised during the Bronze Age in the Aegean was advocated for (Cohen 1938, Marinatos 1933) and against (Casson 1971: 42; Basch 1987, chapt. IV and many others) with most of the scholars refuting the very existence of such a device in that early era. Whether being true ram or just a proto-ram (Wachsmann 1981: 216), ramming as a naval practice of an effective piracy is logically almost a necessity when a small swift, oared galley attempts to stop and take over a merchantman under sail. At least when no other effective means are at hand (such as canons, naval bridges, etc.). The fact that piracy was an hampering factor for both the Minoan seaborne trade and for their contemporary counterparts in the Levant and in Egypt was known to Thukydides as well as it has been attested by the students of the El-Amarna letters and the maritime texts from Ugarit (Linder 1970). The recent archaeological discoveries under the water at Kash and at Cape Galidonya gives us some idea about the size of the trading ships of the time and the value of the prey on board. With these in mind one might wonder why scholars are making their best in order to explain alternative functions for the various types of horizontal projections depicted so lavishly at the iconographic corpus from the Minoan world. If one puts aside the problem of defining prow from stern in most of these depictions (and see M. Wedde's paper in this volume) and will exclude these projections which are clearly depicted as a horizontal continuation of the Keel (considering them as cutwaters) there are still many that ask for reasoning (c.f. Basch 1987: B.1, 4, 5, 6, 7, 11. D.1, 2, 4, 6, 7, 8. F.7, 18). Basch's attempt to include them all under the cutwater category of function (1987: 127-130) is far from being a convincing one. In some cases, as it is in the case of the horizontal projecting device which is shown attached to the ships end, below the image of the leaping lioness, at Thera, the protruding element is clearly *above* the water line (c.f. Basch 1987: Fig.244). If on a depiction engraved on a small seal one can argue that the oval frame and the schematic depiction might have caused non-realistic distortion, for the scene from Thera such an argument is non valid. Could such a device be used for ramming? Very probably yes. Much more suitable for proper ramming of a merchantman than any more solid cutwater which is necessarily under the water and for that would undesirably ram the opponent too low for the purpose of seizing its goodies. For that reason Basch's comparative illustrations (1987: 129) are irrelevant. As for

the cabins at Thera frescos, there are two types shown: a simple one, with low bulk, toward the "Peaceful" end of the boat (Basch 1987: Fig. 271), depicted in a violent context, and a decorated one, a seat for the captain, next to the other "warlike" end, in a peaceful context of a ceremonial procession (for the context see Polinger-Foster 1988 who suggests a strong Egyptian cultural influence on Thera frescos). These cabins, as far as they are from those depicted on the Egyptian crafts from Medinet Habu, may not be excluded as their prototype. Considering Thera ships (Fig. 5) as a double intended, sternfirst sailing vessels (Raban 1984) and stripping them of the occasional decoration for the festival, all other depicted elements on board would make perfect sense for assaulting purposes. It would take only a simple alternation of the helmsman's position - to move to the other end with his steering oar and to fix it at the tholepine depicted there, and the ship would sail stern first. Sailing that direction, the warriors can either man the cabin as a fighting platform, picking their long lancers and rectangular cowhide shields on the way, or board the rammed opponent, as the case demands. The Egyptian vessel from Medinet Habu is better fashioned for such a practice and illustrates the technological progress of 300 years of additional naval warfare.

The shape of the hull of the two comparative vessels is almost identical, though the latter, the Egyptian one, was probably sturdier, due to the demand from a specialized fighting craft - suited for repetitive destructive ramming.

Such slightly curved hull-shape has no parallel among the few depictions from the Levant. The strange diagonal pole (*protoaphlaston*?) at the stern of the Egyptian type from Medinet Habu is also unprecedented either in the Levant, or in the Nile Valley. Yet, it is not far from the "Peaceful" end of Thera ships and has other potential prototypes among the iconographic corpus of the Minoan realm (c.f. Basch 1987: B. 4, 10. D.6 and many others with additional trisected decoration).

With so many different characteristics the type depicting as serving the Egyptian navy can not be considered as being a product of the Egyptian maritime heritage. As it has been suggested that the Great Pharaon, Rameses II has chosen a form of non-Egyptian probably a Canaanite type of vessel as a determinative sign for "ship" in his famous Ode of Victory over the Hittites (Basch 1987: 65), why not assuming that his inferior successor, a century later, Rameses III had done the same? During that century foreign mercenaries, mainly of the Sea Peoples, were more and more a regular part of the Egyptian army, so why not assume that their better sea-going vessels, which had gained some additional perfection during a long period of naval encounters with the Canaanites, were

added to Egyptian military forces as well? Is it correct to call this type "A Sea Peoples Fighting Ship"? We think that it is so, as far as the prototype of this final product can be reconstructed. Yet, through the period of continuous naval encounters various technical innovations were shared by both the Canaanites and the Sea People. So the outcoming type might have incorporated some Canaanite characteristics and some which were new for both sides, such as the loose-fotted brailed rig. Being built very probably in Egypt (though of Lebanese timbers), these ships contained some local characteristics. Yet, the only traceable source for the functional concept, hull shape and some "accessories" (such as the *Proto Aphlaston*) is the Minoan world of the Aegean. In that respect, it is interesting to note that the Bible, in reference to the origin of the Philistines, (which is the only ethnic group of the Sea Peoples to be mentioned) place it in Crete (biblical *Kaphtor*) in many instances (Jer. 47:4; Amos 9:7), and associates Crete with Philistines (Ezk. 25:16, Zeph. 2:5).

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ILLUSTRATIONS

- Fig. 1 The naval battle scene from Medinet Habu (after Nelson et al., 1930: Pl.39).
- Fig. 2 The ships of both sides in the naval battle scene from Medinet Habu (after Nelson 1943: fig.4).
- Fig. 3 Detail from the naval battle at Medinet Habu, top left side (after Nelson and Hoelscher 1929: fig. 24).
- Fig. 4 Rameses II in his royal chariot at the battle of Qadesh (the Rameseum, pylon II, north tower, western wall; after Yadin 1963).
- Fig. 5 The best preserved ship from Thera (see Basch 1987: fig. 232, no. 2).

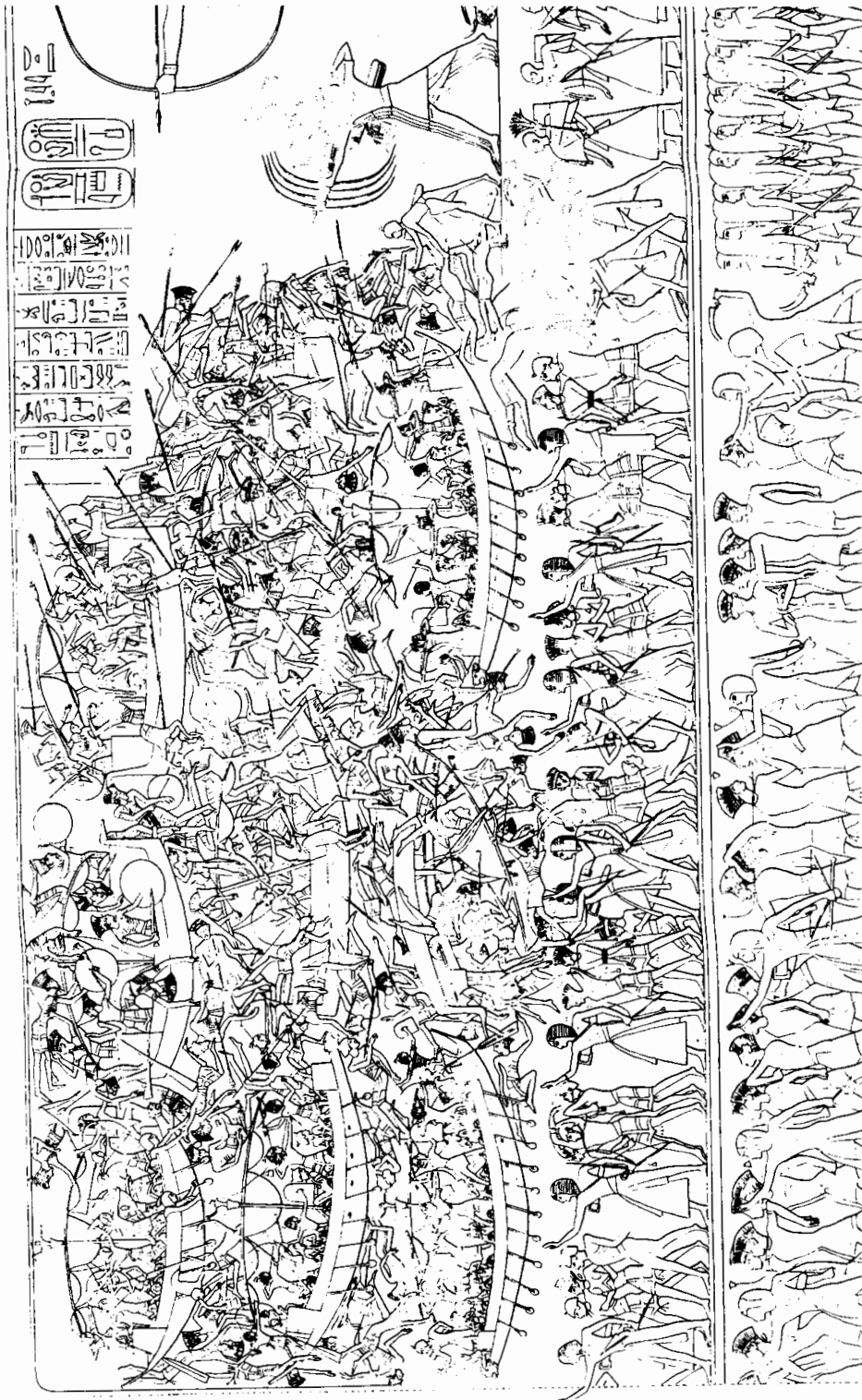


Fig. 1

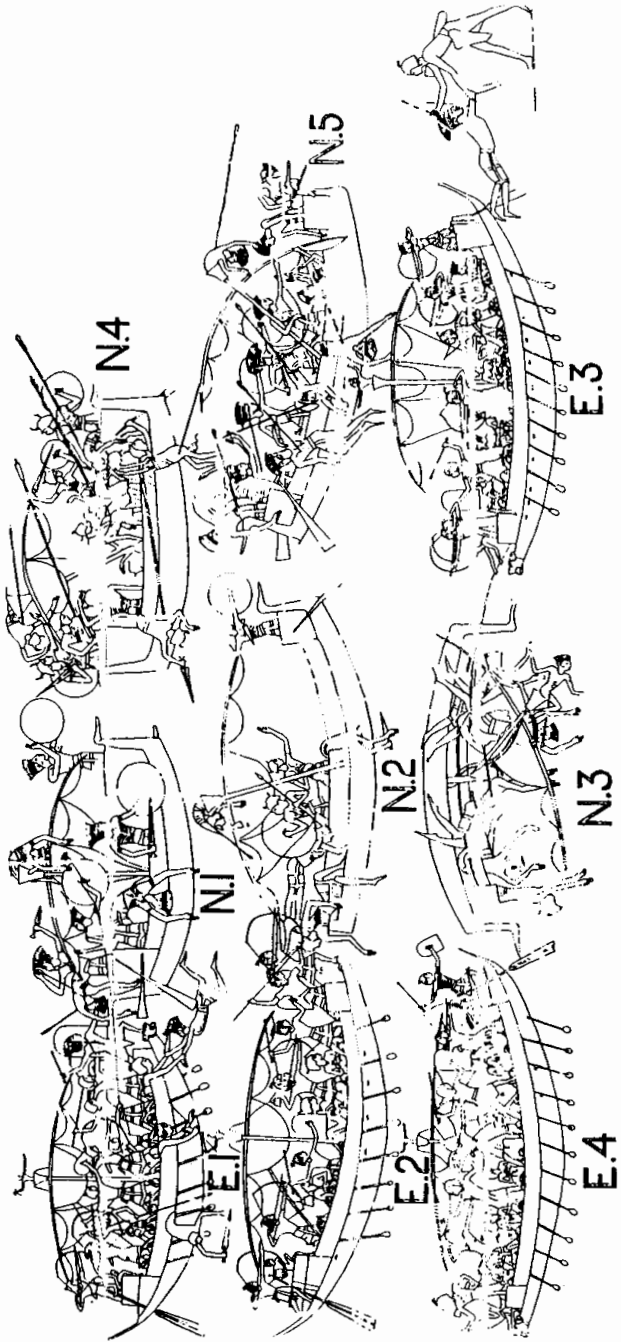


Fig. 2

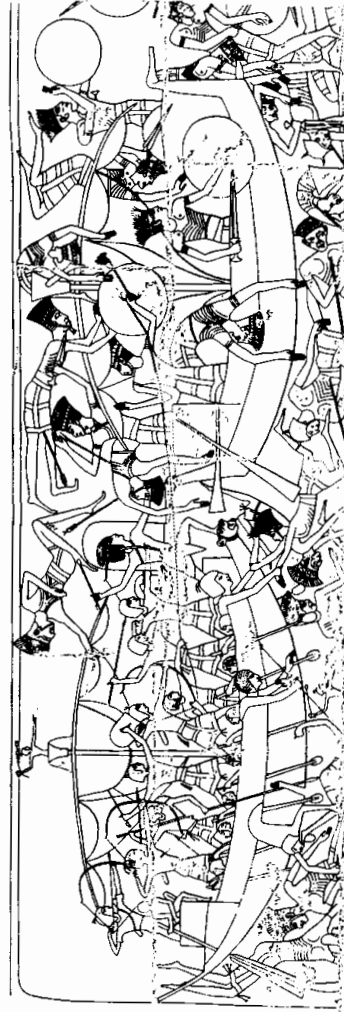


Fig. 3



Fig. 4



Fig. 5

SOME CONSIDERATIONS CONCERNING WRECKS LYING IN SHALLOW WATER

It is the type of seabed and the cargo transported rather than the manner of their sinking that are generally considered to be the chief causes of the more or less good state of preservation of sea-borne craft and boats, when, for one of the various reasons which can lead to the sinking of a ship, they become wrecks¹. It is for these reasons that we are now accustomed to hearing and repeating that it is almost solely cargo boats that are the best preserved when they sink fully laden and finish up on soft bottoms so that the weight of their cargo pushes them down into the sediments at a speed greater than the rate of attack of destructive underwater agents (mechanical and/or animal and vegetable).

As for warships and cargo boats which are either unladen or carrying light, perishable cargoes, we are led to believe that they are only preserved owing to exceptional causes (abnormal quantities of fluvial matter, the sudden formation of a sand bar, etc.).

Some recent finds demonstrate that these exceptions, which, above all, often lead to the preservation of parts of the hull which are not normally present in "normal" wrecks (the sides, extremities, parts of the superstructure), are much more frequent than had previously been supposed. Examples of the sinking of a ship from our age can be of help in understanding the nature of the mechanics by which ancient wrecks could sink into soft bottoms and remain perfectly preserved up to the present day.

Recently, in April 1987, the motor tanker Mont Blanc, of TSL 487.36 and 50 metres in length, was moored and ballasted to the extent of touching the harbour bed of Vado Ligure whilst awaiting demolition. As a result of a sudden south-easterly storm she broke her moorings and went down turning sideways on to the beach, and on account of her weight she dug a trench 8 metres deep in the muddy bottom in only six hours.

At this point the sea bottom is only three to three and a half metres deep so the result was that when the seas calmed, the prow and a good part of the ship was below the surface of the sea bed. Since just one more spell of heavy seas would have sufficed to fill the bow section and cover it completely with mud, and thereby make it extremely difficult if not actually impossible to float her again, salvage operations were immediately effected and completed in 10 days.

Notwithstanding the violent nature of the movements she was subjected to for hours during the heavy seas, at the end of the salvaging the bows were intact. Not even the paintwork had been worn away.

A very similar event must have occurred at Alghero in Sardinia in the case of the wreck "Del Camping La Mariposa" which was partly investigated in 1988 by the Centro Ricerche Ascheosub Sassari-Alghero on behalf of the Soprintendenza Archeologica of Sassari and Nuoro. She is a cargo ship of about 17 metres with a radiocarbon dating from 1440 to 1620 and she lies parallel to the beach at a depth of only 70 centimetres below the surface.

She is laden with small barrels of preserved fish (probably sardines) and organic materials of many kinds (baskets, ropes of vegetable fibre, fishing nets, nautical equipment). Her hull is perfectly preserved from prow to poop along the entire left side and bottom.

The presence and wonderful state of preservation of so many materials in a wreck lying in such a shallow depth is almost certainly due to the fact that the craft went down in exceptional weather conditions and that she ran aground on the sandy sea bottom creating vortices that pushed her under the sediment and filled her with *posidonia* and sand. And so, when it became possible just after the sinking to reach her to salvage what could be salvaged, the points excavated and researched in 1988 were no longer accessible.

This is also borne out by the fact that, even though one might concede that a perishable cargo such as preserved fish might not be an object of interest, it would be unthinkable that costly equipment such as for example pulleys and new pulley wheels would be left behind.

The stratigraphy inside the hull is as follows: free moving sand about 70 centimeters; pebbles and sandy mud of a yellowish colour, from 3 to 5 centimeters; a layer of from 2 to 4 centimeters of dead posidonia leaves; from 20 to 30 centimeters of mud, carrying balls of posidonia fibre and stems; a very fine layer of mud; and finally a layer of dead posidonia leaf of felt-like consistency having a sealant effect, and it is probably the latter that brought about the preservation of the Barrels. The stratigraphic survey stopped at the level on which the barrels lay and should mean that there are at least another 60 to 80 centimetres before reaching the inside face of the left side.

Not as yet ascertained however, is the cause of the sinking of a beaked ship, probably a warship, of frame construction, and therefore of medieval or later date, lying at a depth of 2 metres near Marsala, in Sicily, north of Isola Lunga not far from the more famous Punic ship.

The splendid state of preservation of some of the parts is due to the fact that the wreck even if relatively light (it is certain there was no cargo and it has not yet been possible to calculate the amount of shingle and pebble ballast) went down in a mixed sediment of sand and dead posidonia leaves, a sediment which was therefore very soft and penetrable initially, and that only acquired consistency in the course of time as the progressive decay of the posidonia gave way to sand². This permitted the preservation of the whole of the lower part of the boat and of a good part of the right side from the ram to the sternpost.

We may therefore affirm that what makes us recognise almost solely round ships depends perhaps on the observer's eye being more easily attracted by the cargo than by the hull, and not on the actual number of well-preserved wrecks.

Closer attention to the movements of beaches which today are so violently disturbed by acts of human intervention can help us discover unsuspected treasures even if these are often only perishable cultural treasures that need immediate action to be taken for their preservation at the moment of excavation: and sometimes the professional ethics of the archaeologist prevents him from pursuing this work because of the lack or scarcity of facilities for dealing with organic materials.

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NOTES

1. Factors which can cause wrecking are: war, bad weather, stupidity and piracy.
2. For a fuller treatment of this point please see: Honor Frost, *Atti della Accademia Nazionale dei Lincei, serie ottava*, vol. XXX, pages 14-15.

ΠΑΡΑΣΤΑΣΕΙΣ ΠΛΟΙΩΝ ΣΕ ΤΟΙΧΟΓΡΑΦΙΕΣ ΜΟΝΑΣΤΗΡΙΩΝ ΣΤΑ ΜΕΤΕΩΡΑ

Σε μια επίσκεψή μου στα μοναστήρια των Μετεώρων τον Απρίλιο του 1984 παρατήρησα σε τοιχογραφίες απεικονίσεις πλοίων, οι οποίες είναι χρήσιμο να παρουσιαστούν όχι μόνο για τους ειδικούς της μεταβυζαντινής ζωγραφικής τέχνης, αλλά και για όσους ασχολούνται με την ιστορία του πλοίου γενικότερα. Οι τοιχογραφίες με τις απεικονίσεις των πλοίων φωτογραφήθηκαν από μένα, όπως επίσης και τα μωσαϊκά του Αγίου Μάρκου με απεικονίσεις πλοίων που παρουσιάζονται για σύγκριση, σε επίσκεψή μου στη Βενετία τον Ιούλιο του 1984.

Οι απεικονίσεις προέρχονται από τοιχογραφίες που βρίσκονται στα παρακάτω μοναστήρια των Μετεώρων:¹

- α. Δύο απεικονίσεις από τοιχογραφίες του Μοναστηριού Αγίου Νικολάου (Αναπαυσάς ή Άσμενος).
- β. Μία απεικόνιση από τοιχογραφίες του Μοναστηριού Αγίων Πάντων (Βαρλαάμ).
- γ. Τρεις απεικονίσεις από τοιχογραφίες του Μοναστηριού της Μεταμορφώσεως (Μεγάλο Μετέωρο).
- δ. Μία απεικόνιση από τοιχογραφία του Μοναστηριού Αγίου Στεφάνου και
- ε. Δύο απεικονίσεις από τοιχογραφίες του Μοναστηριού Ρουσάνου.

Το Μοναστήρι του Αγίου Νικολάου Αναπαυσά ιδρύθηκε σύμφωνα με ιστορικές πληροφορίες και αρχιτεκτονικές ενδείξεις το 14ο αιώνα. Η ανέγερση του Καθολικού (Κεντρικού Ναού) πρέπει να άρχισε πριν από το 1510² που πέθανε ο Μητροπολίτης Λαρίσης Διονύσιος, ο οποίος μαζί με τον Έξαρχο Σταγών (Καλαμπάκας) Νικάνορα θεωρούνται οι επίσημοι κτήτορες του Μοναστηριού.

Το Μοναστήρι τοιχογραφήθηκε από τον Θεοφάνη τον Κρήτα, ο οποίος προσκαλείται το έτος 1527 να κάνει την ιστόρηση του Ναού.³ Ο Θεοφάνης, γνωστός με την επωνυμία Στρελίτζας ή Μπαθάς, υπήρξε ένας μεγάλος αγιογράφος του 16ου αιώνα και ο κυριώτερος εκπρόσωπος της λεγομένης Κρητικής Σχολής που άρχισε να διαμορφώνεται στην εποχή του. Ακολούθησε την τεχνοτροπία της εποχής του, παραλαμβάνοντας επίσης στοιχεία από χαλκογραφίες της Δυτικής τέχνης, τα οποία αφομοίωσε στη δική του καλλιτεχνική γραμμή και τα ενσωμάτωσε με επιτυχία στο έργο του.

Η ολόγραφη ιστόρηση του Μοναστηριού του Αγίου Νικολάου Αναπαυσά από το Θεοφάνη, δίνει την ευκαιρία να θαυμάσουμε το πρώτο τοιχογραφικό του μνημείο, που αν στον Αναπαυσά άφησε υπέροχα δείγματα της τέχνης του, στο Μοναστήρι της Λαύρας στον Άθω έφτασε στον ύψιστο βαθμό της καλλιτεχνικής τελειοποίησής. Η αγιογράφηση του Αναπαυσά είναι η μόνη εργασία που φέρει την υπογραφή του, ενώ τα άλλα τοιχογραφικά του έργα στο Άγιον Όρος τα άφησε ανυπόγραφα. Κάτω από την τοιχογραφία της Δευτέρας Παρουσίας που κατέχει όλη τη βορεινή πλευρά του Νάρθηκα του Ναού, η αυτόγραφη επιγραφή του Θεοφάνη μας δίνει πληροφορίες για την ιστόρηση του Ναού: *“Μηνί Ὀκτωβρίου ΙΒ’ (1527) χεῖρ Θεοφάνη Μοναχοῦ τοῦ ἐν τῇ Κρίτῃ Στρελήτζας”*.

Οι δύο τοιχογραφίες με απεικονίσεις πλοίων βρίσκονται στο Νάρθηκα του Ναού. Η πρώτη απεικόνιση παρουσιάζει το Χριστό να καταπαύει την τρικυμία (ὁ Χριστός ἐπιτιμῶν τοῖς ἀνέμοις καὶ τῇ θαλάσῃ).⁴ Γυμνοὶ βράχοι ζώνουν την τρικυμισμένη λίμνη, όπου κλυδωνίζεται το πλοιάριο με το Χριστό και πέντε μαθητές μέσα. Στην πρύμη ο Χριστός κοιμάται και ένας μαθητής σκύβει να τον ξυπνήσει. Άλλος μαθητής στη μέση καταγίνεται με τα άρμενα του καταρτιού και οι άλλοι με παραγμένη έκφραση σε μαζεμένη στάση είναι γεμάτοι φόβο μήπως καταποντισθούν από τη δυνατή τρικυμία. Σε επόμενη εμφάνιση ο Χριστός πλαί στο κατάρτι σηκώνει το χέρι και προστάζει να πάψει ο άνεμος.

Συγκρίνοντας την παράσταση αυτή με παρόμοιο εικονογραφικό τύπο τοιχογραφίας από τη Μονή Φιλανθρωπηνών⁵, παρατηρούμε τις εξής διαφορές: Η ταραχή του υγρού στοιχείου στην παράσταση της Μονής

Φιλανθρωπητών δηλώνεται με έμφαση και όχι με οριζόντιο κυματισμό, το πλοiάριο πλέει με επικίνδυνο βύθισμα στα τρικυμισμένα νερά, η πλώρη του είναι βυθισμένη στα κύματα και φαίνεται περισσότερο το εσωτερικό του. Οι λεπτομέρειες του εξοπλισμού του πλοιαρίου, πηδάλιο, κατάρτι, πανί και άρμενα είναι σχεδιασμένα και στις δύο απεικονίσεις με τον ίδιο μοναδικό τρόπο, που δείχνει πείρα και γνώση.

Σε ένα μωσαϊκό του 12ου αιώνα στον Άγιο Μάρκο της Βενετίας, έχουμε απεικόνιση πλοιαρίου του ίδιου περίπου εικονογραφικού τύπου με τις απεικονίσεις των Μοναστηριών Αγίου Νικολάου Αναπαυσά και των Φιλανθρωπητών. Στην απεικόνιση αυτή το πηδάλιο αποτελείται από δύο κουπιά, το κατάρτι και το πανί είναι όμοιο και τα σανίδια του περιβλήματος διακρίνονται καθαρά. Προφανώς το θέμα της απεικόνισης είναι το ίδιο (ο Χριστός καταπαύει την τρικυμία), αφού ο Χριστός φαίνεται στην πρύμη να καθοδηγεί τους μαθητές στο χειρισμό των ιστίων.

Στο παρεκκλήσιο του Αγίου Ιωάννη του Θεολόγου του Μοναστηριού της Μαυριώτισσας στην Καστοριά, υπάρχει παρόμοιος εικονογραφικός τύπος, με του Μοναστηριού Αγίου Νικολάου Αναπαυσά και της Μονής των Φιλανθρωπητών⁶, ζωγραφισμένος από τον πρωτονοτάριο Άρτας Ευστάθιο Ιακώβου. Στην απεικόνιση αυτή η ταραχή του υγρού στοιχείου δηλώνεται με έμφαση και το πλοiάριο με τετράγωνη πρύμη και πλώρη κατά τα δυτικά πρότυπα πλέει με επικίνδυνο βύθισμα. Οι λεπτομέρειες στον εξαρτισμό είναι σχεδιασμένες και εδώ με μοναδικό τρόπο, δύο μαθητές χειρίζονται τα ιστία με πείρα και γνώση και αντί για πηδάλιο στην πρύμη έχουμε ένα πλευρικό κουπί προς την πλώρη. Σε μία εικόνα από το Μοναστήρι της Παναγίας της Οδηγήτριας του Ηρακλείου Κρήτης που σήμερα βρίσκεται στη Συλλογή Εικόνων της Αγίας Αικατερίνης Ηρακλείου απεικονίζεται θαύμα του Αγίου Φανουρίου. Στο πλοiάριο της απεικόνισης⁷ διακρίνεται καθαρά κατάρτι και πανί όμοιο με αυτό που απεικονίζεται στις τοιχογραφίες Αγίου Νικολάου Αναπαυσά και Μοναστηριού των Φιλανθρωπητών. Ο κυματισμός της θάλασσας διακρίνεται καθαρά όπως επίσης το κατάρτι, το πανί και τα ξάρτια.

Η δεύτερη απεικόνιση πλοιαρίου στο Μοναστήρι Αγίου Νικολάου Αναπαυσά είναι λεπτομέρεια από την τοιχογραφία της Δευτέρας Παρουσίας, όταν ο Κύριος θα έλθει να κρίνει ζωντανούς και νεκρούς⁸. Η παράσταση που παρουσιάζει γυναίκα, προσωποποίηση της θάλασσας, να κάθεται σε θαλάσσιο τέρας και να κρατά πλοiάριο, ενώ τριγύρω μεγάλα ψάρια βγάζουν από το στόμα τους ανθρώπινα σώματα, έχει ληφθεί από την Αποκάλυψη του Ιωάννη⁹.

Το πλοiάριο απεικονίζεται με απλές γραμμές, έχει κυκλικό σχήμα με πρύμη και πλώρη που προεξέχουν, ιστό με τετράγωνο πανί και είναι παρόμοιο με τον δυτικό τύπο πλοίου «καράκα», αν το συγκρίνουμε με σχέδιο εμπορικού πλοίου τύπου καράκας του Φλαμανδού ζωγράφου W.A. που χρονολογείται από το 1470¹⁰.

Το Μοναστήρι των Αγίων Πάντων (Βαρλαάμ), σε τοιχογραφία του οποίου απεικονίζεται πλοiάριο, κτίσθηκε από το 1542 μέχρι το 1544, όπως προκύπτει από επιγραφή πλάκας έξω από το Ιερό Βήμα του Ναού, στην οποία αναγράφονται οι κτήτορες Νεκτάριος και Θεοφάνης της οικογένειας Αψαράδων από τα Ιωάννινα το έτος ΖΝ (=1542). Η επωνυμία Βαρλαάμ οφείλεται στον πρώτο οικιστή του βράχου του Μοναστηριού με το όνομα Βαρλαάμ, τη μορφή του οποίου ο αγιογράφος παρέστησε στο Νάρθηκα του Ναού. Από άποψη αρχιτεκτονικού ρυθμού ο Ναός των Αγίων Πάντων είναι του λεγόμενου αγιορείτικου τύπου, σταυροειδής, τετρακίονιος με ένα τρούλλο στον κυρίως Ναό και ένα στο Νάρθηκα. Η ιστόρηση (τοιχογράφηση) του κυρίως Ναού έγινε το 1548 από τον Φράγκο Κατελάνο¹¹, ενώ του Νάρθηκα το 1566 από τους αγιογράφους αδελφούς ιερέα Γεώργιο και Φράγκο Δικοτάρη (Κονταρή) από τη Θήβα, που έδωσαν αιγλή και μεγαλοπρέπεια στο Ναό¹². Η ιστόρηση του Νάρθηκα άρχισε στις 23 Ιουνίου και τελείωσε στις 17 Οκτωβρίου 1566, σύμφωνα με την επιγραφή που υπάρχει στη βορεινή πλευρά του Νάρθηκα:

Ἡ μὲν ἀρχὴ τῆς ἱστορίας τῆσδε τοῦ Ἁγίου Νάρθηκος μηνὸς Ἰουνίου ΚΓ' ἐτελειώθη δὲ Ὀκτωβρίου ΙΖ' ἡμέρα Α, ΑΦΞς' (=1566), ἱστορήθη διὰ χειρὸς Ἱερέως καὶ Σακελαρίου Θηβῶν ὁμοῦ μετὰ τοῦ ἀυτῶν ἀδελφοῦ ἡμῶν Φράγκου.

Η ολοζώντανη παράσταση της Μέλλουσας Κρίσης (Δευτέρα Παρουσία) βρίσκεται στον ανατολικό τοίχο του Νάρθηκα του Καθολικού των Αγίων Πάντων. Η γυναίκα, προσωποποίηση της θάλασσας¹³, που βρίσκεται πάνω σε θαλάσσιο τέρας, κρατάει στο χέρι της πλοiάριο, ενώ τριγύρω στη θάλασσα μεγάλα ψάρια βγάζουν από το στόμα τους ανθρώπους. Η παράσταση θυμίζει τοιχογραφία με το ίδιο θέμα στο Μοναστήρι Αγίου Νικολάου Αναπαυσά. Νομίζω ότι οι αγιογράφοι έχουν επηρεασθεί από Δυτικά πρότυπα όσον αφορά στον τύπο του πλοίου. Το πλοίο που απεικονίζεται εδώ έχει φανερά τα χαρακτηριστικά αγγλικού γαλιονιού, όπως συμπεραίνεται αν συγκριθεί με σχέδιο αγγλικού γαλιονιού (Galleon) του Mathew Baker του 1586, σε χειρόγραφο, που βρίσκεται στην Pepysian Library.¹⁴ Αν παρατηρήσουμε τις υπερκατασκευές του πλοίου που απεικονίζεται στην τοιχογραφία και του σχεδίου του αγγλικού γαλιονιού, δεν υπάρχει αμφιβολία ότι ο αγιογράφος έχει επηρεασθεί από δυτικά πρότυπα.

Το Μοναστήρι της Μεταμορφώσεως ή Μεγάλο Μετέωρο¹⁵ ανηγέρθη το 1388 και η κτιριακή του συγκρότηση ολοκληρώθηκε το 1552, όπως συμπεραίνεται από επιγραφή που υπάρχει στη νότια πλευρά του Ιερού Βήματος (*ἀνηγέρθη ἐκ βάθρων θεμελίων ... ἐπὶ ἔτους ϚΩΝϚ (=1388)*) και από άλλη επιγραφή στην τοιχογραφία με παράσταση του ἀναπεσόντος Ἰησοῦ (*ἀνηγέρθη ἐκ βάθρων και ἀνιστορήθη ἐπὶ ἔτους ΖΞΑ' (=1552)...*).

Ο Ναός της Μεταμορφώσεως δεν είναι απλά το πιο μνημειώδες κτίσμα των Μετεώρων, αλλά μια από τις λαμπρότερες εκκλησίες της Ελλάδος και ένα από τα ωραιότερα μνημεία της β' και γ' περιόδου της βυζαντινής αρχιτεκτονικής, ναός αγιορείτικου τύπου, σταυροειδής με δωδεκάπλευρο και πλάγιες κόγχες.

Η αγιογράφηση του Ιερού Βήματος, που αποτελούσε το αρχικό Καθολικό του Μοναστηριού, χρονολογείται από το 1484, όπως προκύπτει από επιγραφή στη νότια πλευρά του Ιερού Βήματος (*... ἀνιστορίσθη ... ἐν Ϛ Β' (=1484)...*) και είναι χαρακτηριστικό έργο της μορφής που πήρε η Παλαιολόγεια ζωγραφική της Μακεδονίας μετά την άλωση της Κωνσταντινουπόλεως. Στις τοιχογραφίες και στις εικόνες της εποχής αυτής στο Ιερό Βήμα, έχουμε υπέροχα δείγματα της Μακεδονικής τεχνοτροπίας. Αντίθετα, η αγιογράφηση του κυρίως Ναού που έγινε στα μέσα του 16ου αιώνα (1552), όπως προκύπτει από την επιγραφή στην τοιχογραφία του *ἀναπεσόντος Ἰησοῦ*, που αναφέρθηκε παραπάνω, αποτελεί ένα εντυπωσιακό σύνολο που αντιπροσωπεύει την ακμή της Κρητικής Σχολής.

Ο αγιογράφος που ιστόρησε τον Ιερό Ναό δεν είναι γνωστός, γιατί το όνομά του δεν αναφέρεται σε καμιά επιγραφή. Η ποιότητα όμως της εργασίας, η εικονογραφία, η τεχνική και η τεχνοτροπία, συνδέουν άμεσα το Μεγάλο Μετέωρο με τον Θεοφάνη και την Κρητική Σχολή. Κατά τον Φ. Κόντογλου⁽¹⁶⁾ οι τοιχογραφίες του Καθολικού του Μοναστηριού της Μεταμορφώσεως είναι έργο του ίδιου (άγνωστου επίσης) αγιογράφου της Κρητικής Σχολής που ιστόρησε το Καθολικό του Μοναστηριού Δοχειαρίου στο Άγιο Όρος. Επίσης οι αρχαιολόγοι Μ. Χατζηδάκης, Ν. Νικονάνος και Χ. Μπούρας πιστεύουν ότι η εικονογράφηση του Ναού είναι το τελευταίο έργο του Θεοφάνη του Κρήτα.¹⁷

Σε τοιχογραφία στο Ιερό Βήμα του Ναού της Μεταμορφώσεως με τη σκηνή της *Θαυμαστής Ἀλιείας*¹⁸, Μακεδονικής τεχνοτροπίας, παρατηρούμε αλιευτικό πλοιάριο που οδηγείται με τεράστιο κουπί σαν πηδάλιο, όπως όλα τα πλοία στα λίμνες και στα ποτάμια. Άλλη τοιχογραφία στον κυρίως Ναό με θέμα *ἡ ἄγρα τῶν ἰχθύων* παρουσιάζει τον ίδιο εικονογραφικό τύπο με την τοι-

χογραφία στο Ιερό Βήμα, αλλά είναι φιλοτεχνημένη από άγνωστο εκπρόσωπο της Κρητικής Σχολής που μπορεί να είναι και ο Θεοφάνης. Διακρίνουμε στο πλοιάριο τις σανίδες του περιβλήματος, τις κουπαστές και την τετράγωνη πλώρη και πρύμη. Αντίθετα με τον έντονο κυματισμό στην τοιχογραφία του Ιερού Βήματος, εδώ ο κυματισμός δηλώνεται ήρεμος με οριζόντιες γραμμές. Και εδώ το πλοιάριο οδηγείται με τεράστιο κουπί, ενώ οι μαθητές προσπαθούν να τραβήξουν το γεμάτο από ψάρια δίχτυ

Στα σφαιρικά τρίγωνα οι τέσσερις Ευαγγελιστές παρουσιάζονται στους καθιερωμένους στην Κρητική ζωγραφική Τύπους. Στον Ιωάννη τον Θεολόγο στην δεξιά στενή άκρη αποδίδεται με ανάγλυφη χάρη παραλίμνιο τοπίο και πλοιάριο με τέσσερις κωπηλάτες.

Σε άλλη τοιχογραφία στον κυρίως Ναό παρουσιάζεται ο Νώε κρατώντας στα χέρια του απλή μορφή της Κιβωτού, στην οποία διακρίνεται μόνο η κουπαστή, με την οποία διασώθηκε στον Κατακλυσμό που περιγράφεται στην Αγία Γραφή.¹⁹ Από την κιβωτό διακρίνεται μόνο η κουπαστή.

Το Μοναστήρι του Αγίου Στεφάνου ιδρύθηκε το 14ο αιώνα και η κτιριακή του συγκρότηση ολοκληρώθηκε το 15ο-16ο αιώνα. Κτήτορες του παλιού Ναού του Αγίου Στεφάνου είναι ο Αντώνιος Καντακουζηνός και ο Φιλόθεος. Το 17ο αιώνα το Μοναστήρι μνημονεύεται Αγίου Στεφάνου και Χαραλάμπους, ενώ το 18ο και 19ο αιώνα εκτός από την ανακαίνιση του Μοναστηριού έγινε η ανέγερση του νέου μεγάλου Καθολικού του Αγίου Χαραλάμπους (1798). Ο μικρός Ναός του Αγίου Στεφάνου που η ίδρυσή του ανάγεται στον 15ο αιώνα, ήταν το αρχικό Καθολικό του Μοναστηριού. Πρόκειται για μονόκλιτη Βασιλική με ξύλινη στέγη που απολήγει ανατολικά σε τρίπλευρη κόγχη και στα δυτικά φέρει τετράγωνο νάρθηκα. Επιγραφή στο δυτικό τοίχο μας πληροφορεί για την αγιογράφιση του Ναού χωρίς να μας δίνει χρονολογία. Γύρω στα 1545 ή αργότερα αγιογραφήθηκε το ναΐδριο του Αγίου Στεφάνου επί ηγουμένου Μητροφάνη. Οι τοιχογραφίες του, καλά καθαρισμένες και συντηρημένες σήμερα, αποτελούν ένα ενδιαφέρον σύνολο της μεταβυζαντινής αγιογραφίας. Η ίδια επιγραφή μας πληροφορεί για τη μεταγενέστερη ανακαίνιση της τοιχογραφίας της Κοιμήσεως της Θεοτόκου, που έγινε από τον αγιογράφο ιερέα Νικόλαο από την Καλαμπάκα.

Σε μια από τις τοιχογραφίες του Ναού του Αγίου Στεφάνου παρουσιάζεται ο ίδιος εικονογραφικός τύπος *ή ἄγρα τῶν ἰχθύων*, όπως στο Μοναστήρι της Μεταμορφώσεως. Οι τοιχογραφίες των Μοναστηριών των Μετέρων δεν είναι ζωγραφισμένες με ελαιόχρωμα, αλλά είναι νωπογραφίες (fresco).

Νωπογραφία ή “φρέσκο” είναι η ζωγραφική πάνω στο νωπό ασβεστοκονίαμα του τοίχου με χρώματα διαλελυμένα στο νερό. Το χρώμα απορροφάται από το κονίαμα και η επιφάνεια του τοίχου στεγνώνει έτσι μαζί με τα χρώματα, που διατηρούνται ανεξίτηλα σε μακρότατο χρονικό διάστημα. Στη νωπογραφία ο αγιογράφος πρέπει να είναι γρήγορος και ακριβής στις πινελιές του, γιατί αποκλείεται μετά κάθε αλλαγή ή τελειοποίηση στο σχέδιο και τους χρωματισμούς, ούτε είναι εύκολο να γίνουν επιδιορθώσεις σε χαλασμένες νωπογραφίες. Από τους κυριώτερους βυζαντινούς και μεταβυζαντινούς νωπογράφους είναι και ο Θεοφάνης. Τη νωπογραφία για τη διακόσμηση των τοίχων χρησιμοποίησαν οι Αιγύπτιοι, οι Έλληνες από την Μινωική εποχή, οι Ρωμαίοι, οι Βυζαντινοί και οι ζωγράφοι της Αναγεννήσεως.

Το Μοναστήρι Ρουσάνου πήρε τη μορφή που έχει σήμερα στα μέσα του 16ου αιώνα. Ο βράχος είχε κατοικηθεί πριν από το 16ο αιώνα και πήρε το όνομα πιθανότατα από τον πρώτο οικιστή ή τον κτήτορα του πρώτου Ναού. Το 16ο αιώνα η εκκλησία που ήταν αφιερωμένη στη Μεταφόρφωση του Σωτήρος, όπως και το σημερινό Καθολικό, βρισκόταν σε ερείπια και τα αδέρφια Ιωάσαφ και Μάξιμος από την Ήπειρο ξανάκτισαν το Καθολικό το 1545 και ταυτόχρονα ανακαίνισαν ολόκληρο το Μοναστήρι. Το Καθολικό ανήκει στον αθωνικό τύπο, χωρίς να αντιγράφει πιστά τα αγιορείτικα πρότυπα, που παρουσιάζεται παραλλαγμένος και απλοποιημένος. Η εικονογράφηση του Ναού έγινε το 1560 επί ηγουμένου Αρσένιου, όπως μας πληροφορεί επιγραφή, η οποία δεν παραδίνει το όνομα του ζωγράφου, που πρέπει να ήταν πολύ αξιόλογος, αφού η αγιογράφηση του κυρίως Ναού και του Νάρθηκα του Μοναστηριού αποτελεί ένα από τα λαμπρότερα τοιχογραφικά σύνολα της μεταβυζαντινής ζωγραφικής κατά το β' μισό του 16ου αιώνα. Οι τοιχογραφίες αυτές τεχνοτροπικά ανήκουν στην Κρητική Σχολή.

Σε τοιχογραφία του Μοναστηριού παρουσιάζεται ο ίδιος εικονογραφικός τύπος με θέμα *ἡ ἄγρα τῶν ἰχθύων*, όπως στα Μοναστήρια της Μεταμορφώσεως και του Αγίου Στεφάνου. Το βορεινό τοίχο του Νάρθηκα πάνω από την είσοδο προς τον κυρίως Ναό καλύπτει η επιβλητική και πολυπρόσωπη σύνθεση της Δευτέρας Παρουσίας, που θυμίζει ανάλογη απεικόνιση του Μοναστηριού Αγίου Νικολάου Αναπαυσά. Και εδώ η γυναίκα, προσωποποίηση της θάλασσας, κάθεται σε θαλάσσιο τέρας που βγάζει από το στόμα του ανθρώπινο σώμα, ενώ στα χέρια της κρατάει πλοιάριο παρόμοιο με το Δυτικό τύπο πλοίου “καράκα”. Οι λεπτομέρειες των ναυπηγικών γραμμών και της μορφής του σκάφους όπως και του εξαρτισμού του είναι σχεδιασμένες με μοναδικό τρόπο και δείχνουν γνώση και πείρα του ζωγράφου σε ναυτικά και ναυπηγικά θέματα.

Η τοιχογράφηση του Μοναστηριού Ρουσάνου δεν προσφέρει μόνο ένα εκτεταμένο λαμπρό παράδειγμα της εποχής της ακμής της Κρητικής Σχολής, αλλά παράλληλα δίνει τη δυνατότητα στον προσκυνητή των Μοναστηριών των Μετεώρων να συμπληρώσει την εικόνα της τέχνης αυτής. Καθώς έχει δει κανείς το παλαιότερο έργο της σειράς, τον Άγιο Νικόλαο Αναπαυσά (1527) και τα ζωγραφικά σύνολα των Καθολικών του Μεγάλου Μετεώρου και του Μοναστηριού Βαρλαάμ, χαίρεται στο Μοναστήρι Ρουσάνου ένα από τα υστερώτερα έργα της ακμής της Κρητικής Σχολής και μπορεί να διαπιστώσει τόσο τα κοινά στοιχεία της τέχνης αυτής, όσο και τις επί μέρους διαφορές που οφείλονται στην καλλιτεχνική ιδιοσυγκρασία των ζωγράφων και τις διαφοροποιήσεις που συντελέστηκαν από το 1527 ως το 1560.

Συμπεράσματα:

Παρά το γεγονός ότι η θάλασσα και η θαλασσινή ζωή δεν είχαν σπουδαία θέση στη βυζαντινή ζωγραφική²⁰, εν τούτοις στα θαλασσινά θέματα γίνεται προσπάθεια να παρασταθεί με ζωηρά χρώματα η επιφάνειά της, με λευκές σπείρες ή κυματιστές γραμμές τα κύματά της και την εικόνα να ζωντανεύουν πλοία με ανοιχτά πανιά, ψάρια και τεράστια χταπόδια.

Από τις θαλασσινές παραστάσεις ξεχωρίζουν η θάλασσα στη Δευτέρα Παρουσία, ο Χριστός επιτιμών τους ανέμους και τη θάλασσα, η θαυμαστή αλιεία και η άγρια των ιχθύων.

Στις τοιχογραφίες με την Δευτέρα Παρουσία μια από τις χαριτωμένες μορφές που ξεκουράζει τα μάτια από τα διάφορα τέρατα, είναι η γυναικεία προσωποποίηση της θάλασσας, γνήσια ελληνιστική κληρονομιά.²¹ Στα νερά ανάμεσα σε μεγάλα ψάρια και τέρατα που βγάζουν από το στόμα τους ανθρώπινα μέλη, κάθετα επιβλητική στη ράχη ενός τέρατος η ίδια η θάλασσα, νέα και ωραία γυναίκα, συχνά ντυμένη αρχαιόπρεπα, με ένα καράβι στο χέρι, που τις περισσότερες φορές δεν έχει φανταστικό σχήμα, αλλά αποδίδει τύπους πλοίων της εποχής.²²

Συνηθισμένη είναι και η παράσταση της κατάπαυσης από το Χριστό της τρικυμίας στην αγιογράφηση των Μοναστηριών.²³ Ακόμη συνηθισμένη είναι η παράσταση της θαυμαστής αλιείας και της άγρας των ιχθύων.

Σε όλες τις παραστάσεις των τοιχογραφιών των Μοναστηριών των Μετεώρων τα πλοία απεικονίζονται σε απλή μορφή, αλλά ωρισμένα χαρακτηριστικά της ναυπήγησής τους είναι φανερά, όπως οι σανίδες της κατα-

σκευής, οι κουπαστές, η χρήση πηδαλίου και κουπιών, τα τριγωνικά ιστία κλπ. Το πλοιάρια πλέουν μέσα στα κύματα και οι λεπτομέρειες του εξοπλισμού τους είναι σχεδιασμένες με μοναδικό τρόπο (τροχαλίες, άρμενα, χειρισμοί ιστίων κλπ.), αποδεικνύοντας γνώση και πείρα σε ναυτικά θέματα. Ωρισμένα ναυπηγικά στοιχεία των πλοίων μας οδηγούν με βεβαιότητα σε δυτικά πρότυπα, περισσότερο εμφανή στις απεικονίσεις πλοίων στις τοιχογραφίες της Δευτέρας Παρουσίας στα Μοναστήρια Αγίου Νικολάου Αναπαυσά, Βαρλαάμ και Ρουσάνου (καράκα και γαλιόνι).

Το ερώτημα που προκύπτει είναι από πού οι ζωγράφοι εμπνέονταν για την απεικόνιση των πλοίων. Ίσως η προσωπική εμπειρία να χρησιμοποιήθηκε από μερικούς που επισκέφτηκαν πιθανόν λιμάνια. Οι ζωγράφοι της Κρητικής Σχολής συνήθως ταξιδεύουν στη Βενετία και η Σχολή θα πρέπει να σχετισθεί με την ανάπτυξη των πόλεων της Κρήτης και του εξαγωγικού εμπορίου. Έτσι εξηγείται και η επίδραση των δυτικών ναυπηγικών στοιχείων στις απεικονίσεις των πλοίων της ζωγραφικής τους.²⁴

Δεν πρέπει επίσης να απορρίψουμε τη χρήση εγχειριδίων (sketch-books), στα οποία διάφοροι τύποι σκαφών πρέπει να είχαν εικονογραφηθεί. Τέτοια εγχειρίδια με σχέδια, γνωστά σαν *άνθιβολα*²⁵ κυκλοφορούσαν με βεβαιότητα στους μεταβυζαντινούς, όπως φαίνεται από τις πρόσφατες εργασίες της Λ. Μπούρα και της Κ.Φ. Καλαφάτη.²⁶ Περισσότερο πιθανό είναι οι ζωγράφοι να χρησιμοποίησαν και τα δύο, προσωπική εμπειρία, εφόσον συνήθιζαν να ταξιδεύουν από τόπο σε τόπο και εικονογραφημένους τύπους πλοίων που εύρισκαν σε εγχειρίδια με σχέδια (sketch-books).

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g. 1

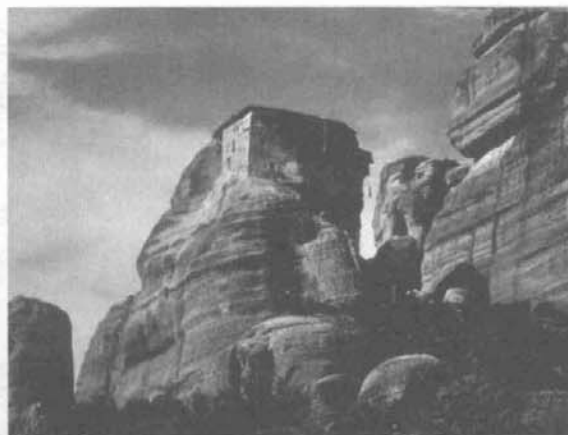


Fig. 2



Fig. 4



g. 3



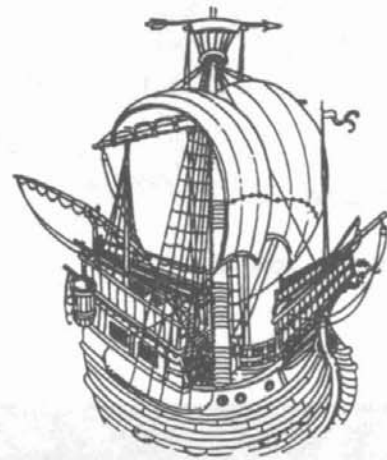
Fig. 5



Fig. 6



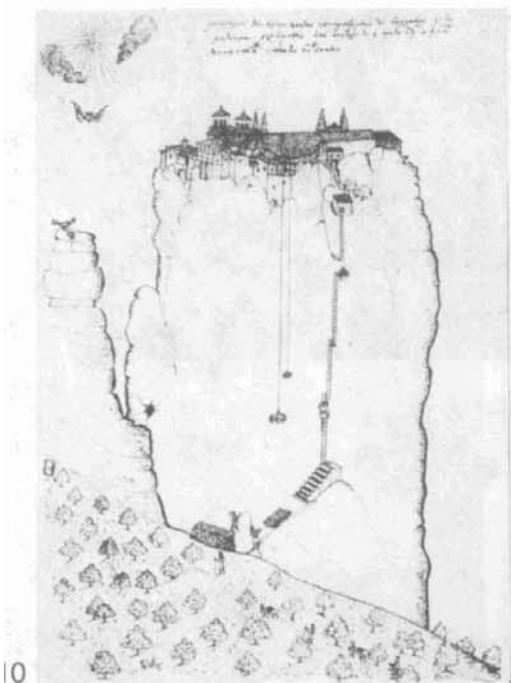
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Fig. 8



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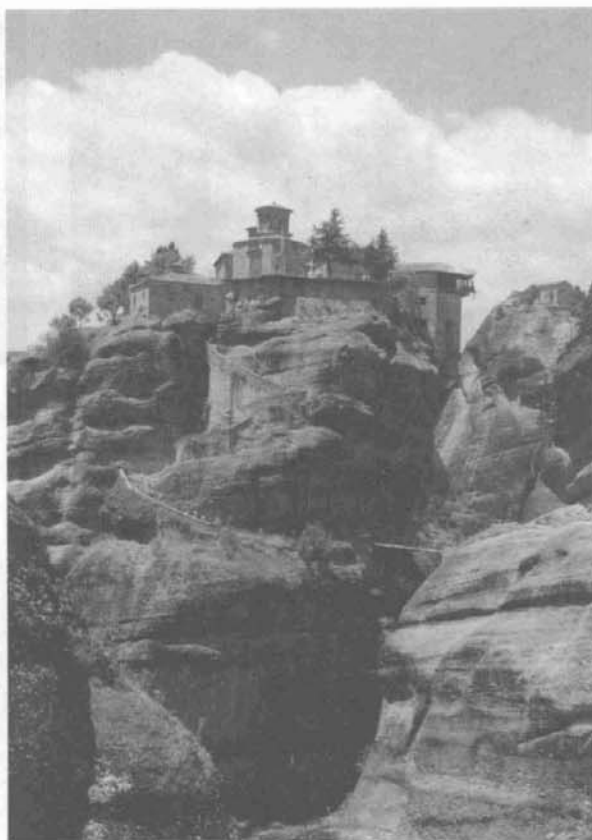
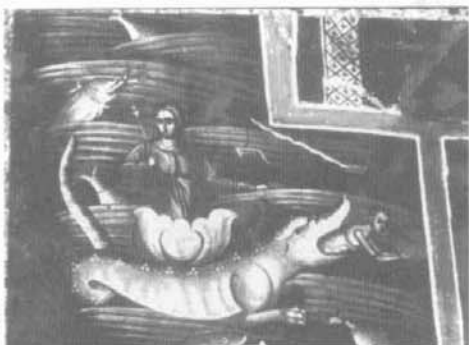
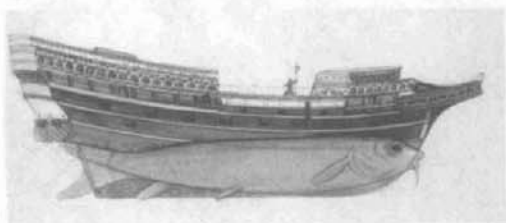


Fig. 11



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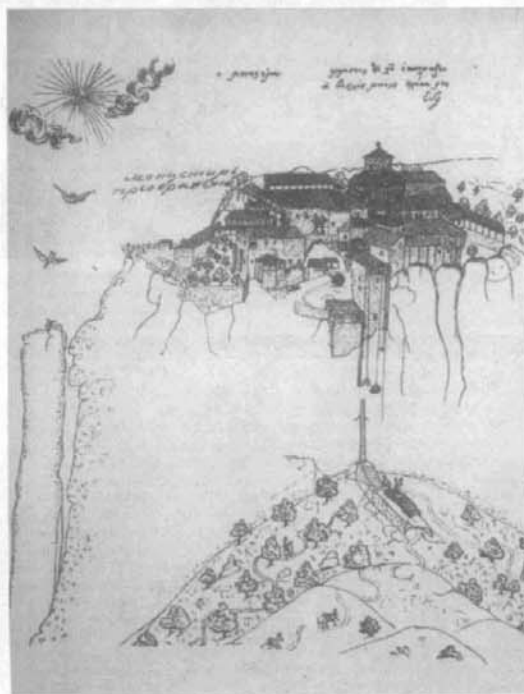


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Fig. 15



Fig.



Fig. 16



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Fig. 17



Fig. 18



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Fig. 22

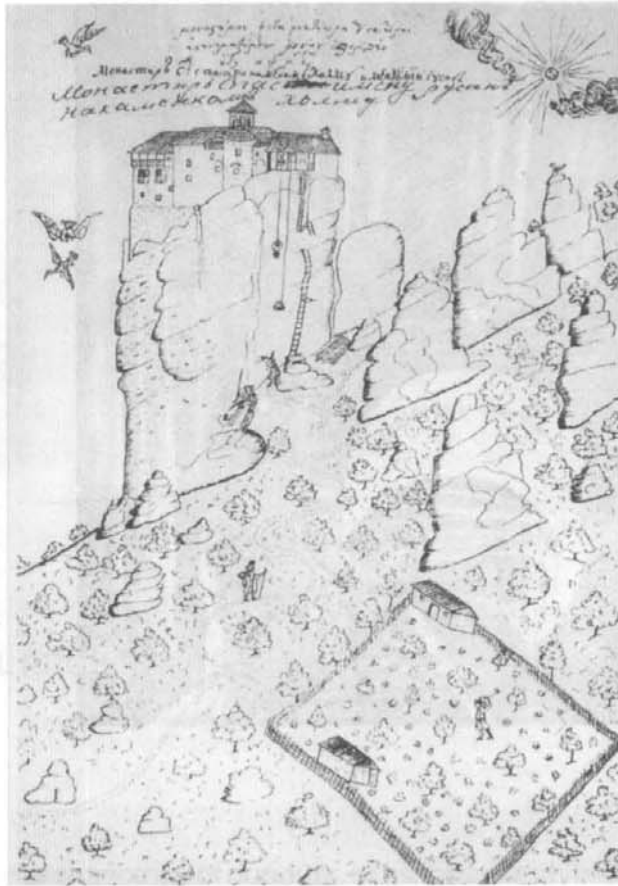


Fig. 23

Fig. 24

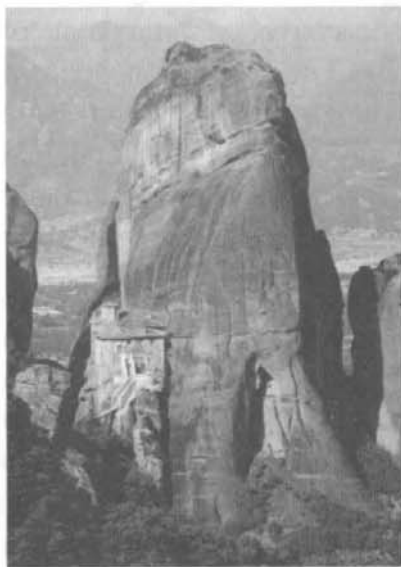


Fig. 25

Fig. 27



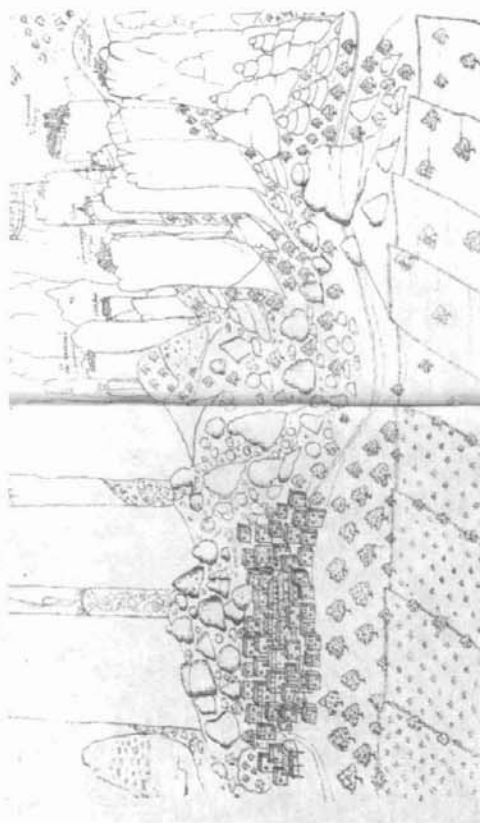
Fig. 26



Fig. 28



Fig. 29



A TECHNOLOGICAL PROBLEM OF THE DUGOUT

Introduction

Although not a specialist on the archaeology of dugouts, or as they are styled nowadays, “logboats”, I nevertheless think that as a technologist and historian of technology I may perhaps contribute a little to our understanding of the technology of these simple craft. There are also more personal reasons why I feel not being totally disqualified to have an opinion on the subject. As a boy, I learned to paddle a canoe in a dugout on Lake Toba on the island of Sumatra and so acquired a small amount of early experience in the handling of such craft. In addition, it so happens that presently I am living a twenty minute’s drive from the museum in the Dutch town of Assen which has as one of its prime exhibits the world’s oldest remains of a dugout, the canoe from Pesse (c. 6300 BC).

The two problems associated with the use of dugouts, and which are generally recognised as being important in the development of water craft, are the narrowness of the hull, and the limited freeboard. The first problem is generally solved by expanding the dugout, i.e. increasing the beam by flaring the hull outwards, which causes its ends to deflect upwards. The improvement is mostly obtained by heating the midship section when it is being deformed. That treatment adds to the second problem of the lack of sufficient freeboard, and to solve this problem expanded

dugouts are often equipped with sewn-on wash strakes. Hornell¹ formulated clearly the idea that stepwise development of the dugout resulted in the genesis of the plank-built boat: "The final stage in the conversion of the dugout into the fully plank-built boat is attained when the dugout underbody is reduced to a keel-like axial beam, when sides raised upon its edges by numerous strakes of sewn-on planking'. Greenhill², who has updated Hornell's discussion of the origin of water transport on several important points, confirms this hypothesis on the development of the planked boat.

These earlier discussions left out a third problem, which curiously enough, one cannot find having received much attention before, viz. the weakness of the crossgrained wood in the ends of dugout. I shall present arguments in the following for thinking that that problem may have been as important as the other two in the development of the planked boat.

Returning to the dugouts on Lake Toba: these were rather primitive as dugouts go, as they were neither expanded nor extended (Fig. 1). These techniques were not unknown on Sumatra because one could encounter expanded and extended dugouts some 900 kilometres to the south-east, on the Musi River near the town of Palembang. These were elegant watercraft which compared to the Toba dugout as swans do to an ugly duckling.

Whether the builders of the ugly ducklings knew about the more advanced techniques on the Musi River I do not know. But it is probable that they did not: on Lake Toba the Batak language is spoken which is rather different from the high Malay spoken on the Musi River. Moreover, the Batak tribes had been living well into the second half of the 19th century in near-total isolation, to which their reputation of fierce warlike cannibals must have contributed not a little.

The dugouts on Lake Toba bore the generic name of *solu*, and if they were very big, as some of the war canoes of the chiefs were, they were simply called large dugout, or *solu bolon*. The large solus were made from larger trees and they were more heavily decorated, but technologically they were not different from the smaller craft.

The cross-grain problem in modern dugouts

The cross-grained ends of dugouts make them very vulnerable to being stoved during beaching in by bumping on large stones and rocks. These are not lacking on Lake Toba, which is in an ancient volcanic crater, of which the largest

diameter is some 80 kilometres. The cutwater, a large vertical piece of deadwood forming an integral part of the prow of the *solu* is quite effective as a protection of the cross-grained bows of this type of canoe. In general, the tensile strength of wood across the grain is no more than one tenth to one twentieth of that along the grain; wood is weak when subjected to tensile strain or bending across the grain, which, of course, is elementary knowledge to most inhabitants of this planet, except perhaps, those that are city-bred.

The only exceptional feature of the *solu* is that she has a horizontal platform on top of the cutwater; both are shaped out of the log. Its purpose is not known with certainty. Perhaps it was copied from the larger war canoes, where it probably served as an elevation on which somebody could stand. Roberts and Shackleton(3) report in their book on canoes of the Americas on a dugout from a prehistoric site in Florida possessing such platforms as integral parts of the hull. They explain its presence there as a platform for poling and for spear-fishing, but neither of the two activities seem to be known on Lake Toba, but on a fighting canoe such platforms were useful to javelin-throwers etc. The same authors explain the somewhat similar flared bows of the Seminole canoes in the Everglades as a device for protecting paddles or polers from being cut by the sawgrass growing in the shallow water, but sawgrass does not grow in Lake Toba.

The observation on the protective function of the vertical deadwood at the bows of the *solu* explains, of course, why that feature is found on dugouts the world over. As we can see, in the canoe from Pesse (Fig. 2), little effort was made to keep the device reasonably light, but such refinement would have been representative of a later stage of development. The remarkable point is that we find in the design of this very early and primitive craft already incorporated what must have been the fruit of earlier experience, viz. the need of protecting the cross-grained bows against being stoved in. Leaving an extra thickness of wood at the prow, as in the canoe from Pesse, was still done in modern times in the least sophisticated types of dugouts, e.g. those of the Indians in Virginia in the 1890's, which were 'fashion'd like a Trough for Swine'³. Which brings us to the question how we can know that the canoe from Pesse was not such a trough. The answer is that in the course of the excavation a paddle was found close to the ancient dugout; moreover, at the early date of this craft the only domestic animal known in Europe was the dog, which was most probably not fed from troughs. Still, the doubts are understandable, because the narrowness of the canoe from Pesse is such that it is unlikely that she could have been paddled in a sitting position: the paddlers either kneeled or stood upright.

In the dugout from Ceylon (Fig. 3) we observe that the massive cutwater tapers sharply, rather suggestive of its protective function. In the celebrated picture of a dugout canoe from Aua Island near New Guinea (Fig. 4), published by Haddon and Hornell⁴, the protective function seems to have evolved into an esthetic expression as well, which is much enhanced by the elegant spurs rising from the ends. Early in this century the bifid cutwaters of dugouts on Bali⁵ combined the protective function with a rather different esthetic (Fig. 5). The upper part of the Balinese cutwater may have been convenient in lifting the bows when drawing up the canoe above the tideline on a beach, although the lower part would have served equally well for the purpose. Even on a lake or a tideless sea such as the Mediterranean, it is necessary to draw the canoes up on the beach, and most dugouts have some provision for that.

A different solution to the problem of the cross-grained ends is more radical: it consists of replacing the wrongly orientated wood by a block of wood of which the run of the grain is approximately up and down.

Horridge⁶ reports that on planked *prahus* in the Aru Islands (off the west coast of New Guinea) most of the strakes end on blocks behind the stern - and stem-posts called *fugears*. In passing he mentions - his treatise concerns planked boats - that such blocks are inserted in dugout canoes as well. There can be little doubt that that represents the original use of the *fugear*, which strengthened each end of such dugouts. As we shall see further on there is evidence that this method was employed elsewhere too.

Ancient representations of boats and canoes

The archaeology of the dugout and its iconography are to a certain extent complementary in the sense that what the latter does not show is sometimes provided by the former. The cultures in which we find watercraft depicted have yielded very little in the way of remains of dugouts, and in those which did yield such remains depictions of watercraft are very scarce, if not totally absent. An example is provided by the curious little canoes from Britain⁷, dating from the 11th c. AD, which have a transom board inserted aft. The system is known from the dugouts of Lake Tondano in northern Celebes¹, in which both ends are closed by transom boards. The prows of the British dugouts are reinforced in a modest way only. The iconography from antiquity (The standard reference nowadays is *Le musée imaginaire de la marine antique* by Basch⁸ which appeared half a year after the symposium) does not show much of what can be interpreted as a dugout

with a transom timber. The question is, of course, on what grounds a picture of a watercraft should be interpreted as that of a dugout rather than of a plank-built boat. There is no absolutely compelling answer to this, except that its interpretation as that of a dugout is sometimes more satisfactory. The two assumptions should a priori be regarded as equivalent.

The shape of the fishing boat (Fig. 6) from the Etruscan tomb (6th c. BC) is very reminiscent of the dugouts of the American north-west coast of a century ago with its little cutwater which is probably best explained as a protection of the cross-grained bows (Fig. 7). The curved rising stern would have been a separate addition, perhaps sewn on, as in many Pacific dugouts.

The rock engraving of a boat (Fig. 8) from Novilara (7th c. BC) probably represents a large dugout with an inserted transom stern. The cutwater under the overhanging *proembolon* looks like a branch of a tree, and if the boat was a large dugout, it may in fact just have been that. According to Bonino⁹ the decoration at its tip was an animal's head. It seems plausible, the more so because at that date this sort of decoration of prows of boats was known in Greece.

The growth rings of the wood in the trunk near a branch are orientated around its centre line. As a result, that wood, if it is made to form part of the prow of a dugout, is not cross-grained and therefore weak, but rather resistant to blows and bumps. Of course, these deviating layers of growth rings go no deeper than the centre line of the branch, i.e. to the centre of the trunk at best. Nevertheless, in combination with a protective cutwater, as sketched in the diagram (Fig. 9), it would have provided an effective protection of the prow of a dugout, such as the Novilara boat probably was. To this interpretation it could be objected that similar use of the orientation of wood near branches as reinforcement in dugouts does not appear to be reported in the anthropological literature. It seems doubtful, though, whether a technicality of this sort would have been noted and reported.

The boats from the Cyclades, dating from the 3rd millennium BC, may perhaps be interpreted as dugouts; the projections of the ends of the hull are surely not rams, but they may plausibly be reconstructed as protections of cross-grained ends. The well-known terracotta boat model from Palaikastro has one end sharply rising, as shown in the drawing (Fig. 10). The original must have been a narrow flat-bottomed boat, and one could imagine that it was taken from a large tree as indicated in the schematic diagram (Fig. 11), with, in this case, the stern timber formed out of a branch, but otherwise in the manner indicated for the Novilara boat. It seems less probable that the upright timber was inserted, although the

model is too crude that one can be entirely certain about the correct interpretation. It seems possible that the inserted stem timber was derived from the stratagem of using the transverse grain of the wood near a branch as a protection.

The last example given here of a boat from antiquity which may sensibly be interpreted as a dugout is the one used by the Sea Peoples. It is depicted most clearly in the relief of the famous battle scene in the funerary temple of Ramses III at Medinet Habu (Fig. 12). Some of the boats in this scene not only have the protective ram-like projections of the dugout, but in addition they possess the bent shape typical of its expanded version; we see, moreover, the wash strakes which are frequently used to improve the seaworthiness of the expanded dugout. The high upward extensions at both ends were additions to the dugout hull, as were the platforms fore and aft. Extensions of this type added to a dugout hull are encountered frequently in Polynesian canoes, and it seems very probable that they were added to dugout hulls in European antiquity as well.

The battle depicted in Ramses' temple took place in 1186 BC. It is not known where precisely the battle took place; the text in the temple accompanying the relief says that the invaders had "penetrated into the canals of the rivermouths". Probably they assaulted the Ramessid capital Piramesse¹⁰ (Tell el-Da 'ba) on the Pelusiac branch of the eastern Nile delta. Evidently they were only repulsed *in extremis*.

Hypothetical further development of the dugout

In the study of ancient technology one frequently encounters the phenomenon that a solution to a technological problem which was found in antiquity still survives in a few isolated communities, although generally it has been superseded long since. Such relicts are not rare at all in the history of technology, and finding them is one of the rewards of the study of anthropological data. It is not to say that technological relicts survive in isolation without change: they were merely never supplanted by a different and newer technology owing to the isolation of the community in which they were used.

Some of the fishing boats used on the southern shores of the Baltic, which were extensively studied by Rudolph¹¹, show in the way they were built that they are very probably direct descendants of the extended dugout. In Rudolph's typology, the bottom of these boats may consist either of planks, or of a "bottom shell", i.e. "a shell-shaped bottom which is gouged out of one longitudinal half of a tree trunk". These hollowed-out bottoms of the second type of craft exist in various shapes,

but that does not detract from the fact that they are all prime examples of Hornell's¹ "dugout underbodies". The sides of these boats are built up of one, two, or three strakes which are clinker-joined, and which end on both stem and stern on blocks of various shapes, which in the Aru Islands would be called *fugear* (Fig. 13). Many of these blocks are hollowed out: the one shown in the diagram is not, and may be regarded as a massive stem timber.

It is not a far-fetched suggestion that these blocks were the earliest forms of the stem- and stern-timbers, in the same manner that the dugout underbody was the earliest form of the keel. Perhaps the use of *fugear* blocks was preceded by employing the deviating grain in the trunk near a branch as a measure of protection of the ends of dugouts.

In summary, it is argued here that in analogy to the problems of the narrowness of the hull and the low freeboard of the dugout, which gave rise to a development in which the dugout underbody evolved into the keel, and the washstrakes into planking, the problem of the weakness of the gross-grained ends was solved by inserting end-blocks, which eventually developed into stem- and stern-timbers.

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ILLUSTRATIONS

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- Fig. 3 Dugout canoe from Ceylon, in the National Maritime Museum, Greenwich.
- Fig. 4 Canoe from Aua Island, near New Guinea. (from Haddon and Hornell⁵).
- Fig. 5 Balinese dugouts, 1906. (From Nootboom⁵).
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- Fig. 10 Terracotta boat model from Palaikastro, 3rd millennium BC, now in the Herakleion Archaeological Museum.
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- Fig. 12 Boat of the Sea Peoples, with cutwater, as depicted in the relief picture in the mortuary temple of Ramses III in the Medinet Habu, early 12th. c. BC.
- Fig. 13 A *Kahn* (punt) from Rostock, with a dugout underbody and a block for a stem. (After Rudolph¹¹).

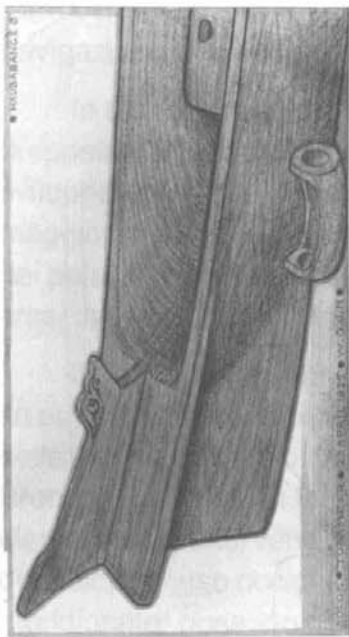


Fig. 1

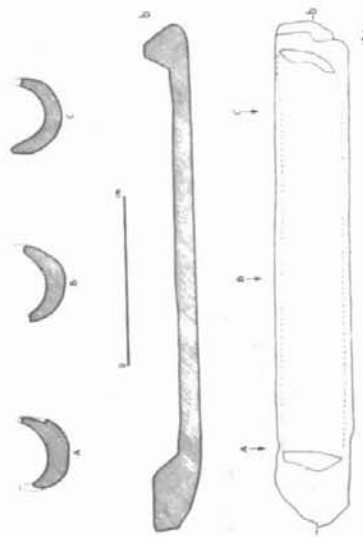


Fig. 2

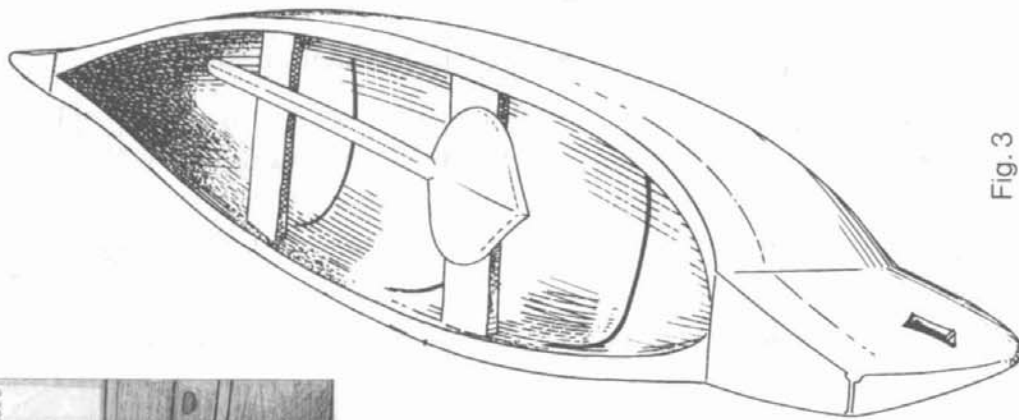


Fig. 3



Fig. 4



Fig. 5



Fig. 6

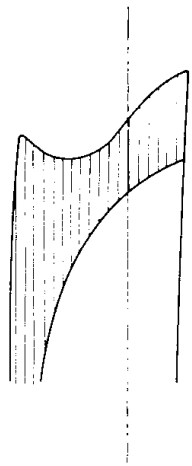


Fig. 7

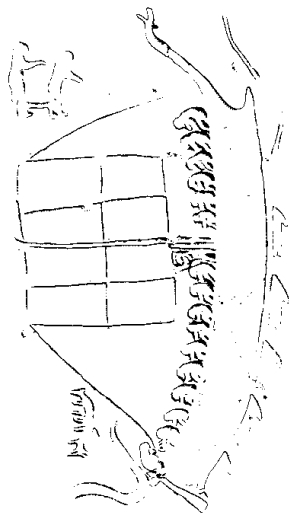


Fig. 8

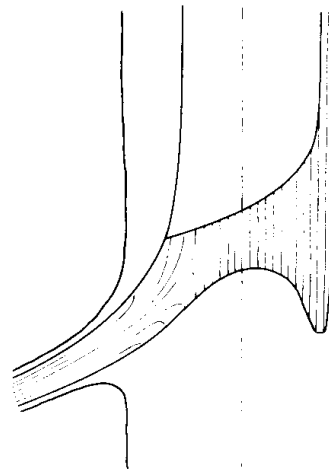


Fig. 9

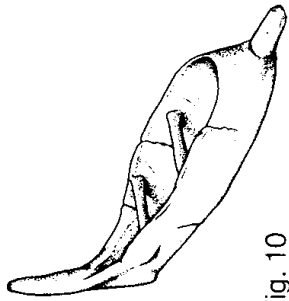


Fig. 10

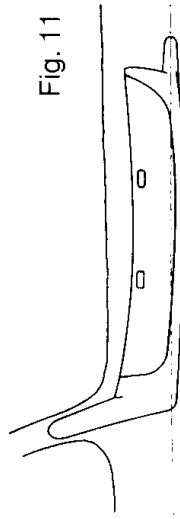


Fig. 11

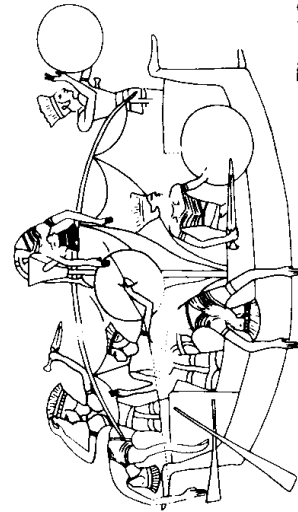


Fig. 12

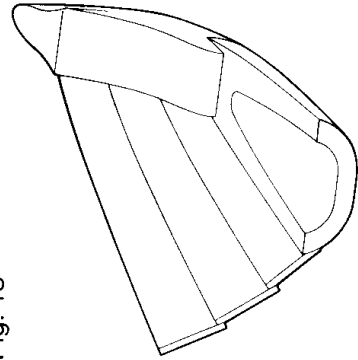


Fig. 13

INDICAZIONI CIRCA ATTIVITÀ MARITTIME LUNGO LE COSTE EPIROTE, DURANTE LA TARDA ETÀ DEL BRONZO

I. Navigazione nei mari dello Ionio e dell' Adriatico durante l'età preistorica

È noto che dall' età neolitica genti di aree differenti, della terraferma e delle isole, collegarono la loro vita allo Ionio e all' Adriatico. Categorie di ceramica e tipologie di selci lavorate di età neolitica rinvenute a Sidari di Corfù e nelle isole Diafonzie (a N di Corfù), come pure nel Gargano (Puglia settentrionale) sono indicative¹.

La bibliografia riguardante le ricerche archeologiche, specialmente della Tarda Età del Bronzo², non lascia margini di dubbio sulle molteplici rotte di navigazione nel Mediterraneo.

In età micenea, dal XV al XII secolo a.C., si osservano dei forti fenomeni di spostamenti anche nelle aree bagnate dal mar Ionio e dal mare Adriatico³. Lo sviluppo delle attività marinare e commerciali a causa della richiesta sempre maggiore di rame, stagno ed altri materiali preziosi e non, condusse all' ascesa dei palazzi micenei, al benessere economico di grandi e piccoli centri, mentre cresceva la pirateria e il banditismo.

Il materiale miceneo rinvenuto lungo le coste dello Ionio e del basso Adriatico su entrambe le sponde, induce a considerare il fenomeno della navigazione e delle attività legate ad essa, non come un fatto secondario della Tarda Età del Bronzo, ma come un fattore fondamentale e fra le cause prime di una serie di elementi sugli interventi nel territorio, nell' economia, nelle ideologie. Gli esempi del Peloponneso occidentale, dell' Acarnania, di Cefalonia e di Itaca, dell' Italia meridionale⁴ possono offrirne un quadro.

Per i naviganti che attraversavano lo Ionio e il basso Adriatico nella Tarda Età del Bronzo, oltre alle rocce bianche di *Λευκάς-Λευκίμμη*- Leuca⁵ che indicavano il percorso dalla Grecia nord-occidentale all' Italia sud-orientale, erano importanti le baie protette e le foci dei fiumi, nonché i porti e le stazioni navali⁶. Per questo, oltre alla ricerca per l' individuazione di principali punti di partenza e di arrivo delle navi é utile ricercare anche i punti che agevolavano il viaggio o promuovevano attività in funzione delle navi locali o di quelle di passaggio. In questa ottica credo che sia interessante presentare il caso del porto di Xilocastro, sulla costa epirota dello Ionio, e delle attività legate ad esso.

II. Le coste epirote fra Parga e Kerenza

A proposito delle coste epirote e delle isole del mar Ionio abbiamo delle testimonianze scritte; manca però la documentazione riguardante relitti di naufragi o raffigurazioni di navi o barche. Al contrario, possiamo concentrare la nostra attenzione sui reperti archeologici e sugli elementi che giustificano attività portuali ed installazioni.

L' Epiro, regione montuosa con una economia basata specialmente sulla pastorizia, sviluppò nell' antichità, anche se limitatamente, dei contatti con il mondo esterno attraverso le coste.

Non possiamo trascurare i riferimenti dell' Iliade e dell' Odissea⁷ alla *Θεσπρωτία* e a *Δωδώνη*, anche se accettiamo che elementi mitologici e poetici intervennero del contenuto dell' Epos. In particolare, secondo i dati omerici, la costa tesprotica era una terra fertile (a causa dei terrazzi fluviali dell' Acheronte e della fascia costiera pianeggiante), con centro amministrativo *Ἐφύρα*; un re; navi da commercio e contatti con Itaca e *Δουλίχιον* (Leucade), Creta e i Fenici; problemi con le razzie. Inoltre, la Tesprozia aveva due luoghi di culto, e di pratiche oracolari, Dodona dedicata a Zeus, e una località nell' area di Xilocastro legata al mondo dei defunti.

Certamente, tutto questo viene appoggiato da citazioni delle fonti antiche, dall' onomastica etnica e da toponimi che dagli anni pre-arcaici si susseguono nel tempo⁸. Nei racconti degli antichi, provenienti da centri greci del periodo arcaico, arrivava l' eco di peregrinazioni di marinai in viaggi importanti e consueti, che nella Tarda Età del Bronzo collegavano il Mediterraneo orientale con quello occidentale.

La rotta attraverso lo Ionio e il basso Adriatico è indubbiamente esistita e fu seguita obbligatoriamente dai coloni arcaici⁹, perchè era già nota. Ugualmente,

l' area di Xilocastro/Efira ricevette coloni Elei che fondarono Πανδοσία¹⁰ e controllavano il porto.

La zona costiera fra Parga e Kerenza (Fig. 1) offre i presupposti che avrebbero potuto alimentare una tradizione legata ai naviganti e alla navigazione¹¹. La linea di costa che parte dal Capo Trofali, a N di Parga, è notevolmente rocciosa fino alla baia di Ai Ghiannakis. Parga, che si può, secondo Dakaris¹², identificare con la *Τορύνη* dell' età ellenistica, si trova fra due baie, quelle di Valtos e di Kryoneri; segue la baia di Lichnòs, subito dopo la località di Aghia Kyriaki e di Kiperi, dove si trova una tomba a tholos micenea¹³. La baia di Lichnòs, insieme a quelle di Valtos e di Kryoneri sarebbero servite nella Tarda Età del Bronzo come porti, secondo le ipotesi non ancora confermate di Dakaris¹⁴. La baia di Ai Ghiannakis, con la sorgente di acqua dolce, si può considerare abbastanza protetta, ma è chiusa da pendii rocciosi e presenta una costa a scogli che non permetteva un facile accesso all' entroterra. Verso S Capo Γλώσσα, noto dall' antichità come *Χειμέριον Ἄκρον*¹⁶, a 181m di altitudine, che Dakaris¹⁷ considera come probabile roccaforte micenea, chiude da NO la baia di Ammudià o Splanza, nota anche questa dall' antichità come *Ἐλέας λιμὴν* oppure *Γλυκὺς Λιμὴν*¹⁸. La baia è sicura, aperta ad occidente, e serviva come punto di approdo, per l' area degli Elei, in età arcaica e classica; gli scrittori antichi¹⁹ la descrivono in relazione al fatto che riceve le acque del fiume Acheronte. Kerenza chiude da S-SO la baia di Ammudià.

Dal punto di vista topografico la baia di Ammudià è la più interessante della costa epirota. Il largo corso dell' Acheronte e le sue foci hanno alterato l' antico porto, formando un area di sabbia e paludi che continua per 5,4 km fino alla località di Mesopotamos (Fig. 3-4). Come ha osservato anche Dakaris²⁰, le linee differenti della vegetazione sul territorio paludoso indicano i diversi livelli dei terrazzi alluvionali e dei depositi di detriti (Fig. 5).

La collina di Xilocastro (Fig.6), 83,3 m di altitudine e, a 600 m a S, quella di Ai Ghiannis, 49 m di altitudine, sorgono alcune decine di metri a nord di Mesopotamos, laddove inizia la pianura del fiume Acheronte (seguendo la quale si arriva fino a Dodona) e laddove si incrociano i fiumi *Ἀχέρων, Πυριφλεγέθων* (o *Βυνὸς*) e *Κωκυτός* (o *Paramithioticos*)²¹. Sulla collina di Xilocastro, identificata con *Ἐφύρα - Κίχυρος*²², sono ancora evidenti resti di un muro ciclopico, mentre sulla collina di Ai Ghiannis²³ si trovano delle tombe a cista litica tardoelladiche e i resti del Nekyomanteion.

Inoltre, esaminando la topografia del territorio, non è da sottovalutare la formazione dell' antico "lago" Acherusio²⁴, che oggi, bonificato, è coltivabile.

Il lago, in pratica, raccoglieva le acque dei tre fiumi e prima del suo riempimento ha funzionato come porto. A favore di questa tesi vorrei citare:

- a) il fiume Acheronte dal lago sboccava nel mare, dopo un breve tratto facilmente navigabile;
- b) la colonia elea di Pandosia²⁵ è stata fondata circa a 4,5 km a E di Efira, sulla riva settentrionale del lago;
- c) il toponimo *Σκάλωμα* oppure *Δρόμος Σκαλώματος*²⁶ (strada di scalo) sulla riva meridionale del lago è in relazione agli scali e agli ancoraggi di barche e navi anche di età successive;
- d) tronchi di quercia lavorati²⁷, di periodo incerto, destinati a carene di barche, sono stati scoperti lungo le coste meridionali del lago Acherusio;
- e) Xilocastro/Efira è una rocca fra due baie che offrono un duplice porto, secondo il modello²⁸ della posizione topografica degli insediamenti di età micenea.

Quindi (Fig. 2), sono propenso ad accettare come realtà storica che la baia nota oggi come baia di Ammudià o Splanza sia in pratica solo l'ingresso di 400 m. fra Chimerion Akron e Kerenza all'antico porto di Elea o Glikis, il quale funzionava già nell'età del Bronzo come una stazione micenea, indicata dalla cinta ciclopica, che portava molto probabilmente il nome di Kichyros / Efira. Sono propenso anche ad accettare l'esistenza di un secondo porto, ancora più chiuso e sicuro, quello che si otteneva dall'ultima parte del fiume Acheronte o/e il lago Acherusio. Non è escluso comunque che ci fosse ai tempi della Tarda Età del Bronzo un altro corso del fiume che sboccava sulla parte NO della baia di Ammudià, formando estuari ugualmente adatti al rifugiarsi delle navi. Un'altra nota sulla topografia dell'area scaturisce dai toponimi *Βαλανιδόραχο*, località fra Mesopotamos e Kerenza, e *Βαλανιδιά* a SO della Pandosia. Si tratta di toponimi che provengono dalla ricchezza dell'area in boschi di quercie²⁹ (*βάλανος-βαλανιδιά*), il legno delle quali poteva essere sfruttato per la costruzione di navi o per lo scambio e il commercio.

III. Documentazione archeologica e interpretazione

I rinvenimenti archeologici riguardanti la Tarda Età del Bronzo nell'area di Xilocastro e di Kiperi (Fig. 1), e più all'interno, di Dodona³⁰ per esempio, documentano tanto la presenza di elementi non epiroti, "nordici" e "micenei", quanto situazioni che implicavano gli abitanti delle coste in attività marittime e portuali.

La linea di costa fra Parga e Kerenza, tenendo conto delle indicazioni topografiche sopracitate e di quelle archeologiche, sembra essere stata il punto più importante dell' Epiro per lo sbarco e l' imbarco, durante la Tarda Età del Bronzo. Il muro ciclopico di Xilocastro³¹ comprendeva, in un perimetro di 1120m, un' area di 4,24 ettari. I reperti di ceramica e di bronzo di tipologia locale e micenea a Xilocastro³², a Mesopotamos³³, a Nekomanteion³⁴; i tumuli sepolcrali che sono addossati al muro ciclopico di Xilocastro³⁵ e i loro corredi; la tomba a tholos a Kiperi³⁶ e il suo corredo testimoniano la vitalità di una stazione navale.

I motivi che giustificano la fondazione di una tale stazione sono molteplici³⁷:

- a) necessità a stazionare o riparare provvisoriamente o per lungo periodo barche, navi lunghe e navi da carico;
- b) necessità di rifornimento di acqua e di viveri per le navi;
- c) necessità di riparazione di navi e di barche o eventualmente costruzione di nuove imbarcazioni;
- d) necessità di un ambiente accogliente per assicurare la pacifica permanenza di navi e marinai specialmente fra novembre ed aprile, ma anche in periodi estivi più brevi;
- e) necessità di un centro di distribuzione delle merci, di uno spazio adatto per caricare e scaricare e di installazioni complementari;
- f) necessità di un controllo amministrativo.

A Xilocastro, nella baia principale di Amnudià, ma anche alle foci del fiume Acheronte, e sul lago Acherusio-se ne ammettiamo l' esistenza-potevano essere soddisfatte tutte queste esigenze:

- a) Poteva approdare ed essere protetto naturalmente dai venti un grande numero di imbarcazioni. Infatti, la capacità di ancoraggio di Glikis supera i 6 km di costa e quella dell' Acheronte supera gli 8 km.
- b) Con prodotti di pastorizia e di allevamento, ma anche con prodotti agricoli della pianura di Acheronte, come pure con l' acqua dolce si potevano rifornire le navi. È nota dalle fonti antiche³⁸ l' economia pastorale dell' entroterra epirota, come pure la fertilità dell' area Paramithià-pianura di Acheronte; questo fiume con Piriflegetone e Cocite riforniva di acque e ottimo terreno sedimentario la parte sud-occidentale della Tesprozia.

- c) Boschi di quercie e di ulivi potevano fornire di legname i riparatori di navi ed anche i costruttori di nuove imbarcazioni³⁹.

Aggiungo anche la notizia di Leake⁴⁰ e Hammond⁴¹, secondo cui un tipo di quercia, il *quercus ilex*, è stato individuato a Riniassa, vicino Kastri/Pandosia: il suo legno viene considerato come il migliore per costruire navi. Non è un caso, inoltre, che l' Epiro fra Dodona e Ambracia si chiamava in antico *Δρυοπίς*⁴² e gli abitanti *Δρύοπες*⁴³ dall' antica parola *δρῦς* (quercia) a dai boschi di quercia che coprivano la zona⁴⁴. Le quercie epirote erano note nelle fonti scritte: della sacra quercia oracolare di Zeus di Dodona proveniva un frammento di legno della prua della nave degli Argonauti, insegna il mito⁴⁴.

- d) Se le coste dei mari Ionio ed Adriatico fossero state frequentate da pirati e da genti che vivevano di razzie, come *Τάφιοι*⁴⁵, *Τηλεβόαι*⁴⁶, *Λιβυρνοί*⁴⁷, come ci tramandano le fonti, c' era da aspettarsi che si verificassero le condizioni per una convivenza pacifica fra indigeni e gruppi più interessati alla navigazione; fra questi ultimi potrebbero includersi anche i portatori di civiltà micenea; è possibile dunque che ci fosse una comunità nella quale dominavano i micenei perchè più forti. Così era assicurata una tranquilla permanenza nell' area di Xilocastro e c' era pure l' opportunità di una più facile difesa nella baia che chiude naturalmente da Capo Chimerion (Glossa) e Kerenza, con una roccaforte ciclopica e sulle foci di un fiume che penetrava dopo un tratto nel lago Acherusio, chiuso e nascosto. Con i traffici micenei nel Mediterraneo, come dato di fatto⁴⁸, è naturale ipotizzare l' esistenza di punti ospitali e utili per agevolare le navi e gli equipaggi durante i mesi invernali o per brevi periodi.
- e) Non è da escludere l' eventualità deducibile dalla distribuzione di oggetti micenei all' interno dell' Epiro⁴⁹, o oggetti "esotici" (come per esempio l' ambra), che ci fosse a Xilocastro/Efira un pur minore centro di distribuzione di merci e punto di partenza di mercanti, se non un punto dove la gente dall' interno veniva a scambiare i suoi prodotti fronteggiando i fabbisogni dei naviganti. Questo motivo avrebbe fatto sviluppare anche un traffico interno oppure avrebbe spinto alcuni ad attività legate al mare, il che avrebbe favorito le necessità locali o ancora il fiorire di nuovi contatti. Un movimento del genere comportava anche l' esigenza di preparare delle costruzioni e degli spazi adatti,

come per esempio magazzini per derrate e merci o tettoie per proteggere le barche o le navi lunghe se tirate a secco.

- f) É ovvio che il funzionamento di una stazione navale a Xilocastro presupponesse una struttura adatta: un' amministrazione e un potere, come pure un personale che si occupasse di carico e scarico, di lavori portuali e riparatori, di costruzioni di barche e navi, di tasse e pedaggi, di controllo e difesa.

Inoltre, la fondazione di una comunità organizzata e di un potere amministrativo suggeriscono anche l' ipotesi dell' esistenza di culti. Il Nekyomanteion ellenistico dedicato all' Ade e a Persefone eretto sulla collina di fronte a Xilocastro continua probabilmente la tradizione di un culto di età micenea incontrato anche nel Peloponneso occidentale, culto implicante Poseidone/Ade e Grande Dea/Persefone⁵⁰.

Appare naturale che le paure sulla vita e la morte che preoccupavano da sempre l' uomo abbiano trovato sfogo in due località, dove si sono organizzati luoghi di culto: a Dodona, punto di incrocio di vie di terra e a Xilocastro/Efira, punto di incontro di vie di mare. Il culto di Poseidone/Ade, quindi, poteva soddisfare una necessità nell' ambito dell' organizzazione della comunità, una necessità del potere per riscuotere tasse e pedaggi⁵¹ in cambio del permesso all' approdo. Un culto del genere poteva contemporaneamente consolare i naviganti, come Ulisse⁵², che nell' attesa di ritornare a casa o proseguire il viaggio facevano offerte alle divinità e domandavano agli spiriti dei defunti il futuro che li aspettava, realizzando un rituale specifico.

Concludendo, si pone la domanda: come si può definire⁵³ Xilocastro/Efira/Kichiros? Non certo come un semplice approdo, perchè non si giustifica una cinta ciclopica; nemmeno un semplice emporio, perchè Xilocastro é posto in un area con duplice porto esteso, chiuso e assicurato per tutte le stagioni; neanche si può parlare di una colonia, perchè non è testimoniata la fondazione di un centro con "programma di popolamento del territorio" come succedeva per la colonia arcaica di Pandosia vicina ad Efira, neppure si può dire che la stazione influenzasse radicalmente l' entroterra.

Lo si può definire, invece, come uno scalo nelle rotte del Mediterraneo, un punto fermo sulla rete che appoggiava la navigazione micenea, raccogliendo delle merci dall' interno, accogliendo sistematicamente le navi facenti capo ad interessi micenei nei loro viaggi più lunghi; rappresentava pure un punto di riferimento per un traffico minore fra coste dello Ionio e del basso Adriatico. Delle

stazioni analoghe a quelle di Xilocastro possiamo ricercare in Etoloacarnania, nelle isole del mar Ionio, a Itaca, a Cefalonia, in Italia meridionale⁵⁴.

IV. Importanza di una ricerca ulteriore

I dati finora noti spingono ad una ricerca ulteriore sulla linea di costa epirota e del tratto Parga-Kerenza. Bisognerà studiare e verificare di nuovo dal punto di vista geomorfologico l' antica linea di costa e gli antichi corsi dei fiumi; studiare ancora l' area da tutti i punti di vista: topografico e archeologico; individuare e documentare sufficientemente i porti della Tarda Età del Bronzo nelle rotte della navigazione antica che toccavano l' Epiro.

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NOTE

1. Cfr. Sordinas 1965, 141-148; Idem 1968, 81-83; Idem 1969, 401-407; Idem 1970, 10-12, 24-25; Idem 1974, 91-93; Tiné 1973 (1983), 25-44; Tiné-Simone 1984, 75-100; Papadopoulos 1974, 127, 134; Biancofiore 1975; 127-162; Idem 1984 (1987), 87-108; Sueref 1976, 98-100; Idem 1976-1977, 11-15.
2. Cfr.p.es. Vagnetti 1977 (1979); Harding 1984; *Ο Μυκηναϊκός Κόσμος* 1989; *Traffici micenei nel Mediterraneo* 1984 (1986); Van Compernelle 1988.
3. Cfr.p.es. Pugliese-Carratelli 1968/1969; Biancofiore 1975; Idem 1984 (1987) Cremonesi 1978; Nenci 1979; Pancrazzi 1979, 283-291; Moscati 1980, 13-23 Vagnetti 1982; *Magna Grecia e Mondo Miceneo* 1982 (1983); Sueref 1986.
4. Cfr. Hope Simpson-Dickinson 1983; cap. B, E, K; *Magna Grecia e Mondo Miceneo* 1982 (1983).
5. Nenci 1973.
6. Per una discussione sul ruolo dello Ionio e dell' Adriatico nell' età del Bronzo e nell' antichità vd. Pallottino 1973 (1983); Lepore 1973 (1983), Van Compernelle 1978; Nenci 1979. Cfr. anche Laviosa 1982 (1983) e nota 3.
7. Iliade II. 744-751; XVI. 223-235 e 253; Odissea I. 259-262; II.328-330; X. 487-570; XI. 1-640, XIV. 314-324, 327-330 e 334-335, XVI. 60-67 402-403 e 425-427; XIX. 269-299.
8. Per un esame delle fonti sull' Epiro pre-classico vd. Lepore 1962, 1-107, 113-126; Hammond 1967, 365-395, 399-400; Dakaris 1964, 3-21; Idem 1971, 25-32; Idem 1972, 50-76; Idem 1984 (1986). Altra bibliografia vd. Sueref 1986, 18 nota 3.
9. Cfr. Taylour 1958, 183-184; Vallet 1962 (1963), 119-122.
10. Cfr. Dakaris 1971, 32-33; Idem 1972, 76-77.
11. Per notizie geografiche e storiche sull' area in prossimità alle coste fra Parga e Kerenza vd: Leake 1835. I, 185, 231-234, 242; III, 3, 7-8, 53; IV, 7-8, 51-56, Philippson-Kirsten 1956/1958, 39, 100-101, 104, 212-213; Hammond 1967, 35, 37, 43-44, 50-51, 63-66, 68-77; Dakaris 1971; 4-17 Idem 1972, 7-9, 13, 15-18, 21-23, 25, 28-29, 32-34, 37-39, 58, 62-64, 70.

*INDICAZIONI CIRCA ATTIVITÀ MARITTIME LUNGO LE COSTE EPIROTE,
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12. Dakaris 1972, 15, 33 (Plut., Anton. 62), 135-136, 200.
13. Dakaris 1960; Papadopoulos 1981.
14. Dakaris 1972, 15.
15. Paus. 8.7.2. (sorgente di acqua dolce vicino Capo Χειμέριον. Cfr. Dakaris 1972, 15 e n. 43 (bibl.), 87.
16. Odiss. XI 14 ss., Tuc. 1.46.3-4; Strab. 7.7.5; Paus. 8.7.2; Cfr. Dakaris 1972, 15-16, 28, 32, 63, 80, 96, 134.
17. Dakaris 1972, 63.
18. Inc. 1.46.3, Pseudo-Scyl. 30, Strab. 7.7.5, Paus.1.17.5, Ptolem. 3.14. 5. Cfr. Dakaris 1972, 15-16, 28-29, 32, 37-39, 80, 96, 134.
19. Vd. nota 18.
20. Dakaris 1972, 18, 32; Idem 1984 (1986), 154.
21. Cfr. Dakaris 1958, 107-112; Idem 1960, 201-205 Idem 1972, 28-29, 32, 62-63; Hammond 1967, 63-64, 66, 76, 285.
22. Dakaris 1958, 108, 111-112; Idem 1972, 62-63.
23. Dakaris 1963, 89-92; Idem 1976, 84-85; Idem 1977, 68-69.
24. Paus. 1.17.5. Cfr. Dakaris 1958, 107-110; Idem 1960, 201-202, 204-205; Idem 1971, 4-5; Idem 1972, 17-18, 28; Idem 1984 (1986), 165-166. Hammond 1967, 39, 43-44, 66, 69, 450, 455, 478, 513, 673, 677, 707.
25. Cfr. Dakaris 1971, 31, 44-45, 52, 81-82, 164-170; Idem 1972, 76.
26. Dakaris 1960, 204-205; Hammond 1967, 66.
27. Dakaris 1960, 204-205; Idem 1972, 23.
28. Cfr. Laviosa 1982 (1983), 334-335.
29. Cfr. Hammond 1967, 19, 22, 37, 40, 46, 51, 55, 57, 79, 89, 162, 368.
30. Cfr. Dakaris 1971, 25-31; Idem 1972, 49-71; Papadopoulos 1976; Sueref 1986.
31. Dakaris 1958.
32. Dakaris 1958; Idem 1975; Papadopoulos 1980.
33. Dakaris 1963.
34. Come nota 33.
35. Papadopoulos 1978; Idem 1979; Idem 1980; Idem 1984; Idem 1987, 139-142.
36. Dakaris 1960.
37. Cfr. Laviosa 1982 (1983).
38. Cfr. Hammond 1967, 39-45; Dakaris 1971, 12-17; Idem 1972, 21-27.
39. Ripeto qui il rinvenimento sulla riva meridionale del lago Acherusio, i tronchi di quercia in corso di lavorazione destinati a servire come carene di barche: vd. nota 27.
40. Leake 1935, IV, p.49.
41. Hammond 1967, 51.
42. Dion. Calliph. 56.
43. Cfr. Hammond 1967, 375, 394, 425.
44. Relativi sono anche i toponimi attuali di Valanidoracho e Valanidiá nell' area: vd. nota 29.

- Apollo. Bibliot. 1.19.16. Cfr. Dakaris 1972, 23.
45. Odiss. I. 180 ss; XV. 425 ss.; XVI. 426. Cfr. Hammond 1967, 378-379.
46. Hesiod. Eoëae fr. 55.19 (Traversa). Cfr. Hammond 1967, 378.
47. St. Byz.s.v. *Λιβυρνοί*; Strab.6.2.4; 7.5.8; Cfr. Hammond 1967, 414-418; 424-425, 452, 461, 469.
48. Cfr. p.es. *Traffici micenei nel Mediterraneo* 1984 (1986).
49. Cfr. Papadopoulos 1976; Sueref 1986.
50. Cfr. Dakaris 1984 (1986), 162-164. Anche: Pugliese-Carratelli 1964 (1966).
51. Cfr. Laviosa 1982 (1983), 323.
52. Odiss. XI. 1-640 (νέκεια).
53. Cfr. la problematica sulla definizione dei punti fermi micenei in Laviosa 1982 (1983), 324.
54. Aghios Ilios, Poli. Aetòs, Pelikata, Mazarakata, Scoglio del Tonno, Punta Melisso. Cfr. Hope Simpson-Dickinson 1979, cap. B, E, K; Bernabò Brea 1982 (1983); Van Compernelle 1988.

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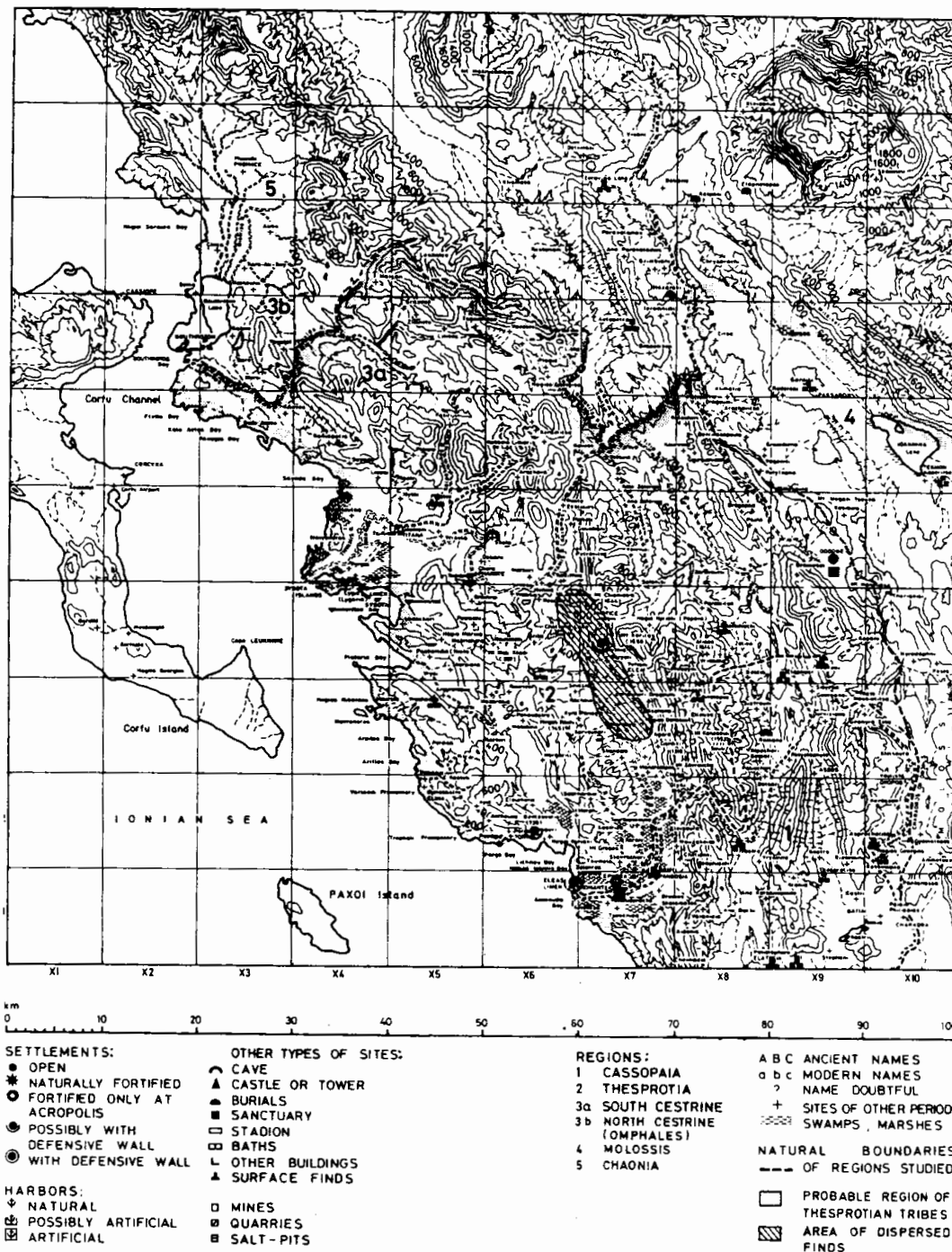
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ILLUSTRATIONS

- Fig. 1 Coste epirote: insediamenti dell' Età del Bronzo [da S.DAKARIS, Θεσπρωτία, A.G.C. 15, Athens-USA 1972, fig. 19].
- Fig. 2 Ricostruzione grafica ipotetica del porto di Ephyra (Xilocastro).
- Fig. 3 La baia di Ammudià.
- Fig. 4 La baia di Ammudià da Mesopotamos.
- Fig. 5 La collina di Ephyra (Xilocastro): sono evidenti resti di un muro ciclopico.
- Fig. 6 L'antico porto di Ephyra alterato dalle paludi.

THESPROTIA - BRONZE AGE (c. 2500 - c. 1200 / 1100 B.C.)

TYPES OF SITES



Based on archaeological data by S. Dakaris, on A. G. C. Vol. 4, Fig. 22 and maps 1:200,000 of the Hellenic Army Geographical Service

Fig. 1 A. C. E. RESEARCH PROJECT: ANCIENT GREEK CITIES 0-AGC-1989

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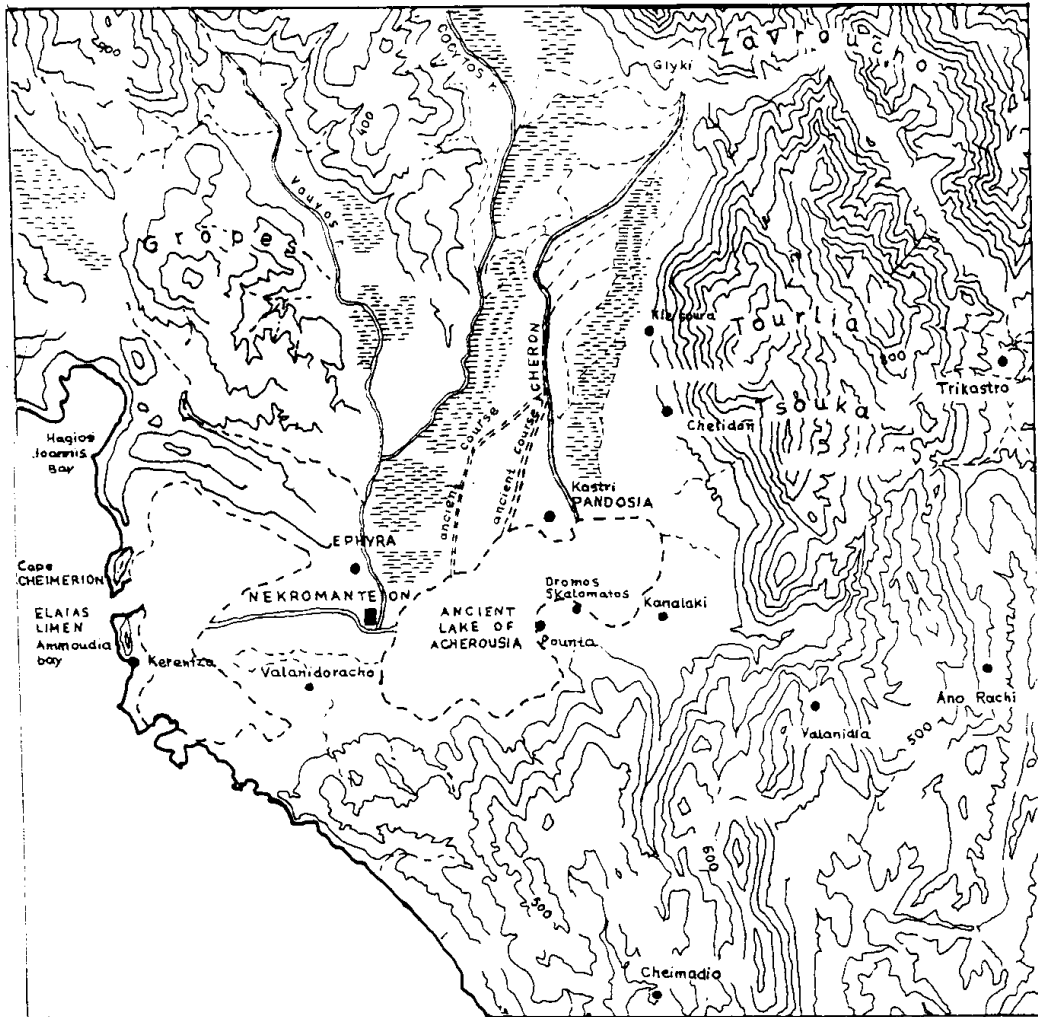


Fig. 2

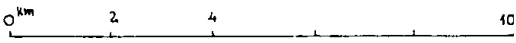


Fig. 3



Fig. 4



Fig. 5



Fig. 6

ANCIENT SCANTLINGS: THE PROJECTION AND CONTROL OF MEDITERRANEAN HULL SHAPES

It has been eighteen years since Lionel Casson combined most of the known literary and archaeological sources to produce *Ship and Seamanship in the Ancient World*,¹ still a basic sourcebook for our discipline, and nearly that long since Lucien Basch wrote his thought-provoking article on the state of nautical archaeology that introduced the first volume of *IJNA*.² We have recorded a lot of frames, planks, nails, and mortise-and-tenon joints since then, but our research has added virtually nothing concerning the methods by which ancient Mediterranean ships were designed, the ways in which shipwrights controlled hull construction, the techniques that permitted large fleets of warships to be built as quickly as literary sources claim, or a clear understanding of the economics of shipbuilding. In short, we have documented a lot of trees these past two decades, but we still have to find the forest.

Part of our problem might be attributed to the limited number of extensively preserved wrecks that have been excavated, while economic, political, or other constraints affected some of the projects. Nevertheless, we must concede the fact that our recording of hull details also has been generally insufficient and our avenues of research too narrow and unimaginative. Now archaeology has entered the computer age, bringing with it expanded possibilities for examining data and analyzing hull structures. More than ever before, we must document our finds more completely to take advantage of this new medium. At the same time, we must reevaluate the ways in which we have been considering our hull remains and take new approaches to these old problems.

As an example, this paper will consider one of these problems—the ways in which shipwrights projected and controlled hull shapes. In the past, theories have ranged from the use of standing control frames to the haphazard assembly of planks, but I am not convinced that any of them are accurate and certainly none of them are complete. Let's examine the problem by first reconsidering the *Kyrenia* and *Serçe Limani* wrecks, which are used as examples only because they are so similar. Both had approximately the same principal dimensions, sailed the same waters, were built almost exclusively of pine, had identical planking thicknesses, relatively small keels, and two belts of heavy wales.

Fig. 1 illustrates the midship section of the *Serçe Limani* merchantman, which was excavated off the southern coast of Turkey about ten years ago and whose remains have been reassembled in the Medieval castle at Bodrum, Turkey³. It shows one of ten frames, or partial frames, whose shapes were predetermined and erected immediately after the keel and posts were set up, before any planking was installed. By the first quarter to the eleventh century in the eastern Mediterranean, and probably long before, the assembly and resulting shape of the outer shell of planking was controlled by standing frames, at least in the middle of the hull. That control was lateral in orientation.

The midship section of the *Kyrenia* ship, which was excavated off the northern coast of Cyprus and whose remains have also been reassembled in a Medieval castle at Kyrenia, Cyprus, is shown in Fig. 2⁴. It sank in the late fourth century BCE. By means of outward-driven tenon pegs beneath frames and other features, we have determined that none of the frames was erected before the planking strakes they spanned. In fact, none of the frames was fastened to, or even touched, the keel. There is an abundance of evidence to suggest that the nine bottom strakes were installed immediately after the keel and posts were erected, being held to each other by means of closely-spaced mortise-and-tenon joints. Next the floor timbers were installed, then the side planking and wales and, finally, the rest of the frames, futtocks, and top timbers. But was the control of the resulting hull shape also lateral in orientation? Probably not. Many of us are accustomed to studying hulls by means of body plans, section drawings, and other lateral views. Therefore, it is quite natural for us to use this modern perspective for ancient hulls as well, and perhaps to be influenced into thinking that ancient builders also pondered their construction in this manner. But if one builds a faithful model of a mortise-and-tenon joined vessel, another perspective becomes practical in the shaping of the hull, a perspective that should be considered in future research. I believe that the *Kyrenia* ship's hull shape (and to varying degrees, all ancient hull

shapes) was formed and maintained from a longitudinal perspective. In the Serçe Limani hull, the initial shaping members were frames set transversely on the keel; thus the hull was shaped by a series of transverse guides. In the Kyrenia and similar ancient hulls, the initial shaping members were planks set parallel to the keel; thus the hull was possibly shaped by a series of longitudinal guides.

Therein, I believe, lies the greatest difference between the construction of ancient Mediterranean and later vessels—the direction on which hull shapes were accomplished. I will go one step further and suggest that the greatest difference between the mentalities of ancient and later shipwrights—the difference in their structural philosophies—was that one visualized his hulls in longitudinal bands, the other in athwartships configurations.

There were other notable differences between these two vessels, the most profound of which was the fact that the seams of the Kyrenia ship's planks were joined with pegged mortise-end-tenon joints, while the seams of the Serçe Limani planks were not.

Herein lies the key to understanding ancient Mediterranean ship design and construction methods. The mortise-and-tenon joint is the very hallmark of ancient Mediterranean construction, the feature that most profoundly separates those ships from all others. Our initial problem in comprehending this form of construction perhaps lies in our designation of ancient shipbuilding. We say these hulls were “shell-built” or made “shell-first”. Those might have been acceptable terms in the past, but they are now insufficient, even misleading, and should be retired with the other ghosts of the past. We seldom refer to Viking ships as shell-built; we say they are “clinker-built”, a term that simultaneously recognizes the primary role of their shells of outer planking and the method by which those overlapping planks are secured—with clencher. Then why not extend the same degree of accuracy to the designation of their southern counterparts and call them “tenon-built?” Such a term would be far more descriptive, since it is not so much a matter of whether or not planks preceded frames as it is whether or not mortise-and-tenon joints were utilized in the hull's construction.

Secondly, we have not examined the function of these joints thoroughly enough—we have not fully appreciated their true purpose. Too often they have been treated as mere fastenings when actually they were hull components, just as frames and knees and stringers were hull components. One of their functions was to serve as fastenings, of course—where they were pegged on either side of the seam, they held the plank edges together. But if that were their only purpose,

they could have been spaced much farther apart and their spacing would have varied according to the amount of tension on the seam; at the ends of the hull they would have had to be spaced closer together than along its flat sides, as they were at the end of the Classical period and the beginning of the Medieval period, when their employment had declined to that of mere fasteners or aligners.

But from the fourth century BCE to the first century CE, the period in which mortise-end-tenon joinery had reached its apex in Mediterranean shipbuilding and to which this paper is limited, there is plenty of evidence to suggest additional reasons for their existence. Only four arguments will be presented here.

1. Joints were spaced about 12 cm between centers on small vessels, and that spacing remained rather consistent throughout the hulls (Fig. 3). On large, single-planked vessels such as those at Nemi⁵ and Antikythera⁶, spacing was similar but here the joints were staggered to take advantage of the thicker seams, the tenons being so large that their adjacent edges were sometimes in alignment or nearly so (Fig. 4). On large, double-planked hulls such as the Madrague de Giens ship, the inner layer joints again were spaced about the same frequencies as on the other vessels but the outer layer joints were spaced somewhat farther apart (Fig. 5)⁷. However, the combined seam ratios of tenon thicknesses, widths, and frequencies to planking thickness exceeded that of single-planked hulls. The consistency of dimensions, spacing, and the ways in which these joints were adapted to their hull forms over half a millennium suggests structural functions beyond that of mere fastenings.
2. The fact that outer planking layers of double-planked hulls were edge-joined, rather than being directly fastened to the frames and interior planking, indicates a structural function other than mere edge attachment.
3. Even when rotten planks were replaced, the structural importance of mortise-and-tenon joints was recognized and maintained. On the Kyrenia ship, a rotten seam was cut away to nearly the centers of the adjacent plank and a new plank inserted.⁸ With the frames and adjacent planking still in place, it would have been necessary only to nail the new plank in place and caulk it. That was done eventually, but not until elaborate repair mortises were carved into the inner and outer plank surfaces and curiously-shaped tenons inserted to maintain the normal joint dimensions and spacing (Fig. 6). It was obvious that this shipwright

considered these joints to be more than mere fastenings. Indeed, when one compares the workmanship lavished on these mortises, tenons, and plank edges with that of the fit between inner plank surfaces and frames, it appears that he considered the edge system to be more important than the frames.

4. It required a lot of effort to mark off the mortise locations on the planks, cut the mortises to the desired dimensions and angles, manufacture the hardwood tenons, drill the peg holes in either side of the seams, shape the tapered pegs and drive them, and align and fit the planking edges to the standing tenons and to each other. And yet, little *Kyrenia* had nearly 4,000 such joints and the big Roman freighters must have had at least five times as many. That was a staggering investment in labor, materials, and time. Even if slave, or poorly compensated, labor was utilized, the cost of those joinery systems still had a profound effect on shipbuilding economics and construction schedules. If those joints were intended to be mere edge fastenings, surely many cheaper and faster alternatives were available.

I have long maintained that mortise-and-tenon joints were, in addition to being edge fastenings, little internal stiffeners—miniature inside frames, if you will—that contributed greatly to the strength of the planking shell. That was evident when we built our sectional and sailing replicas of the *Kyrenia* ship. With very little shoring and no frames to stiffen the planking shell at all, the shells were quite solid when workmen walked around within them. But there was an additional advantage to these joints. Tests have shown us that they created a seam bond that was nearly as strong and, in some cases, stronger than the plank itself. From a lateral orientation, that explains the relatively weak framing systems found in most of these ancient hulls. For instance, the *Kyrenia* framing system was much lighter and weaker than that of the *Serçe Limani* hull of the same size and plank thickness. The added integrity of *Kyrenia*'s seams, however, contributed enough additional strength to more than account for framing deficiency, whereas the *Serçe Limani* frames provided the sole lateral strength of the submersed part of that hull. Even the framing system of the big *Madrague de Giens* ship seems relatively weak, considering the size of the hull and the discontinuous nature of its frames⁹. Here, however, both the double rows of joints and the laminating effect of the two layers of planking combined to create a very strong outer shell.

It was from a longitudinal orientation, however, that these joints provided the most benefit, and we have not given this factor enough consideration. The sum of all the joints along a continuous planking seam resulted in an enormous longitudinal strength factor, as if a thick stringer were placed here and, because the joints were internal, locked the curvature of the seam in its desired sweep. That was, I believe, the most important reason for closely and evenly spaced mortise-and-tenon joints—the longitudinal strength factor. Thus small, round hulls like *Kyrenia* could be made sufficiently strong without the longitudinal benefits of a keelson, stringers, or even permanent ceiling. Longer, larger hulls required additional support, if only to reduce the possibility of tenon shear; the stringers on the *Madrague de Giens* ship are a good example¹⁰. Long, narrow warships perhaps required even more stringers and *hypo-zomata* as well. But, in all cases, the joints themselves contributed appreciably to the longitudinal strength of the hull. It is because of the above statements, as well as the fact that the ratio of frame to shell strength of all these ancient hulls was rather low, that I contend we should reconsider the ways in which the ancient shipwright might have pondered his hull structure. Look again at the midship section of the *Kyrenia* ship (Fig.2). The lateral shapes of the hull on either side of the keel are not symmetrical, frames are discontinuous and relatively weak, and the floor timbers, which are only 9 cm square and spaced at approximately 50 cm intervals, do not touch, nor are they fastened to, the keel. That hardly looks like a laterally planned section, but rather one that resulted from the construction process.

The planking, on the other hand, appears to be planned rather well. They are not the sort of planking shapes one would use if the frames had been there already, but for this form of construction they are perfect. The first four seams are distributed to compliment the areas of the bottom and ends so that a relatively straight plank could be installed just before the turn of the bilge. The next four strakes are very broad and establish the rounding of the bilge, as well as beginning the definition of the sheer of the sides. By the time the main wale is reached, the desired sheer is nearly accomplished. This, I suggest, is the way in which ancient shipwrights viewed their hulls— by the longitudinal shapes of their inner or outer planking surfaces. I will go one step further and suggest that given hull designs employed given proportions for the shapes of those planks— not precise dimensions or edge angles necessarily, but proportional widths at given locations so that the shape of the hull could be described with a fair amount of accuracy solely by the erection of the planks. Such a process, if formalized and recorded, could have simplified greatly the construction of large numbers of warships at widespread locations.

This, after all, is the way hulls were being shaped in the Bronze Age. Planking shapes such as those for the Royal Ship of Cheops are excellent examples of the way in which planking shapes can form hulls¹¹. Better still are those of the Dashur boat at the Carnegie Museum in Pittsburgh, which was completely disassembled, recorded, and then reassembled in the new Egyptian museum section there¹². These planks appear to have been made by cutting rough, oversize blanks and then literally carving their curvatures in all directions with adzes. This hull, which has no frames at all, was entirely formed by those planking shapes.

The Kyrenia ship is but a sophisticated extension of that form of construction, and the lines of pegged mortise-and-tenon joints are the greatest contributor to that sophistication. I believe that its builders shaped the hull one plank at a time, determining those planking shapes by means of traditional or predetermined proportions or dimensions, and securing the standing structure with rows of closely-spaced joints whose effect on the structure was that of stiff longitudinal frames or stringers. Toward the end of the Classical period, when labor became more of a factor in overall cost, these longitudinal joint systems were replaced by stringers, keelsons, and other internal framework, and joints became smaller and more widely spaced. Eventually, in the Medieval period, they were no longer pegged and contributed little, if anything, to hull strength.

I chose this topic because I feel it is time to alter some of our standing theories, as well as our methods of recording, in order that better progress can be made toward unlocking the secrets of ancient shipbuilding. The recording of hull scantlings, especially, has been a problem in the past. Of the twenty seven wrecks used for this study, few have been recorded well enough to permit a complete analysis of the hull structure. Too often planking widths have been given but not thicknesses, while the reverse would be more informative, or frame and joint spacing was not observed, or key timber dimensions omitted. To record a shipwreck properly, scantling lists and drawings should be complete enough so that one could write contract specifications from which the surviving part of the hull could be built. This includes the dimensions of all timbers and strakes, taken at frequent intervals, planking thicknesses both at the center and edges of the planks and, especially, the complete recording of joint details—widths, lengths, and thicknesses of both mortises and tenons, tenon and mortise shapes, peg location with respect to the seams and the joints, external and internal peg diameters, and the distances between joint centers. The precise recording of these joints is especially important, for they are not merely fastenings. They are components of the primary structure of the hull—the shell—just as much as the planks are components.

To conclude, the following points should be reemphasized as viable considerations in future shipwreck recording and research.

1. The ancient shipwright considered his planking shell the primary hull structure.
2. Whether by mental image, traditional proportions, or formal documentation, he comprehended his hull design before construction began and could predict and control it with a fair degree of accuracy.
3. The hull was shaped, and its form controlled, by the careful determination of longitudinal planking shapes. On the Kyrenia ship, that might have been a fairly simple and informal process. On large warships or freighters, such as the Madrague de Giens vessel, it must have been a rather sophisticated process and probably at least as accurate and scientific as the projection of frame shapes in the seventeenth century. Such a process, if formalized and recorded, could have simplified the construction of large numbers of warships in widespread locations.
4. While cleats, braces, control frames, and other devices might have been used to help maintain the hull shapes during construction, it was the mortise-and-tenon joints that played the most important role in this respect.
5. Mortise-and-tenon joints were as vital to ancient Mediterranean hull structures as frames, keels, and planks. They joined the seams, provided longitudinal and lateral stiffening, and contributed greatly to the overall strength of the hull.
6. We must record and publish hull remains more completely if we are to fully understand ancient shipbuilding technology.

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NOTES

1. Lionel Casson, *Ships and Seamanship in the Ancient World*, Princeton, 1971.
2. Lucien Basch, "Ancient wrecks and the archaeology of ships", *The International Journal of Nautical Archaeology and Underwater Exploration* 1.1 (1972): 1-58.
3. J. Richard Steffy, "The reconstruction of the 11th century Serçe vessel: a preliminary report," *The International Journal of Nautical Archaeology and Underwater Exploration* 11.1 (1982): 13-34.
4. J. R. Steffy, "The Kyrenia Ship: An Interim Report on its Hull Construction", *American Journal of Archaeology* 89.1 (1985): 71-101.
5. Guido Ucelli, *Le Navi de Nemi*, Rome, 1933.
6. Peter Throckmorton, "The Antikythera Ship," *Transactions of the American Philosophical Society* 53.3 (1965): 40-47.
7. Patrice Pomey, "La Coque," in A. Tchernia et. al., *L'Epave Romaine de la Madrague de Giens* (suppl. *Gallia* 34 [1978]: 75-100.
8. Steffy, "Kyrenia Ship," *AJA* 89, 97-98.
9. Pomey, *Madrague de Giens*, 80-84, Pl. XXX, XXXVII.
10. Pomey, *Madrague de Giens*, Pl. XXVII, XXXVI.
11. For instance, see fig. 42 in Paul Lipke, *The Royal Ship of Cheops*, BAR Int Series 225, Greenwich (1984).
12. Cheryl Ward Haldane, *The Dashur Boats*, Master's thesis, Texas A&M University (1984): 39-64.

ILLUSTRATIONS

- Fig. 1 A half-section of the Serçe Limani hull at amidships.
- Fig. 2 A simplified drawing of the Kyrenia ship's surviving timbers at amidships.
- Fig. 3 Mortise-and-tenon joint details for a typical small vessel. Not to scale.
- Fig. 4 Typical arrangement of joints at the planking edges of large, single-planked hulls. Not to scale.
- Fig. 5 Typical arrangement of joints at the planking edges of large, double-planked hulls. Not to scale.
- Fig. 6 A portion of one of the replacement strakes in the bow of the Kyrenia ship. The view at right shows a cross-section of a typical repair ("patch") tenon installation. Not to scale.

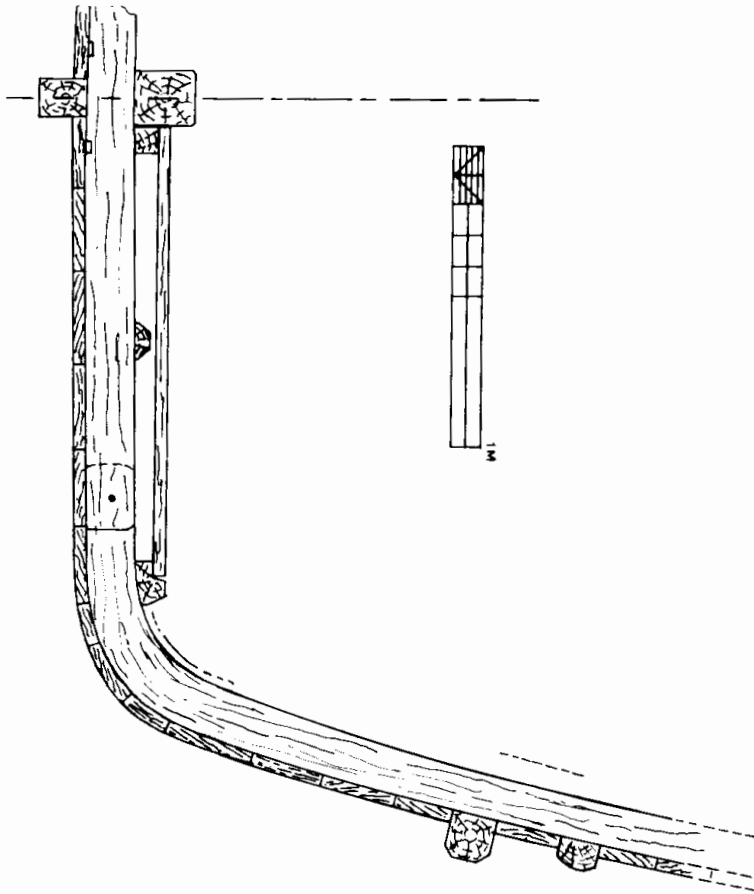


Fig. 1

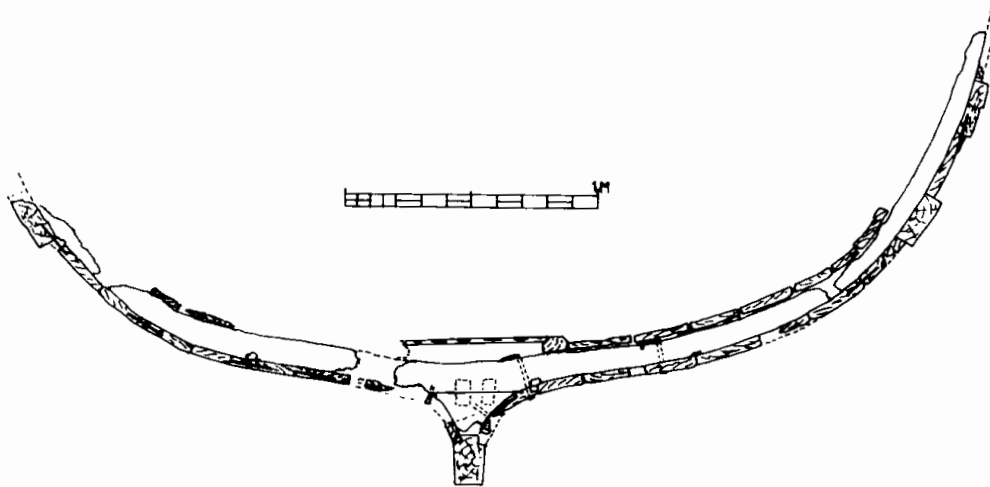


Fig. 2

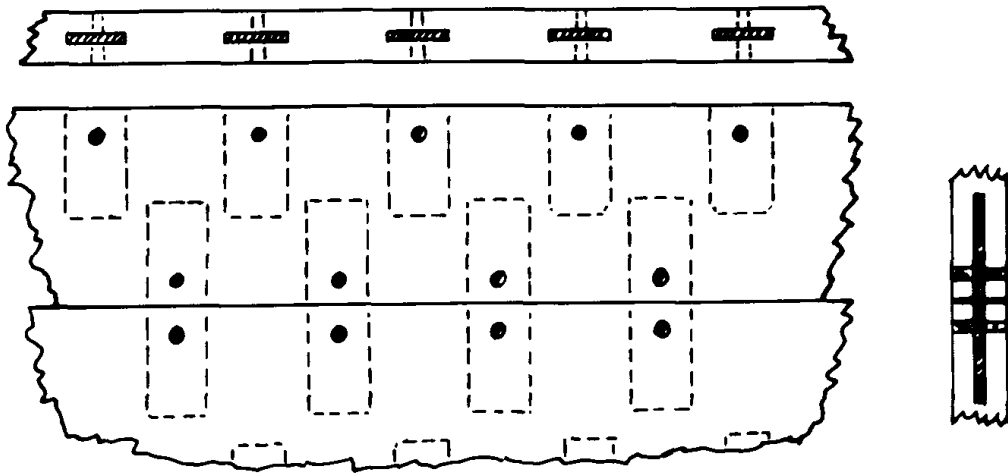


Fig. 3

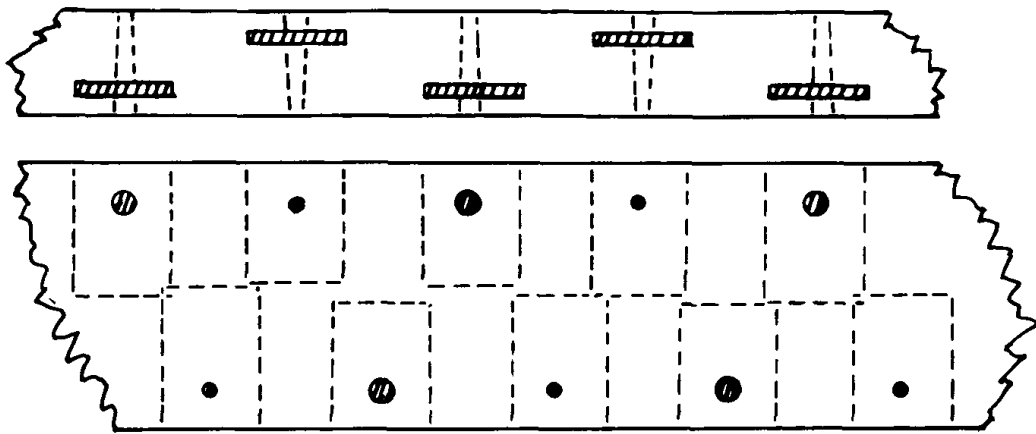


Fig. 4

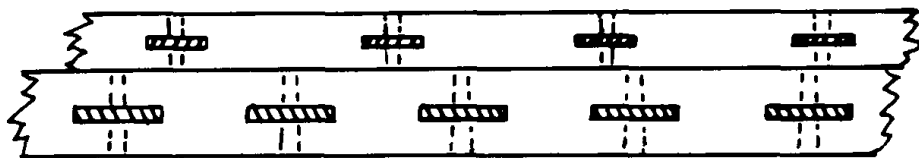


Fig. 5

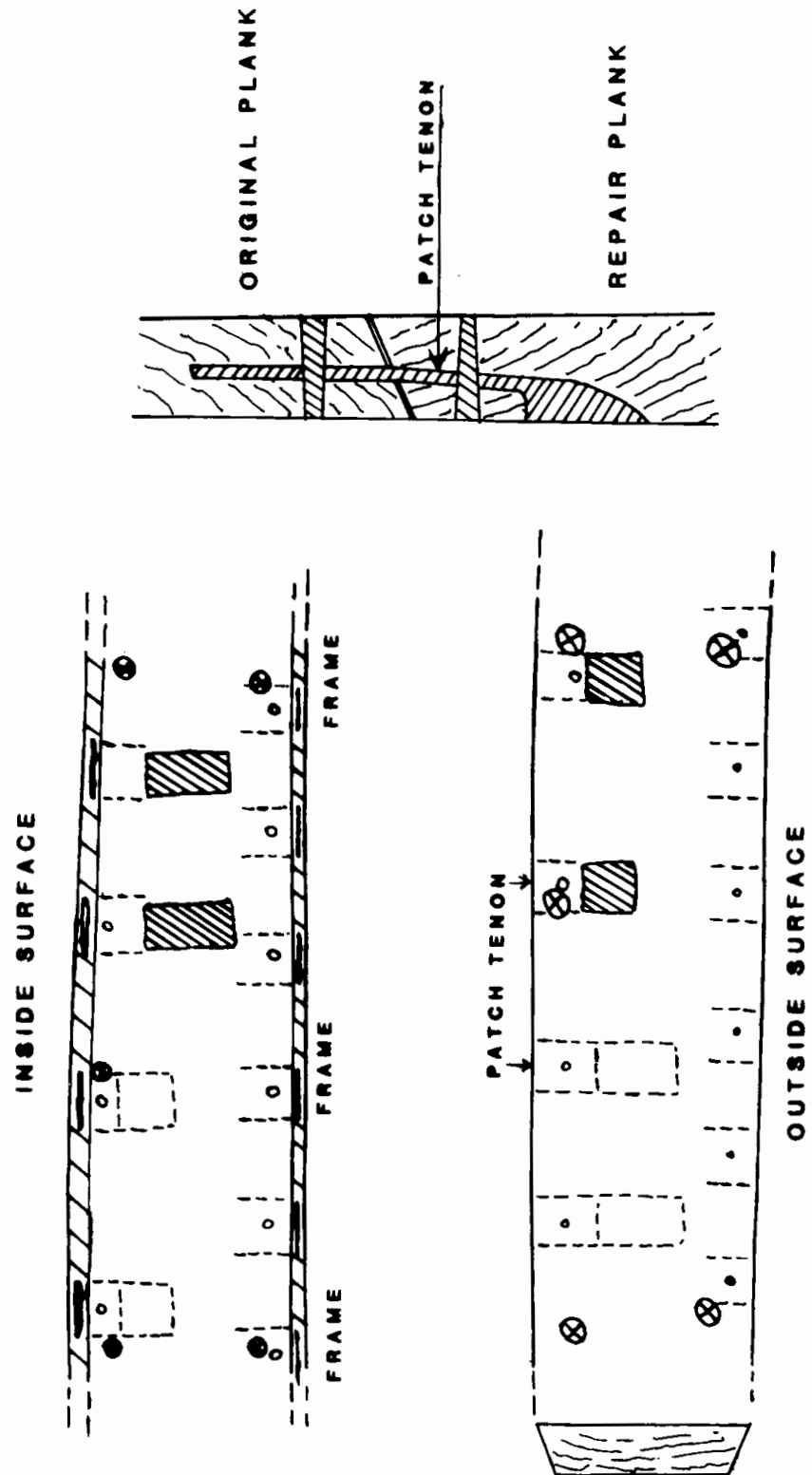


Fig. 6

WARSHIPS OF THE ANCIENT MEDITERRANEAN

Many types of warship in the ancient Mediterranean had names which incorporated a number. The English words bireme, trireme and quadrireme imply the numbers two, three and four. So do the Greek and Latin words from which the English is derived. It has always been thought that the numbers referred to *half* the number of oarsmen in each cross-section of that particular type of ship: a bireme has been thought of as having had four oarsmen in each cross-section, a trireme six, and so on. The nub of this paper is that the number in the name originally referred to the whole number of oarsmen in a cross-section, and in particular that the original triremes had three, not six, oarsmen in each cross-section. This amounts to a radical revision of ideas on ancient Mediterranean warships.

First it is necessary to clarify English rowing nomenclature. In the *Oxford English Dictionary* and in English seamanship manuals, a boat with a single line of oarsmen, such as the eight-oared boats that compete in the modern Olympic games, is called "single banked". Double-banked boats are those with two lines of oarsmen. They have a port oarsman and a starboard oarsman on each rowing bench.

Oddly enough, most writers on the subject of ancient ships call a double-banked boat "single-banked", e.g. Tarn (1905, 145) and Anderson (1962, 13). It is the same with the word "room", introduced into the English language from Scandinavia to describe a single unit in the oared craft. In his book *The Ship*, Landström (1961, 64) rightly explained that in Scandinavia "... the size of a ship was measured by the number of *rooms* as they called them Each of these *rooms* on a fighting ship meant a pair of oars, and for each pair of oars there was a thwart". In *Greek Oared Ships*, Professor Morrison (1968, 339) described a trireme as "... a ship in which there were three oarsmen to each unitary division

or “room”, called in Latin *interscalmium* ...”. These words are in accordance with the hypothesis put forward in this paper: on the other hand, the diagrams in the book make it clear that *six* men in each room was what the author had in mind. This linguistic confusion has, I believe, been the main reason for keeping the triereme problem so long unsolved.

Iconography

As well as disagreement over nomenclature, there is disagreement as to the accuracy with which ancient artists depicted ships. Many writers have suggested that when it came to nautical subjects, the iconography is not to be relied upon. For example, M. Basch (1976, 231) wrote “Most of the galleys painted on Attic black figured vases of the sixth century are but copies made from a few originals and certainly not the product of direct observation of the real thing”.

I am more inclined to a later view expressed by M. Basch (1988, 177): “Whereas geometric art abounds in iconographic conventions, especially in matters of perspective, ever since the seventh century Greek art required, especially in the case of ships, an almost photographic realism”.

But in this paper it is intended to avoid all disagreement as to the quality of the ancient evidence, by eschewing any claim to prove anything. It is only suggested that the theory put forward is in accordance with the evidence, not that it is true.

The siren vase

Consider the Siren Vase (Fig. 1) made here in Athens about 480 BC but now in the British Museum. Four port-side oarsmen can be seen, each pulling an oar. Few people would doubt that the artist had in mind four starboard-side oarsmen, hidden by the men we can see. But there are six oars (not counting the steering oars) where you would expect to see only four. An extra oar appears to go under the arms of the aftermost oarsman, the one who is looking over his shoulder. It runs across his midriff, presumably into the hands of a man we cannot see. The next man is not encumbered by an extra oar. The next again, the man whose head obscures his captain’s knee, is like the first oarsman we considered - he is pulling one oar and there is another which he is not using himself, but which seems to run across his chest. The last oarsmen, the bow oar, is not associated with any oar apart from his own, but there is an extra, empty oarport, well placed for the sort of extra oar associated with two of his shipmates.

If M. Basch is right (as I think he is) about “almost photographic accuracy” there should be an answer other than artistic error or whimsy. The boat is triple banked, like this (Fig. 2). The empty oarport allows the foremost centre-line oarsman to row on either side. There is no difficulty in rowing triple-banked, Siren Vase fashion. I tried it in this boat (Fig. 3) originally a double-banked naval cutter, modified by cutting extra oarports (or more precisely “rowlocks”) to allow a third line of oarsmen between the other two.

It is hard to say how widely the idea that the Siren Vase shows a vessel with three oarsmen on each bench has been accepted. It has not to my knowledge been criticised in print, though since it was first published in 1970 it has always been ignored in discussions on ancient ships. It did meet with approval in a book on experimental archaeology (Coles, 1973, 103-106). In order to borrow the boat for the experiment it was necessary to convince many naval people, from Admiral to Ordinary Seaman, and no one doubted the idea once he had seen a photograph of the Siren Vase and compared it with the view from above “decoding” it (Fig. 2). At first, Professor Morrison thought the suggestion was interesting and original and quite likely to be right, but I believe he has since changed his views about it.

It is a question which I very much hope will be considered by the participants in this symposium. Is it a triple-banked vessel? Or did the artist paint oars at random, producing just by chance a hitherto unknown but entirely practical rowing system - one which might actually have been useful to seamen, had it not been for the tiresome invention of the internal combustion engine.

Apart from the arrangement of oars, almost every detail of the Siren Vase ship has been accepted as accurate and informative. In *The Athenian Trireme* (Morrison and Coates, 1986, 174) the oars themselves are regarded as exceptionally carefully drawn. The report of the 1987 *Olympias* sea trials (Morrison and Coates (Ed), 1989, 15) cites the Siren Vase ship for its metal-sheathed ram, for the fitting at the mast-head, which appears to have been drawn by an artist who understood nautical technicalities, and for oars not carved from a single piece of timber, but with fitted blades. Thus it is difficult (though no doubt not impossible) to assess the Siren Vase painter’s arrangement of oars as mere whimsy, or to regard its resemblance to a triple-banked boat as mere chance. The system he shows is, I suggest, that used by the first Athenian triremes. I do not, of course, suggest that triremes were only four benches long. I believe they were generally 30 benches long. As this is so close to the general view, I will not go into it further in this paper.

The Victory of Samothrace

The method of rowing shown on the Siren Vase is exactly suited to the ship on which the Victory of Samothrace stands. On either side the ship has a pair of oarports close together, the after one a little higher than the other (Fig. 4). The width between the thole pins (oar pivots) is 2.4m. These arrangements and dimensions are exactly suited to three men abreast, each with his own oar, as on the Siren Vase. This stone ship has always been considered life-size, or nearly so, and it has been a puzzle that the width is too little for the four men abreast suggested by the four oarports. The Siren Vase, you remember, gives the three foremost oarsmen four oarports, the man in the middle having the choice of rowing either to port or to starboard. I think it would be well worth making a partial replica of the Victory of Samothrace ship, to test these rowing arrangements.

Other ways of rowing triple banked

The method shown on the Siren Vase and the Samothrace sculpture is not, of course, the only way of rowing triple banked. A Japanese print shows whaling boats with three rows of oarsmen who stood and pushed, one-man oars and two-man oars alternating. Another triple-banked system was published by M. Basch (1975, Fig. 16) though not in connexion with triremes. A nineteenth-century engraving shows a Sicilian fishing boat in which a man amidships adds his efforts via the oars of the rowers on either side of him, one hand on each oar. The method originally used in triremes was, I believe, rather like that.

Two-level ships

One of the great difficulties with the three-level trireme theory is that during the era in which the ancient historians tell us that the trireme was being introduced, the ancient artists depicted two-level ships (and, of course, one-level ships) but not three-level ships. As Davison (1947, 23) put it: 'There are no signs of anything which anyone has tried to identify as a trireme on any vase, plaque or relief of the sixth century or earlier'. If one compares the iconography with the written history, without the preconceived idea that the trireme had oars at three levels, one is led to the conclusion that the trireme had oars at two levels. This (Fig. 5) shows a Phoenician vessel of about 700 BC, which is some time after Thucydides (I 13-14) tells us that triremes were in service. Lethbridge (1952, 114) called this Phoenician vessel 'a great war canoe' and considered that it was propelled by two single lines of men, one above the other, each man using an oar in either hand

(Fig. 6). Most other writers have envisaged four men in cross-section, each man using a single oar (Fig. 7). I suggest an arrangement somewhere between the two (Fig. 8) - on the lower level a single line of men with an oar in either hand, and on the upper level, two lines of men with one oar each. Instead of sitting and pulling, the men on the lower level may well have stood and pushed, like the Maltese dghaisa-man.

Dr. Fanouria Dakoronia's paper at this symposium yesterday was centred on sherds which seem to show standing oarsmen facing the bows in ships which she suggested most convincingly were probably built especially for war.

The three-man cross-section (Fig. 8) fits the shape of the hull better than cross-sections with the same number of men at each level, because (it is generally agreed) the hull widens out above the incised line that the artist has drawn just below the oars. As M. Basch (1969, 149) wrote: "Such a widening would have been intended to let two rowers occupy about the same space as one without increasing the beam at the water-line."

This arrangement (Fig. 8) would have had advantages for a warship that needed to manoeuvre violently in battles in which the ram was a major weapon. When an oared craft moving ahead at speed has to make the sharpest possible turn, the rudder or steering oars play little part. The propulsive oars on the inside of the turn are held in the water to act as brakes. It is no easy matter. Inexperienced oarsmen ordered to 'hold water' (as the use of oars as brakes is called) may be swept off their benches, unable to hold on against the adverse leverage. With strong, determined but inexperienced oarsmen, oars are often broken. In craft with oars arranged as I suggest (Fig. 8) the men with two oars could have let go of one in order to use both hands and their full strength on the other. With two-thirds of her oarsmen holding water on the inside of a turn, a ship like this would have turned more sharply than a comparable ship having only one oar for each man.

A Corinthian ship of the 6th century BC is shown here (Fig. 9). The oars appear to be out of time with each other. I suggest that the ship's oars were arranged as in Fig. 8. What is this ship's crew trying to do? I have never read a rational explanation.

The *keleustes* (the man standing up) is making a different gesture with each arm. He is the man in charge of the oarsmen, and would not, while on duty, wave his arms about at random. He is signalling orders to the crew, the two dissimilar gestures implying two different orders. He would not want the upper level to row

forwards and the lower level backwards, as that would make no sense. The need for two different orders arises when the oarsmen on one side are to do something different from the oarsmen on the other side. Though he is not the helmsman, the gestures of this *keleustes* are those of a helmsman in a ship steered like the *Olympias* when he wants to turn to port (to the left). His right arm pushes the starboard tiller forward, while his left arm pulls the port tiller back. Used by the *keleustes*, these gestures order the starboard oarsmen to row on ahead, and order the port oarsmen to hold water. We can see that the upper starboard-side oarsmen row strongly ahead. Unseen on the other side of the ship, the upper port-side oarsmen are, I suggest, holding water. The unseen lower oarsmen (a single line) are also holding water to port, using both hands and all their strength on their port oars. The starboard oars which they have let go are those we can see, trailing in the water. The assumption that the ship is triple banked as in Fig. 8 is, I believe, the only one that will provide a rational explanation for the behaviour of the ship in Fig. 9. Here is the explanation for the presence of two-level ships and the absence of three-level ships in the iconography of the trireme era: the two-level ships are triple-banked triremes.

Four-banked systems

Each of the two triple-banked rowing systems just described (Fig. 2 and Fig. 8) would very easily have developed into four banks. The man who invented either triple-banked system might (given a suitable hull) have produced the corresponding four-fold system the same afternoon. We know from Plutarch (*Life of Cimon*, XII 2) that the ships which fought at Salamis were afterwards widened by Cimon. To widen a triple-banked vessel with oars arranged as in Fig. 2 would make room for a fourth row of oarsmen. After Cimon's alterations, I suggest that triremes were often, but not always, rowed with four banks of oars; and that the earlier sort of trireme (Fig. 8) was also given a fourth bank of oars and was usually rowed as in Fig. 7.

Thus for the trireme problem, I put forward the following solution:

- a. Triremes were originally triple banked, some using the system in Fig. 8 and others the system in Fig. 2.
- b. Later triremes were four banked.
- c. The full crew of a later trireme consisted of:
30 officers, petty officers and marines

120 oarsmen

A support group, the *hyperesia*, consisting of 50 men under the command of the *pentekontarchos*.

- d. The three classes of oarsmen sat forward, amidships and aft.

Comparison

Now I will compare the evidence concerning *triremes* with

- a. my solution to the *trireme* problem.
b. the six-banked *trireme*.

No one piece of evidence proves anything: it is always possible to beat down evidence by postulating error or omission on the part of the ancient artist or author. Each piece of evidence, however, suggest that my solution is right. The evidence is underlined.

There are no representations dating from the trireme era of oars at three levels.

The *Olympias* militates against Professor Morrison's suggestion (1968, 169) that triremes were so difficult to draw that '..... artists in general had been avoiding the task'. Drawing the *Olympias* presents no special difficulty to modern artists. The posters we were kindly given yesterday on board the ship show oars at three levels with complete clarity.

If there is any doubt about it, trials could be undertaken to establish how many artists, if offered their usual fee, would avoid the task on the grounds that the ship was too complicated a subject to depict.

There are representations dating from the trireme era of triple-banked ships.

The representations of triple-banked ships correspond perfectly as to time and place with what the ancient historians say about triremes.

The ancient historians make no mention of a type of warship intermediate between the pentekontor with two oarsmen one each of 25 benches, and the trireme.

My solution requires no intermediate type, unlike the six-banked solutions.

The word "dieres" is absent from ancient literature until the Roman period.

If the word *dieres* described four-banked, two-level ships, as the six-banked

trireme theory requires, then its absence is extraordinary, as all modern writers on the subject (e.g. Morrison and Coates, 1986, 32) find two-level ships remarkable. If, on the other hand, *dieres* means (as my theory requires) the commonplace arrangement of a port oarsman and a starboard oarsman on each bench, then its absence is not remarkable. This simple arrangement can be assumed unless the ship-type name implies something more complicated.

A type of merchant vessel called a "phaselos" could be converted in an emergency into a "phaselos trieretikos".

The word *trieretikos*, like the Greek and Latin words for trireme, implies a three-fold arrangement. No one supposes that a *phaselos trieretikos* had six banks of oars (Casson 1971, 168). The likely explanation is that an ordinary merchant *phaselos* was double banked and became *trieretikos* when a third bank of oarsmen was added down the middle, as I modified the naval cutter in Fig. 3.

The "tetreres" (quadrireme in English), named after the number four, was the first type of warship to have had oars worked by more than one man.

The innovation is likely to have been introduced in its simplest possible form: I know only too well how hard it is for a radically different idea on how to row ancient warships to gain acceptance. As Professor Morrison (1968, 291) said: 'The *tetreres* could then have had four men to each "room" rowing two men to each of two oars'. A *tetreres* like that supports my theory. Professor Morrison no doubt meant to write eight men and four oars to each room, as the six-banked trireme theory requires. But that is too complicated to be likely.

In Italian, a double-banked boat is said to have "doppio ordine di remi", the word "doppio" implying the number two, and the word ordine implying lines.

This suggests that the Latin word *ordo* used in connexion with oarsmen, meant one line (as required by my theory) not two lines as the six-banked trireme theory requires.

In modern Greek, a double-banked boat is called "diplokopos", diplo implying the number two.

This suggests that the ancient Greek word *dikrotos* meant double-banked, as my theory requires, not four-banked, as the six-banked trireme theory requires.

One of the trireme's officers was the "pentekontarchos", whose title implies that he was the leader of 50 men.

Six-banked trireme theories have no group of 50 men, and admit (Morrison 1968, 268) that the title *pentekontarchos* is '..... completely obscure for a single officer on a *trieres*'. My solution to the trireme problem gives the *pentekontarchos* the 50 men that his title implies.

Some part of a trireme's crew was collectively known as "hyperesia".

The title *hyperesia* implies a group of people of low status (Jordan 1975, 249). In the six-banked trireme theory, the title has to be allocated to the ship's officers and marines, for which it is unsuitable. In my theory, the *hyperesia* consist of low-status support personnel.

The capital ship that preceded the "trireme" was the "pentekontor".

Nobody doubts that the *pentekontor* originally had two oarsmen on each of 25 thwarts. In order to provide a link between this sort of ship and the supposed six-banked, 170-oared trireme, current theories assume another sort of *pentekontor* with four oarsmen to each room. No such development is mentioned by any ancient author. Quite apart from that difficulty, a 50-oared ship of 13 rooms is clearly inadequate as a link with the supposed 170-oared trireme with over 30 rooms. This is not a new opinion or mine alone. Anderson (1962, 5) made the point in his book *Oared Fighting Ships*. The difficulty was ignored in 1968 in *Greek Oared Ships*. I included it in an article in 1976, and it was ignored in Professor Morrison's reply in 1978. It was, I think, ignored in the discussions which preceded the building of the *Olympias*.

By contrast, there are no improbabilities in the evolutionary sequence that I suggest.

Conclusion

It may seem shocking to conclude that centuries of scholarship have given an entirely wrong answer to the trireme problem, while two minutes spent looking up the meaning of 'double banked' in the *Oxford English Dictionary* (or the equivalent phrase in a German, French, Spanish, Italian or modern Greek dictionary) indicates the right answer.

But there will be advantages. One need no longer believe that the triremes which Athenian shipwrights could build in such numbers and Athenian seamen row with such immortal success, were too difficult for ancient artists to portray.

Nor need we continue to believe that the two-level ships which artists of the trireme era painted so often and so lovingly were totally ignored by the authors of their time.

The maritime history of the era will seem no more paradoxical than history in general.

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- Fig. 1 The Siren vase c.480 BC.
- Fig. 2 The Siren vase "decoded".
- Fig. 3 Triple-banked Cutter.
- Fig. 4 Oarports of the Victory of Samothrace.
- Fig. 5 Phoenician war vessel of c.700 BC.
- Fig. 9 Corinthian war vessel of c.575 BC.

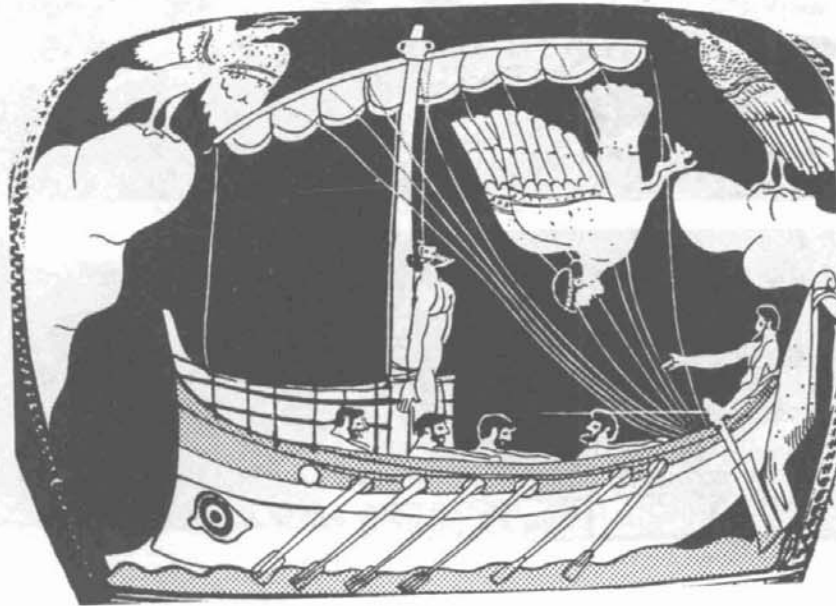


Fig. 1

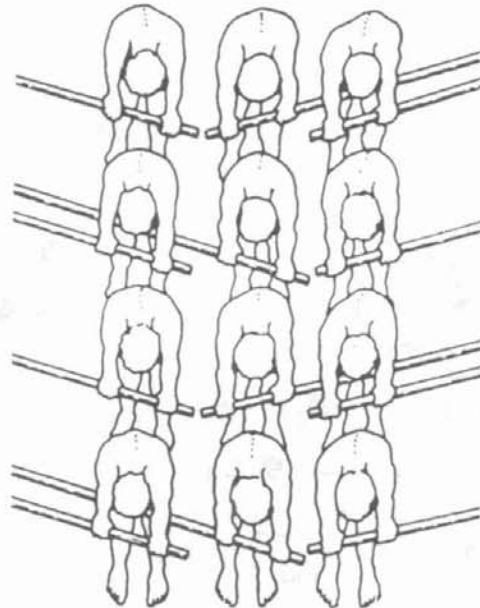


Fig. 2

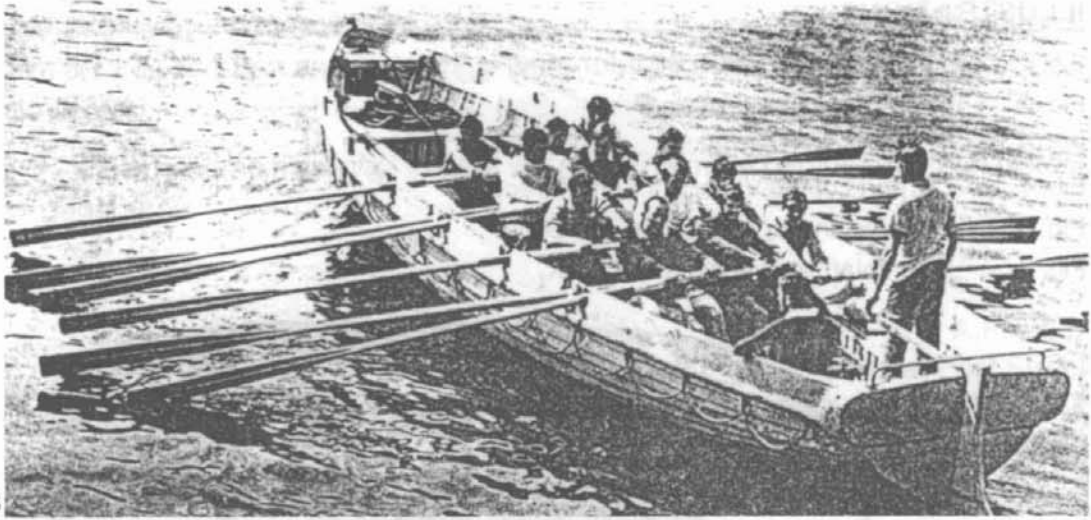
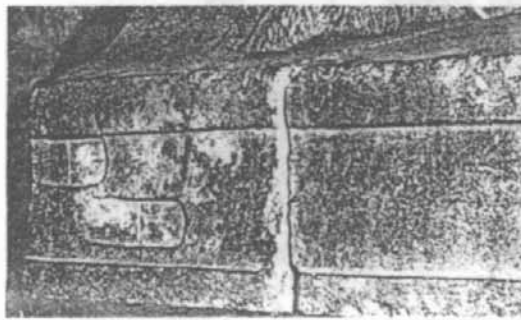


Fig. 3



g. 4

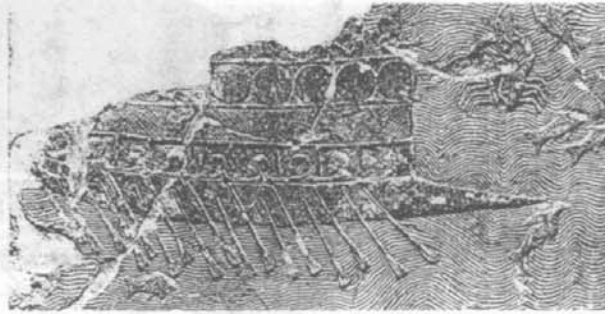


Fig. 5

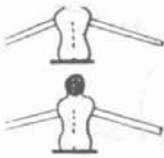


Fig. 6

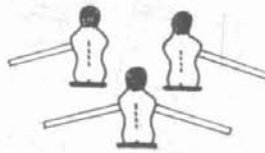


Fig. 7

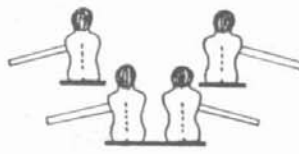


Fig. 8



Fig. 2

ON THE OBSIDIAN TRAIL

With a papyrus craft in the Cyclades

This paper deals with an attempt at experimental archaeology concerning the construction and the voyages of a seacraft made of papyrus.

What led me to undertake this programme, were the archaeological excavations that started in 1967 at the Franchthi Cave in the bay of Koilada, Argolis.

The excavations under the direction of Professor Thomas Jacobsen continued through 1979 and brought to light important information on the life of the inhabitants of this region during the Paleolithic, Mesolithic and Neolithic periods.¹

What, however, is of particular interest to scholars researching early maritime history is that in this cave, obsidian dated to circa 9000 BC was found.

The provenance of this obsidian is the island of Melos. Consequently, it can be assumed that some 11000 years ago people who lived in the South-Eastern Peloponnese travelled to the Cyclades or were in direct or indirect contact with "mariners" who had the ability to undertake such voyages in the open sea.

We are thus faced with the earliest tangible evidence in the world of an open-sea voyage.

In the mid 70's when I first became aware of this discovery, the question asked was: with what means of transport did the voyage from Melos to the mainland take place.

Having studied the little we know of the conditions prevailing in Mesolithic times, such as: the geographic area, the way of life of those primitive people, the tools they used, the possibilities that these tools afforded, and the climatological conditions, I was led to formulate the hypothesis that a craft made of papyrus was the likeliest to have been built and navigated in 11000 years BP.

A determining factor in my choice was certainly the fact that a small papyrus-made seacraft, locally known as a *papyrella* still "survived" on the island of Corfu.

This small craft was studied by the Corfiot Archaeologist and Ethnologist, Prof. Augustus Sordinas² and is reported by Paul Johnstone,³ Thor Heyerdahl⁴ and more recently by Captain A.I. Tzamtzis.⁵

I believe that the question of what type of craft were used to transport the obsidian found in the cave of Franchti will never be answered. We can however formulate an educated guess supported by a programme of experimental archaeology.

I started my quest in 1984, and in 1987 my work was placed under the auspices of the Hellenic Institute for the Preservation of Nautical Tradition.

The search led me to communicate with and meet the excavator of the Franchthi Cave, Prof. Thomas Jacobsen, who gave me invaluable information on the finds and encouraged me in proceeding with the programme. I also had the opportunity to gain information on stone tools from a specialist, Prof. Curtis Runnels and at a later stage I was fortunate in meeting Prof. Catherine Perlès the specialist on flint tools and obsidian, who has studied, dated and published the Franchthi Cave microlithic industry.

From the information obtained it became clear that the limitations imposed by stone tools did not allow people of the Late Paleolithic and Mesolithic to build complicated seacraft made with planks and frames. I believe that this type of advanced marine construction made its appearance in the Aegean at least 6000 - 7000 years later with the introduction of bronze tools.

Excluding the planked boats, however, did leave other possibilities: the dugout, the craft made of sewn hides, and rafts made of inflated hides or tree logs. The above constructions and their numerous derivations could have been built with the available tools and the technology of that time.

I eliminated the dugout as its seagoing capabilities would have made it, in my opinion, unsuitable to face the often rough sea conditions of the Aegean. For

the same reason I did not attempt to duplicate the small craft made of sewn hides of Messopotamia and Northern Europe, while Tim Severin's replica inspired by the Medieval voyage of St. Brendan⁶ is too elaborate a craft for any stone age constructor.

That left the craft made of papyrus. It combines most of the positive features:

- a) Papyrus can easily be cut with a stone tool.
- b) It can easily be lashed together in bundles with vegetable fibers or leather strips.
- c) It has great buoyancy.
- d) There is wide proved evidence that such craft were built in Egypt and in other parts of the Mediterranean.
- e) Two large papyrus craft, the RA I and RA II, sailed across the Atlantic.
- f) Papyrus existed in Greece in Antiquity⁷ and a specimen of papyrus still grows in North-Eastern Corfu in a lake called Kavourolimni in the Ghialinas property.⁸

I also investigated the construction of papyrus and reed craft that have survived until today in the Middle East, Southern Italy and South America, but as the intended construction had to be as "locally authentic" as possible, no foreign elements were "incorporated" and I confined myself strictly to the Corfiot *papyrella*.

While it was believed that the Corfiot *papyrella* was extinct and that the only known examples were the crafts made in the 1970's for the Museum of Exeter,⁹ the Maritime Museum of Greece in Piraeus,¹⁰ the Folklore Museum of Central Corfu¹¹, our persistent search in Corfu revealed the existence of the last *papyrella* still in use. We found it in Palaiokastritsa - a bay in North-Western Corfu - and it was used for lobster fishing. It had the advantage of unquestionable authenticity as it was built for everyday use and not as a museum exhibit¹².

The frame of the Palaiokastritsa *papyrella* was made in 1965, and the bundles of papyrus were replaced every 2 - 3 years.

Let me describe the very simple method of construction of the Corfiot *papyrella*:

The craft is composed of a frame made of six young cypresses cut and bent when still green. They are lashed together with a rope at their thinnest ends and are bent in a manner as to form a raised stern. The main part of the boat is composed of bundles of "papyrus" (the Corfiots call this diminutive papyrus *papyri*) cut from the nearby lake of Kavourolimni.

The length of each bundle is defined by the length of the papyrus, which reaches approximately 2.50 metres. Thus the length of the *papyrella* is, in a way, limited by the length of the bundles. The framework made of cypresses keeps its curved shape at one end when dried, and the papyrus bundles, closely bound together between wooden planks, form the body of the craft. These roughly cut planks tightly hold the papyrus bundles lashed between the lower planks (bottom) and the upper planks (deck) in a sandwich manner. No nails, pegs or any fastenings are needed; only many metres of rope, firmly tied with numerous knots.

The local tradition, as recorded by Prof. Sordinas, refers to "double - ended *papyrellas*" made of two crafts joined stern to stern by means of *pountellia*. Neither Prof. Sordinas nor the local people had the slightest idea of how the joining was done, nor could they explain what the *pountellia* are¹³.

I discussed my intention to build a double-ended *papyrella* that could undertake an open sea voyage in the Aegean with Prof. Sordinas, Captain A.I. Tzamtzis, Spyros Tsamis (Mihalas) son of the last *papyrella* builder from the village of Liapades (then aged 87) and Spyros Mihalas of Palaiokastritsa, owner of the last "papyrella" in use. All of them encouraged my attempt and promised to help with their knowledge.

A seaman from Liapades, Spyros Agathos-Gianitsellis agreed to undertake the construction of the proposed craft.

After explaining to Spyros the scope of the programme and after gathering locally the necessary first-hand information concerning the method of construction, he was left on his own to build a reduced model on a 1:2 scale of a double ended *papyrella*.

It took Spyros two weeks to build a 2.70 metre double-ended craft using the same technology as the traditional cut-stern craft.

During the Summer of 1987, I made brief sea-trials and paddled the scale model in a bay near the village of Liapades. Its stability, buoyancy and speed were satisfactory and the builder was asked to go ahead with the construction of the larger craft.

The construction started in Liapades in early November 1987 and took most of the 1987-88 winter.

Originally we thought that 30 days would suffice, but eventually three full months were needed. Only two or three days are required for the construction of

the traditional *papyrella*, but the time taken to build our double-ended craft was due to the following reasons:

- 1) The builder had never built a papyrus craft before.
- 2) He was *working alone*.
- 3) He had constantly to ask for advice from the old man in the village who was specialized in the construction, but was blind and had difficulty in moving.
- 4) The double-ended *papyrella* is twice the length of the traditional craft but its bulk is at least 6 times greater.
- 5) The traditional Corfiot *papyrella* is very light and can be easily lifted single-handed. Our craft weights over 100 Kg and is certainly a more complex construction, although it follows the same traditional design.

With the experience gained in building our papyrus craft, I believe that 12 days would suffice if we were to build a similar one today.

The method of construction of both craft is identical except for the following differences:

The single-ended *papyrella* is a craft with a cut stern of 2.50 metres in length, a beam of 1.10 metre at the stern and a total maximum thickness at the stern of 44 cm. Bundles forming the bulwarks have a height of 13 cms. Our double-ended craft has a total length of 5.48 cm, the beam amidship is 1.50 metre. The thickness of the body averages 50 cm and the height of the bulwark-bundles is of 13 cm. To build it, 12 young cypresses were cut. Such cypresses grow among the large trees, in their shade, and in trying to reach the daylight their trunk remains very thin and slim. Each two cypresses were strongly lashed together at their thicker ends, to form a total length for the pair of approximately 6 metres.

The 6 pairs of cypresses were laid side by side and spaced approximately 25cm apart. A roughly cut plank of 110 cm long, 25 cm wide and 3.5 cm thick was placed under the cypresses at the point where they are lashed together in pairs. Holes were opened in such a way that a rope through them keeps the cradle thus formed in position. Both extremities were then lashed together and pulled in the direction of the center of the craft by a tension rope; thus forming a raised stern and stem. Day after day the pressure on the tension rope that held the two ends was increased, adding to the curvature. After two weeks, when the cypresses dried, the curved ends kept their raised shape.

The construction continued and 10 more planks were placed under the cypress frame-work, between the central plank and the ends of the craft (5+5). Each plank was pierced and lashed tightly with sisal rope to the stalks in the same manner as the central plank.

Now the “cradle” that formed the underbody of this flat bottomed craft was laid and bundles of papyrus were placed on it to build the body.

Eleven wooden planks similar in size to the ones forming the bottom were placed above the papyrus bundles. Holes were made in these planks too and a “sandwich” was formed with the *papyri* caught tightly between the wooden planks, squeezed by strong rope-lashing.

As for the Corfiot *papyrella*, the craft was completed by forming a “bulwark” around the edges, using bundles of papyrus to keep out the water in a choppy sea.

With the exception of the wooden planks, the whole of the craft was made of unprocessed materials:

- a) cypress stalks, that could easily have been cut and cleared of their branches by using small stone adzes,
- b) papyrus, that is easily cut with a flint tool or obsidian blade,
- c) the sisal rope we used, although a vegetable fibre, is certainly a processed industrial product, but the lashing could without much difficulty have been achieved by stone age builders with vegetable fibre or by using strips of leather. Actually, if we were to repeat the trial, I would use leather-lashing, which is more resistant to damp than the vegetable rope.

The planks we used were made of pine, adzed to obtain a smoother surface. A bow drill was used to make a few holes, and then for practical reasons we used an electric drill. Having discussed the matter with specialists in stone-age tools, I am led to believe that such simple planks could be made using small stone adzes and flint scrapers, while making the holes with a bow drill is a much simpler matter.

One may be surprised by the strong resemblance of the completed craft to those depicted in Ancient Egypt. Our builder, however, was not influenced by such representations, of which he had no knowledge. But it would have been very difficult, if not impossible, to obtain a different form. The shape of the papyrus, which starts thick at the root and becomes extremely thin at the top-end, is what predetermines the shape of the boat. I believe that it is this primitive shape of the papyrus boats that influenced the profile of most of the later vessels in the Eastern Mediterranean. Some ships depicted on Minoan¹⁴ seals are typical examples. I

also believe that the *aflasta* and *akrostolia* of historical times are relics of the “uncut” papyrus ends seen on the extremities of earlier craft. These “papyriform” decorations were probably passed from generation to generation, influencing even the *ἀφλαστον* of the *trieres*.

After the construction was completed, the craft was transported from Corfu to Lavrion in Attica, where it was decided that the trial voyages would take place.

At that stage I had to decide on the mode of propulsion of the craft and in my opinion it had to be moved solely with paddles.

A mast in the shape of a “Λ” for setting a square sail, could easily be stepped but this means of propulsion was not considered. The first known representation of a ship¹⁵ with sail dates from circa 3200 BC and in my opinion it would have been arbitrary and unscientific to anticipate 5000/6000 years and place a sail on our craft. Placing a sail would require some sort of keel and a steering mechanism. And if we had used such “advanced” techniques for such a primitive craft, the experiment would have been artificial and have lost its scientific value.

Having studied the known representations of early boats and the methods of propulsion of primitive crafts used by people who lived or still live in similar conditions to those in the stone age, I decided to use solely paddles to move the *papyrella*. Paddles, however, also presented problems when we came to decide on their shape.

Then the problem arose of recruiting a proper crew to paddle such a heavy craft.

We started the first short sea-trials using a crew of five members of our Institute that had neither experience in paddling nor in seamanship.

It became apparent that our craft had great stability, excellent buoyancy and could easily take 5-6 paddlers, as well as a reasonable amount of fresh water - in goat-skin bags - provisions and a limited load, duplicating a possible ancient cargo of some 30 Kg in three straw baskets.

I was aware that the Corfiot *papyrellas*, at least in the recent past, were used not by “professional” seamen or fishermen, but by farmers. Influenced by this, I assumed that in the remote 9000 BC, hunters and fruit-gatherers occasionally became mariners. So I kept experimenting using different crew.

The first crew of non-seamen, who had no knowledge of rowing or paddling, although composed of strong young men, became exhausted after a distance of only one nautical mile.

We then experimented with well-trained, physically fit seamen, who knew how to row a boat using oars secured to tholepins. The performance improved, but it became obvious that to propel a craft with paddles requires a special training.

It was calculated that a one knot minimum speed had to be achieved. If this minimum speed could not be reached then the voyage to Melos would not be possible, because of the considerable distance separating the islands leading to Melos. That one knot speed limit was reached by the first paddlers we tried, but only for half an hour. Such a pace could not be maintained during extended crossings.

It is not at all surprising that our craft was so slow, as the method of construction duplicating the Corfiot *papyrella*, with the transversal boards under her flat bottom, goes against the laws of hydrodynamics. So the first trials were far from encouraging.

But still, I reasoned: "Obsidian was transported from Melos to the mainland during the Mesolithic period and our craft seems to have the capability of making such a voyage, therefore what we now need is an adequate crew, able to paddle over long distances: well-trained men who will be able to "conquer" the long crossings between the islands." So my main concern became to recruit proper "kayak" athletes to volunteer as crew for our project.

During other nautical attempts of Experimental Archaeology, (and I shall refer only to the most well-known: the KON-TIKI, the RA I and RA II, the medieval Scandinavian vessels, the voyage of the Brendan, the Kyrenia II), the method of propulsion was the wind. The most important piece of equipment on the ship was the sail. In the case of the *papyrella*, it was a totally different matter; the propelling force was man himself and the most important piece of equipment was the paddle.

It is worth stressing that from the moment the sail made its appearance in the Aegean, probably in the 2nd millennium BC and until the first half of the 20th c., people living in this area have not stopped using it. The skill for working a sail has been transmitted by the islanders from father to son without interruption.

For the paddle-propelled craft of the "kayak" or "canoe" type, the situation is totally different. With the appearance of the sail and with the acquisition of advanced shipbuilding techniques during the bronze age, this primitive way of propulsion, with paddles, came abruptly to an end and was lost for the Aegean¹⁶.

Thus, it is not surprising that the words "paddle" and "paddling" have not survived, even in the oldest texts of the Greek language¹⁷.

Wherever the sailing ship needed an alternative moving-force, say for manoeuvring, oars attached to tholepins were used. Such oars survived on small Greek sea craft until today.

On the Thera frescoes rowing and paddling co-exists together with ships carrying a sail. It is, however, believed that the depiction of the Thera paddlers - in their impossible position - is ceremonial and refers to a means of propulsion long out of use.

As the use of paddles in the Aegean has been interrupted for thousands of years, this hiatus means that we cannot expect to gain any help from local tradition. This may also lead to the conclusion that in the Early Bronze Age there was a boom in Aegean shipbuilding and seafaring, while in other parts of the world, where paddling has survived, the craft used have remained primitive and no evolution was achieved. Thus it can safely be said that wherever paddling has survived there has been no evolution in shipbuilding.

But one may ask: how is the Corfiot *papyrella* propelled? A long pole with a blade at each end called a *σταλίκη* is used by its single occupant, who stands in the style of the fishermen of the Messolonghi lagoon. The pole has a total length of 2.30 metres including the two blades which have a length of 50 cm each. But as previously stated, the minuscule Corfiot *papyrella* is now only used for lobster catching in secluded bays and not in the open sea.

Putting together a crew of 5-6 paddlers proved quite difficult, as "kayak" athletes are scarce in Greece.

During the summer of 1988 twelve short sea-trials were performed. These voyages took place in the Lavrion area and the crew gained experience in moving our papyrus-craft under different weather conditions and with winds of various forces coming from different directions.

These voyages confirmed the original confidence I had in the sturdiness of the craft and her nautical capabilities.

Paddles with blades of different shapes were used and the paddlers sat and stood in various positions. We studied the scant evidence of types of prehistoric paddles that have been found in northern Europe¹⁸, but I did not insist on making replicas of such paddles as I do not consider these cumbersome specimens as representative of what may have been the prehistoric Aegean paddles.

I concentrated on studying the iconography of ancient Egyptian paddles, and especially the shape of the paddle blades used by primitive tribes over the last two centuries in Africa, Asia, South and North America.

Finally, being pressed for time, I compromised for the ready available "Menzeler" "kayak" paddles - with a single blade to each paddle - whose design derives from primitive ones. The stern paddler used a paddle with double blades - one at each end; this mode of paddling helps in steering the craft and maintaining it on course.

The trials also proved that my original hypothesis that the "sea-going-travellers" of the Mesolithic age could have been non-specialized seamen, was erroneous. Such long and strenuous crossings could not have been undertaken by hunters and fruit-gatherers, who occasionally turned mariners.

In my opinion, it was proved, beyond doubt, that travelling in the open of the Aegean with a papyrus craft is not a simple matter suitable for amateurs. Specialized seamen with strong arms capable of exhausting paddling, coupled with nautical skills were required. Another of my assumptions, that had to be modified, after the knowledge gained from the first trials, was the route to be followed. Originally, when I envisaged the voyage to Melos I thought of a Franchti - Melos itinerary and vice-versa, via a circumnavigation of the Saronic gulf. Direct crossing from the Peloponnese to the Cyclades is probably beyond the capabilities of any paddlers, ancient or modern, and involves great risks¹⁹. I was also under the wrong impression that during that remote past, a voyage by sea would have been briefer and easier than a land voyage on foot. This reasoning, however, is correct only for much later years, when ship construction had evolved, the sail appeared and sea routes were opened, and such criteria are not applicable for the period of our quest.

A voyage from Franchthi to Melos via the coasts of the Argo-Saronic Gulf and Sounion would have been very arduous. It would have required much more time than the combination of a land voyage from the Argolis to Attica and a sea-crossing from Lavrion to Melos.

A sea route is advantageous when a large cargo has to be transported and when a "proper" sea craft is available. I believe that this was not the case during the Mesolithic period.

The fact that obsidian was found in the Franchti Cave, dated from circa 9000 BC (the earliest obsidian in Greece), does not necessarily mean that such early

obsidian exists only in that location. Actually, the extremely small quantities found at Franchti corresponding to that period may well be an indication that the obsidian did not reach this settlement directly from Melos. It is most probable that the dwellers in Mesolithic Franchthi had never been to Melos and may have been ignorant of the provenance of this mineral.

In contrast to Franchti, the Lavrion district is a most suitable location that could have been used very early as a transit center for obsidian.

The Lavrion district is the nearest mainland to Melos and Makronissos - an island today - was very probably in the Mesolithic period a peninsula, attached to Attica. The whole area is scattered with splinters of obsidian and although no such material found in Lavrion has been dated to the early Mesolithic, this wide scattering of obsidian should make us wonder as to the causes of this concentration.

Many caves used by early settlers that were near the coast may today be below the present sea level, concealing obsidian tools of the 8000 - 9000 BC or earlier. It is a fact that in many locations of the Aegean the sea has risen by 50 to 100 metres during the last 10000 years²⁰. This however should not lead us to the erroneous conclusion that the geography of the Cyclades 11000 - 10000 years ago, was dramatically different from what it is today. That there was more land on the islands is a valid conclusion, but the changes affect only limited areas of the perimeter of each island and because of the great depth of the sea the difference in the sea level did not alter the land mass to such an extent as to influence the navigable distances between the islands. When I tried to investigate the possibility of drawing a chart of the Cyclades showing these islands approximately as they were 10000 - 11000 BP, I was dissuaded in my attempt by the scientists of the Institute of Geological and Metallurgical Research of Athens. It was made clear that such a task would be impossible, as each area should be independently surveyed, because the geological changes are not only the result of the rise in the sea level, but also of tectonic phenomena and volcanic action.

At the end of the summer of 1988 we were ready to start the voyage from Lavrion to Melos.

After the repeated sea-trials the *papyrella* was still in very good condition and the paddlers sufficiently trained.

A date had to be set for the commencement of the voyage. It is known that a strong North-East wind, the *Meltemi*, blows in the Aegean from Mid July to Mid September and usually drops at the end of September; during October we have

calmer seas. So it was decided to start the voyage on the 8th of October.

We figured that 7 days would be needed to reach Melos stopping at one, two or three locations at each of the islands that link Lavrion to the island of the obsidian. Unfortunately, the weather conditions were unusually adverse and the little "Indian Summer" typical for the month of October did not occur.

The route followed by the *papyrella* was the following:

- 8 October: **LAVRION - BAY OF GAIDOUROMANDRA**
1½ n. miles - 1 hour paddling.
- 9 October: **GAIDOUROMANDRA - MAKRONISSOS (CAPE ANGALISTROS)**
3 n. miles + 1 n. mile drift - 3 hours 25 min. paddling.
- 10 October: **MAKRONISSOS - KEA (KOUNDOUROS BAY or BAY KAVADIA) - (CAPE TAMELOS)**
12½ n. miles + 1 n. mile drift - 8 hours 20 min. paddling.
- 11 October: **KEA (CAPE TAMELOS) - KYTHNOS (1½ N.M. SOUTH OF MERIHAS BAY)**
11½ n. miles + 2 n. miles drift - 7 hours paddling.
- 12 October: **KYTHNOS (S. OF MERIHAS BAY) - (CAPE AGHIOS DIMITRIOS) - SERIFOS (BAY AVESSALOS) - (BAY LIVADI)**
13½ n. miles + 1 n. mile drift - 7 hours 30 min. paddling.
- Note: From the Bay of Avessalos the *papyrella* was transported to the Bay of Livadi as the weather was deteriorating and the escort vessel had to seek shelter in a protected area. Between the 13th and the 20th of October the *papyrella* remained immobilised in Serifos because of extremely bad weather. Winds of 7 and 8 Beaufort strength were blowing.
- 21 October: **SERIFOS (VOUS ISLET) - SERIFOS (KAMARES BAY)**
11 n. miles + 3 n. miles drift - 10 hours 30 min. paddling.
- 22 October: **SIFNOS (KAMARES BAY) - KIMOLOS (CAPE KENTROS) - (STRAITS PIRYI)**
14 n. miles + 1 n. mile drift - 9½ hours paddling.
- 23 October: **KIMOLOS (STRAITS PIRYI) - (STRAITS KIMOLOS) - (CAPE LAKIDHA) - MELOS (ADAMAS BAY)**
5 n. miles - 4½ hours paddling.

Note: Because of very heavy rain the craft was transported from the straits of Kimolos to Cape Lakidha.

The *Papyrella* was paddled over a total distance of 72½ nautical miles for 51 hours 45 minutes, thus averaging a speed of 1,65 knots per hour. The total drift was calculated to be some 9 n. miles.

The distance was covered in 8 days, (in fact 7 days, as the first day's paddling was only for 1½ hours) while the craft remained immobilized in Serifos for another 8 days due to bad weather. I believe that our ancestors of the stone age, would have done the same in the case of adverse weather conditions. They would have waited for calmer sea.

The double-ended papyrus craft was paddled under very different weather conditions, from flat calm to 5-6 Beaufort. In some instances, the height of the waves was 1.20 m to 1.50 m. The prevailing winds were North-North East. A pronounced sea current from the North-East direction prevailed. This often resulted in driving the craft off-course.

Most of the voyage was made under a clear sky and in warm weather (16°C-27°C). Only on the last day was the craft paddled in the rain.

The crew consisted of 5 paddlers but there were times when a 6th paddler was used (four men and two women). The *papyrella* was paddled only in daytime except when starting, as she left Lavrion at night because of the delay in the departure ceremony.

Studying all the data of this voyage (which were meticulously noted in a log by the observers of the experiment that accompanied the *papyrella* on board the escort vessel), I believe that under more favourable weather conditions, by making slight modifications and reasonable "improvements" to the craft and after a better training of the paddlers, a voyage from Lavrion to Melos could be made in 4 or 5 days.

Some modifications, "improvements", to the *papyrella* could be envisaged should another similar craft be built in the future. Those modifications are described below:

1. The overall construction should be made lighter. Our builder's overcautiousness in producing a robust craft able to face the waves of the Aegean led him to build an unnecessarily heavy frame-work with an excessive weight, sturdiness and rigidity.
2. The flat bottom of the craft must certainly be maintained, but the thickness of the transversal lower exterior planks should be limited, as this acts negatively on the hydrodynamic and reduces the "hull speed". It also creates a problem in keeping the craft "on course" and increases its drift.

3. It would be preferable to use leather strips to lash the papyrus bundles and the other parts of the *papyrella* as the vegetable rope has proved weak and loses its strength when kept wet for long periods.

It should also be noted that the effort of the paddlers during this experimental voyage was carefully monitored by a scientist of the Hellenic Sports Research Institute of Athens who accompanied the Archaeologists-Observers on the escort ship.

During all the voyage, the paddlers were equipped with electronic sensors that recorded their heart performance, and after each of the paddled stretches they were submitted to medical examinations. So their heart activity, blood pressure and general physical condition were closely monitored - from a computer installed on the escort vessel - during the effort produced and after their daily performance. The study of the data led the specialists to believe that each of the paddlers used only 50% to 60% of his/her physical capacity.

A further voyage with the *papyrella* should be made in the future to investigate the possibilities of a return voyage from Melos to Lavrion. The paddlers will have to move against the sea-currents and probably face headwinds. This will not however be an insurmountable obstacle as paddling under such conditions has already been experienced successfully during some of the trial voyages.

I do not consider this programme of Experimental Archaeology finished, but some thoughts - if not conclusions - can be advanced based on the Lavrion-Melos voyage:

Let me first emphasize once again, that it has certainly not been proved that man living in this area of the Aegean 10000 - 11000 years ago used papyrus craft to transport obsidian - raw or worked - from the island of Melos to the nearest mainland. There will never be proof of how our ancestors of that early age ventured on the open sea. What our experiment has indicated is that a voyage in the Cyclades with a simple papyrus craft is feasible.

Many may wonder: but can it be that Mesolithic man voyaged in such small craft? Why did they not build larger sea-crafts?

The answer is that firstly, the larger a craft is the more difficult it is to construct. Secondly, one should also bear in mind that the decisive factors in deciding on the size of a vessel are the necessities of transportation prevailing at that specific time. In the period that concerns us, in some 9000 BC, the articles that could be exchanged were extremely limited. What could be "traded" between communities

that did not yet have domesticated animals, had no control over the crops, had no basic agricultural economy and had not yet invented pottery? What could be available to be transported by sea by these fruit gatherers and hunters? Perhaps animal skins, salted fish and sea shells, stone tools, flint, obsidian, simple decorative artefacts made of shells and stone and eventually some passengers.

Several millennia later, larger sea-going craft certainly became necessary to transport bulky cargos: ceramic receptacles, agricultural products and domesticated animals.

The timid first steps that were taken in the Mesolithic period, or even earlier, started a process that later led to a dense sea-trade in the Aegean and all the Eastern Mediterranean.

But would it have been possible 10000 - 11000 years ago for primitive man to undertake, even occasionally, such voyages to Melos, if this island and the other islands *en route* were deserted and uninhabited? Should we not contemplate the possibility that these fishermen and early seafarers had established small settlements on the shores of these islands scattered on the "obsidian trail"? May it not be that these islands were inhabited much earlier than the 5th, 6th or even the 7th millennia BC? May it not be that the remains of early man's activities are today submerged in the sea, covered by deep strata of sediments, or waiting to be uncovered by the archaeologist's spade in other caves of similar or even greater importance than Franchthi? This is another question that may be answered by future land and/or underwater excavations.

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NOTES

- 1 A list of publications about to the excavations at Franchthi Cave is given at the end of the selected bibliography.
- 2 Sordinas (1970). Σορδίννας (1977).
- 3 Johnstone (1980).
- 4 Heyerdahl (1971).
Dr. Thor Heyerdahl in a letter of 9 May 1988 to the author states that "... the *papyrella* undoubtedly

represents a rudimentary survival of a kind of watercraft that was in common use in North African waters since the dawn of civilisation. In fact, whenever we encounter descendants of the ancient forms of reed boats today, they have two prototypes, the one, which like the *papyrella* has a transversally cut off stern, and the other with both bow and stern pointed and curved up. Both forms are represented in the ancient art of Messopotamia as well as in the rock paintings of *Tassili* where I saw them a few weeks ago. And I have seen both types in present-day Ethiopia respectively on Lake Chad and Lake Zwai. Both forms were used well into the present century in Lixus on the Atlantic coast of Morocco, and the *papyrella* form is only now disappearing from Sardinia. Even in Peru and Bolivia, both forms have survived side by side until the present-day, and the same on Easter Island. I therefore consider your experiment with a *papyrella* with both ends pointed up to be fully valid as far as shape is concerned."

- 5 Tzamtzis (1990).
- 6 Severin (1976).
- 7 At Delos' Sacred Lake two grains of *Cyperaceas* pollen were found. Evans, Renfrew (1968) also Warren (1976). Rackham (1979). Diapoulis (1980).
- 8 Contrary to what was commonly believed, the papyrus of Lake Kavourolimni - locally called *papyri* - is not *Ferula Communis* L but *Scirpus lacustris* L. ssp. *lacustris* of the *Cyperaceae* family, as is the Egyptian *Cyperus papyrus*. The crafts of Lake Titicaca are made of similar papyrus, locally called *Totora*. *Scirpus Californicus*.
- 9 This craft was built in 1976 by Nicolas Tsamis. *Exeter Maritime Museum guide*.
- 10 This *papyrella* was also built by Nicolas Tsamis in 1986.
- 11 Nicolas Paktitis founder of the Folklore Museum of Sanaradon and president of the Folk-Historical Society of Central Corfu undertook in the early 70's the task of having a genuine *papyrella* built for that Museum.
- 12 This *papyrella* built and used by Spyros Mihalas from the village of Kolombi, Lakonias, Corfu was still in use during the summer of 1987.
- 13 Some old inhabitants of the village of Liapades, N-W Corfu, told us the story of the construction of the last double-ended *papyrella* that was secretly built in 1942 during the Italian occupation of the island. The occupation forces seized and later destroyed the craft to avoid *clandestine* activities. According to the same sources, before 1940, some double-ended *papyrellas* undertook long crossings to the shores of Albania and sometimes even to Italy. The feasibility of such lengthy crossings was discussed with Prof. A. Sordinas who does not believe that such voyage to Italy could be undertaken (A. Sordinas letter of 23 February 1989 to the author). However, during the prolonged exodus of Albanian emigrants in the years 1991-94, several minuscule crafts made of scrappy materials, of much inferior construction than the double-ended *papyrella* succesfully made their way from Albania to the coasts of Italy.
- 14 See Basch (1987), pages 95 to 106; in particular figures. A7, A8, C15, F12, F14, F15.
- 15 It is not certain which is the earliest representation of a ship. There are four depictions of boats, all from Egypt, dated between 4000 and 3050 BC. The most ancient is a small ship model at the University College (University College, London no. 9024). Landstrom (1970). A graffito on a palette datable 3700 BC depicts a fishing boat. Basch (1987). These are other representations of ships on Egyptian vases of circa 3500 BC Vandier (1952). See also Casson (1971) Le Baron Bowen Fr. (1960).
- 16 Prof. L. Casson believes that paddling in the Aegean sea was no longer in use in 1500 BC Casson (1975).
- 17 S. Marinatos had to "invent" a word to render in Greek the English paddle and paddling and the French "pagaie" and "pagayer". He used the homeric terms *ταροοπλεῖν* derived from *ταροός*

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- 1991 Fascicle 7, *The Palaeoethnobotany of Franchthi Cave* (Julie M. Hansen).
- 1993 Fascicle 8, *Franchthi Neolithic Pottery. Volume I: Classification and ceramic, Phases 1 and 2*

ILLUSTRATIONS

- Fig. 1 The double ended *papyrella*. (Drawing by K. Damianidis).
- Fig. 2 Map of the Cyclades showing the *papyrella* voyage. (Drawing by Y. Pantzopoulos).
- Fig. 3 The *papyri* of lake Kavourolimni (photo by G. Kastanas).
- Fig. 4a-d The Corfiot cut-stern *papyrella*. (Photos by Y. Vichos).
- Fig. 5a-e The double-ended *papyrella*. Various phases of its construction. (Photos by M. Vavouri).
- Fig. 6a,b The completed craft. (Photos by the author).
- Fig. 7a,b Details of the lashing. (Photos by the author).
- Fig. 8 During the first sea trials. (Photo by the author).
- Fig. 9a,b Paddling to Melos. (Photos by Th. Troev).

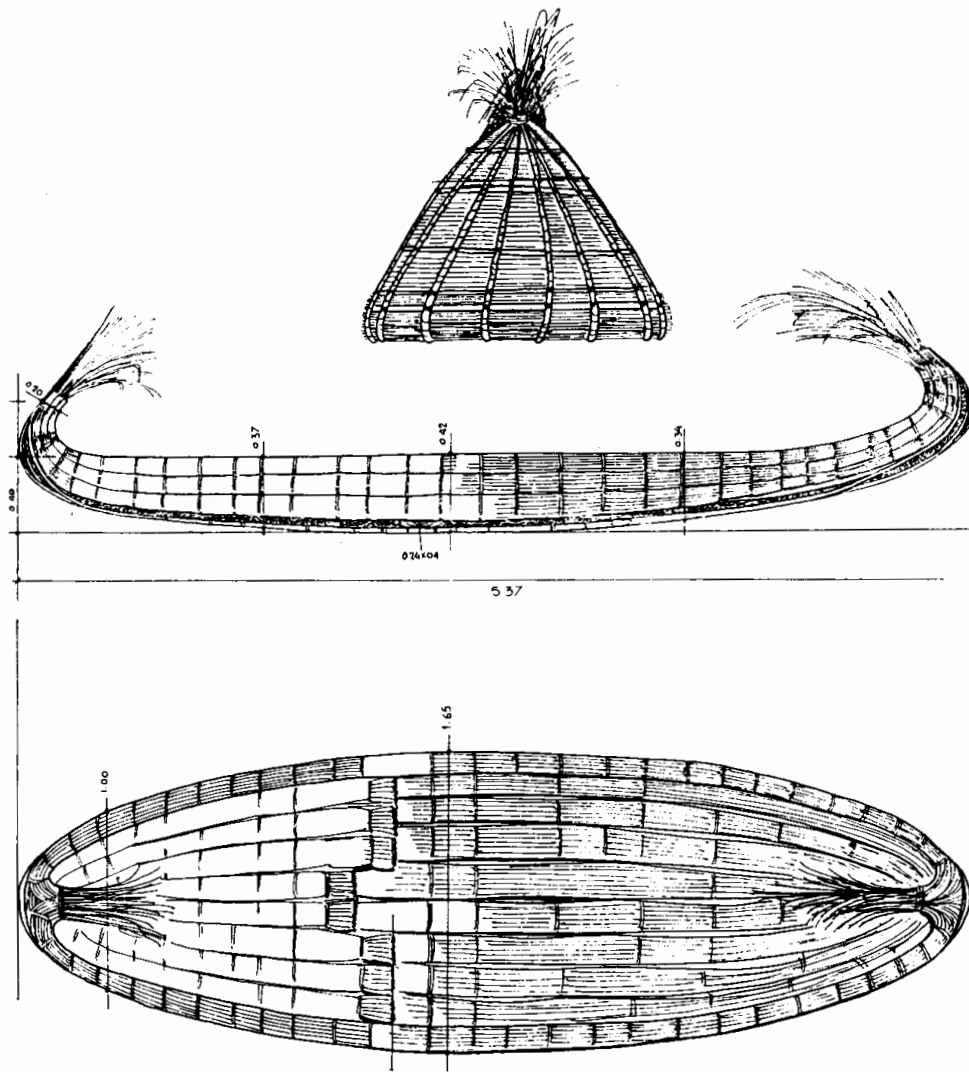


Fig. 1

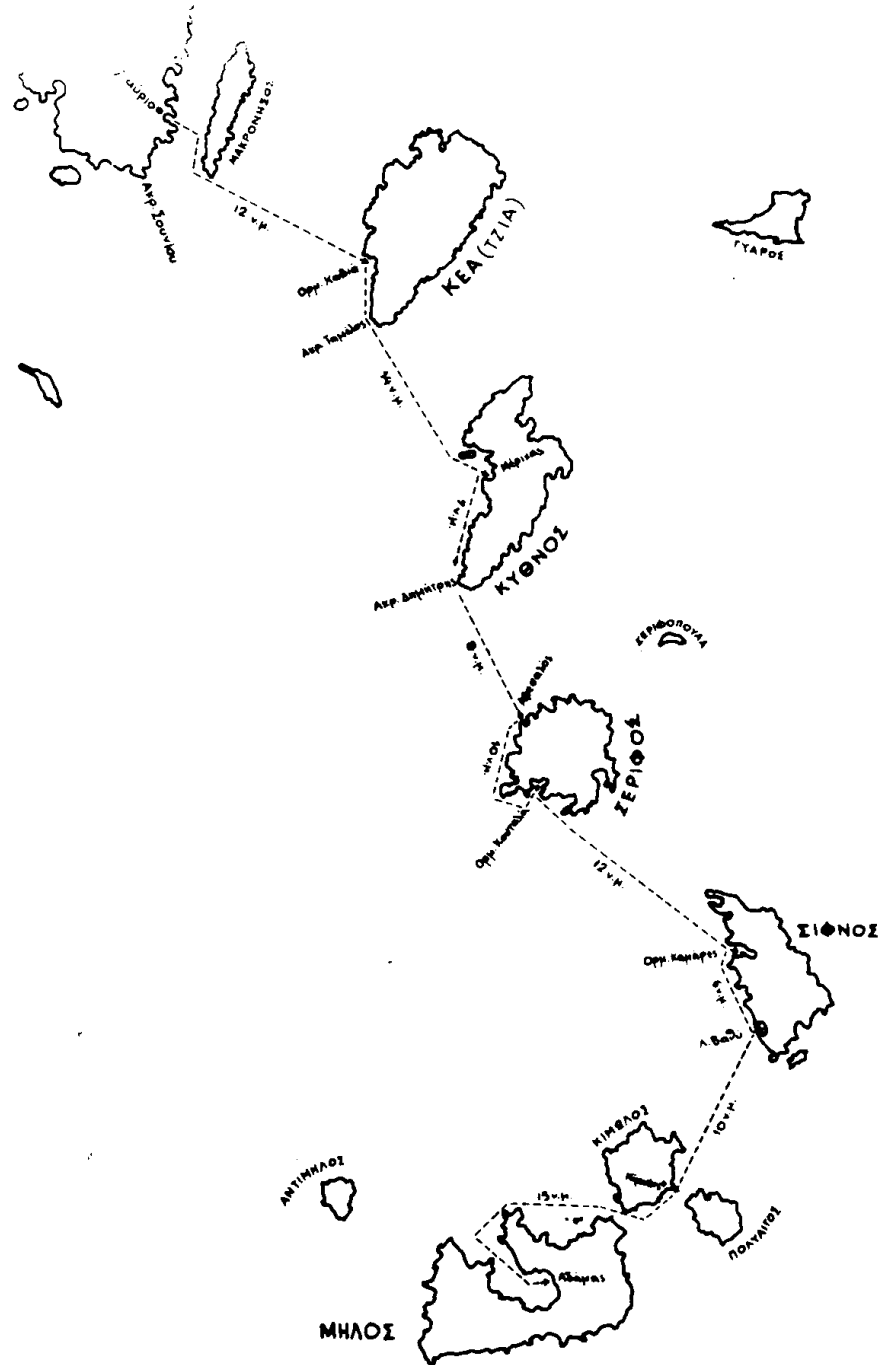


Fig. 2



Fig. 3

Fig. 4a



Fig. 4t



Fig. 4c



Fig. 4d



Fig. 5a



Fig. 5b



Fig. 5



Fig. 5



Fig. 5

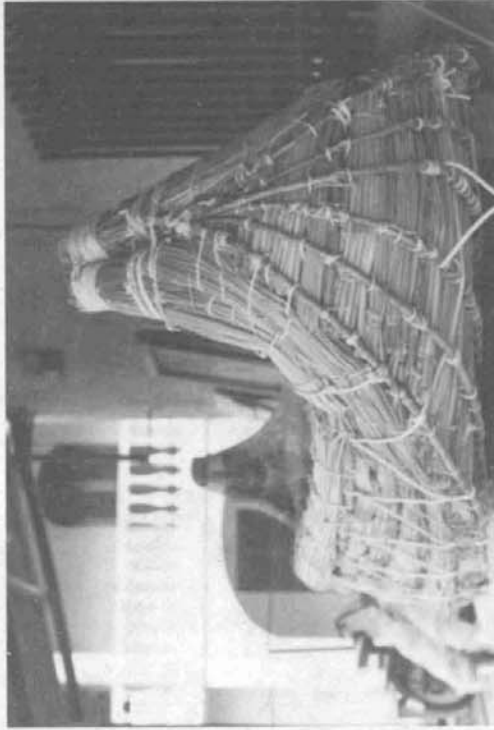


Fig. 6b



Fig. 7b



Fig. 6a



Fig. 7a

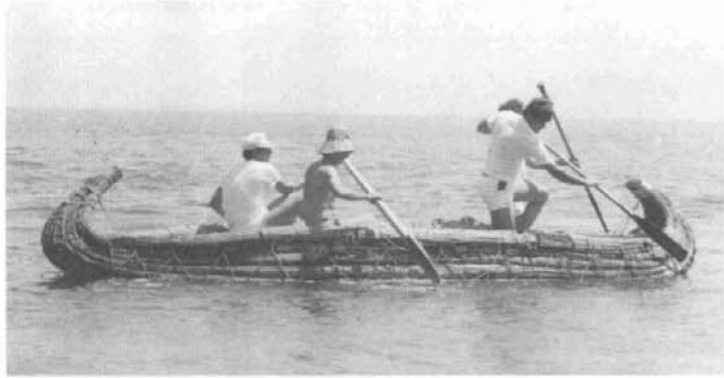


Fig. 8



Fig. 9



Fig. 9

THE KINNERET BOAT: THE EXCAVATION REPORT

Two years ago at Delphi I described the discovery, excavation and removal of the Kinneret Boat from its site to the conservation facilities constructed for it at the Beit Yigal Allon Museum next to Kibbutz Ginosar. Since its discovery in 1986, the boat has been the subject of detailed study by a number of experts and scholars (Fig. 1). These studies help us to understand the boat, its construction, the milieu in which it lived its work life as well as its significance vis-à-vis activities that took place around the Kinneret (the Hebrew name of the freshwater inland lake commonly known as the Sea of Galilee) during the first century AD.

The excavation report is now in press and will appear as volume XIX of *Atiqot*, the English language journal of the Israel Antiquities Authority. This should be published early in 1990.

The Kinneret Boat has turned out to be a treasure trove of information about a time and a place that literally changed history. It has acted as a catalyst, requiring us to go back and reexamine the existent evidence concerning seafaring in antiquity on the lake. I would like to summarize here a few of the main archaeological and historical conclusions that will appear in the report. As Professor Steffy discussed his contribution at Delphi in 1987 I will refer to his work only in passing here.

Date

One of the most difficult questions raised by the boat is its dating. This is based on three considerations: construction techniques, ¹⁴C dating and pottery. All three of these have their limitations.

Comparing the hull to Mediterranean forms of ship construction, Steffy suggests that the vessel was built between the first century BC and the second century AD.¹ However, he is quick to emphasize that building traditions may have lingered longer on the Kinneret than on the more cosmopolitan Mediterranean coast. Furthermore, Steffy notes that dating a hull by construction techniques alone is normally unreliable; for the Kinneret Boat it is impractical due to the lack of comparative material there.

Ten samples of wood from the boat were submitted for ¹⁴C dating by Dr. Israel Carmi at the Weizmann Institute.² These give an average age of 40 BC±80.

The lamp and cooking pot found during the prode excavation can be dated from the mid-first century BC to the mid-second century AD. However, by comparing datable sherds found in the excavation itself to nearby stratified assemblages, Dr. David Adan-Bayewitz concludes that all the ancient pottery found with the boat is typical of the period from the latter first century BC to the decades following the mid first century AD, or about the year AD 70³. He emphasizes that none of the pottery sherds belong to forms beginning after the late first century AD.

The boat carried no cargo. The pottery was found in unstratified contexts in and around the boat and, therefore, cannot be directly linked to it. However, the pottery is a chronological indication of a period of human activity in the immediate vicinity of the boat.

The coins found during the excavation, unfortunately, are of no help at all in dating the boat. None of the coins were found inside the hull, and all of the coins came from unstratified contexts. Of the 57 coins found during the excavation and studied by Mr. Haim Gitler, 43 were identifiable⁴. These range in date from the third century BC to the 19th century AD.

The concluding date, based on the ceramic evidence, may be linked to historical events in the area. The boat was found a scant kilometer from the ancient site of Migdal. Josephus' description of the land and sea battle between the Jews and the Romans at Migdal in AD 67, and its aftermath, suggests that the city was depopulated at that time. He mentions a total of 44,300 Jews from Migdal who were either killed or sold into slavery during and after that battle⁵. Even if Josephus' numbers are exaggerated, there can be no doubt that, if the city of Migdal did not cease to exist entirely for a time, at the very least, its population was considerably depleted.

All this must have had an affect on human activity in the area of the excavation site for years after the battle. The boat was found in an area of boat-building activity;⁶ it is probable that work ceased at the site for a period following the battle. Therefore, it seems highly likely that the boat was deposited at the site, and its reusable parts removed, prior to the battle of Migdal.

Iconography

One of the most memorable moments for me during the excavation took place during Steffy's first day at the site. After he had studied the boat for awhile he showed me a rough outline of the boat's sheer plan as he perceived it—with a pointed prow and a high recurving stern—not unlike his preliminary sheer plan (Fig. 2). I asked him how many rowers in his opinion, would have rowed a boat this size. Probably four, he replied.

No sooner had he returned to his recording than we had a visit by Fathers Stanislaw Lofreda and Virgilio Corbo, two Franciscan priests who had excavated at Capernaum and at Migdal. As I showed them around the excavation, they told me about a first century AD mosaic of a boat that they had found ten years before at Migdal. Corbo drew a picture of the mosaic in my notebook. It had a pointed bow and recurving stern and looked exactly like Steffy's drawing. When I showed the drawing to him, Steffy was sure that I was pulling his leg. The Migdal boat that Corbo had drawn had three oars to a side. This suggested that it was rowed by six oarsmen and represented a vessel of a class larger than ours. When later I examined the mosaic in detail, however, I found that each of the two forward oares were represented as a single line of red mosaic stones (Fig. 3). But the sternmost oar widened at the bottom - it was a quarter rudder. This meant that the boat in the mosaic must have had four rowers, as Steffy had predicted for our boat, and a helmsman—a minimum crew of five.

Literary sources

The evidence of the Kinneret boat and the Migdal mosaic concerning crew sizes is supported by the literary evidence in both Josephus and the Gospels(7). Josephus describes how, when he was magistrate of the Galilee, he prepared a sham war fleet of boats at Migdal that he sent to Tiberias to frighten the inhabitants into following him. Lacking his army he placed skeleton crews in each of he boats. Josephus writes that he:⁸

...collected all the boats that he could find on the lake —some two hundred and thirty, with no more than four sailors in each— and with this fleet made full speed for Tiberias.

Later the boats were loaded with the men of Tiberias who had been taken as hostages. Josephus notes.⁹

As the boats were successively filled he ordered the captains to make with all speed to Tarichaeae [Migdal].

From this we may conclude:

4 Sailors + 1 Helmsman/Captain = 5 man crew

Similarly, in the Gospels we read:¹⁰

And going on a little farther, he (Jesus) saw James the son of Zebedee and John his brother, who were in their boat mending the nets. And immediately he called them; and they left their father Zebedee in the boat with the hired servants, and followed him.

Thus, the boat of the Zebedee family was crewed by five or more men:

1 [Zebedee] + [James] + [John] + (2 + ?) ['hired men'] = 5 (+ ?) man crew

Similarly, when Peter decided to fish one evening, presumably in his own boat, six other disciples worked with him, forming a seven man crew.¹¹

How many men could have been carried by a boat of this size? During the excavation we were repeatedly asked if a boat of this type could have carried thirteen men. So naturally when I began collecting literary evidence I first read through the Gospels looking for the passages where Jesus is recorder sailing on the lake with twelve apostles. I was surprized to discover that nowhere do the Gospels state that the twelve accompanied Jesus on any recorder boat trip.

The Gospels record Jesus being accompanied by his disciples—and Jesus had many disciples, from among whom he chose the apostles¹². So there is no way of knowing how many people were in the boat in any of the voyages recorded in the Gospels.

Fortunately, several passages in Josephus do suggest the maximum capacity of passengers of these boats. Returning to Josephus' adventure of the sham fleet we read:¹³

I also myself went on board one of those boats, with my friends, and the seven armed men already mentioned and sailed for Tiberias.

Therefore, Josephus' boat held at least 15 men:

1 [Josephus] + ['armed men] + [2 + ?] ['friends'] + 4 [Sailors] + 12 [Helmsman/Captain] = (15 + ?) men.

Furthermore, during this action Josephus notes in connection with the taking of the captives from Tiberias:¹⁴

Ten citizens, the principal men of Tiberias, at once came down; these he took on board one of the vessels and carried out to sea.

Therefore, this boat also carried fifteen men:

4 [Sailors] + [Helmsman/Captain] + 10 [men of Teberias] = 15 men

Anson Rainey remarks that although Josephus normally uses the Greek word πλοῖον for boat, here he uses the term *μιὰ τῶν ἀλιάδων*—one of the fishing boats', indicating their primary function.

Josephus notes that in all he lured 2600 of the leading citizens of Tiberias into the boats to be jailed in Migdal. Previously, as we have seen, he refers to 230 boats that took part in this action. Both of these numbers may be exaggerated, nevertheless, the number of men per boat is similar to the previous calculations:

2600 men of Tiberias : 230 boats = 11 or 12 men per boat.

11 or 12 men per boat + 5 men crew = 16 or 17 men per boat.

Based on skeletons he has examined, Joe Zias, a physical anthropologist at the Israel Antiquities Authority estimates that in the Roman-Byzantine period Galilean males averaged about 166 centimeters tall¹⁵. Based on current data on height/weight ratios, they probably would have weight about 62-63 kilogrames. Thus fifteen men would have weighed about a ton and could have easily fit into the boat.

Boats of the Kinneret in the 19th and early 20th centuries

Descriptions of the larger boats used on the Kinneret prior to the introduction of motorized transport show remarkable similarities to characteristics of the Kinneret boat. MacGregor, who visited the lake on 1869, notes that the largest boats on the lake were about 30 feet long with a breadth of seven feet (in metric

terms, 9.14 meters by 2.13 meters)¹⁶. In comparison, the Kinneret boat, with some of its parts removed in antiquity, is 8.20 m long and 2.5 m in breadth. Intuitively, MacGregor suggests that this was the larger limit of ancient craft on the lake. This is the way he describes these craft:¹⁷

“The boats now used in the lake by the fishers are all about the same size, rowing five oars, but very clumsy ones, and with a very slow stroke.¹⁸ Generally only three oars were in use, and I much regret that I failed to remark whether there was a rudder, but I think there was none. Their build is not on bad lines and rather “ship-shape”, with a flat floor, likely to be a good sea-boat, sharp and rising at both ends, somewhat resembling the Maltese.¹⁹ The timbers are close and in short pieces, the planks “carvel built,” and daubed with plenty of bitumen for that is readily obtained here.... The waist is deep, and there are no stern sheets, but a sort of stage aft.”

We are also fortunate in having a description of boats on the Sea of Galilee by James Hornell.²⁰ The largest type of boat recorded by him was the Arabiye. The largest of these craft measured by Hornell was 7.2 meters long with a beam of 2.4 meters. The Arabiye was used primarily for work with the seine net and had fore and aft decks.

The influence of the seine net on Kinneret boat construction

The seine net was the largest and most valuable net used in fishing on the Kinneret. This net could be from 150 to 300 meters in length and required from ten to twenty fishermen to employ it. It had ropes about 70 meters long at either end and was 2 meters high at the sides, rising to 5-6 meters in the center. The net is termed *segena* in Greek and *jarf* in Arabic.

Nun gives a detailed description of the handling of a seine net, still used by fishermen until recent times.²¹ The net is carried on the boat's stern deck. When everything is ready the boat goes to the starting point. Half of the crew remains on land holding the first rope, which is spread as the boat advances perpendicular to the shore under oar. When all the ropes of one end of the net have dropped into the sea, the boat turns, advancing parallel to the shore until all the net has slipped over the stern into the water. When this is completed, the boat returns to shore letting out the remaining ropes.

When the boat lands the remaining workers disembark and taking the end rope, begin to pull the net to shore as do their counterparts at the other end of the

net, thus capturing all the fish between the net and the shore, as is illustrated numerous times in Egyptian tomb paintings (Fig. 4). Nun notes that Jesus refers specifically to this type of net in the Parable of the Net:²²

“Again, the Kingdom of heaven is like a net (Gr. *segena*) which was thrown into the sea and gathered fish of every kind; when it was full, men drew it ashore and sat down and sorted the good into vessels but threw away the bad.”

This net appears to have had two basic influences on the large class of boats used on the Kinneret.

- a. First, it defined the largest size of fishing boat required on this inland lake as one capable of using a seine net. This size, about 7-9 meters, is true for both the two millennia-year-old Kinneret Boat and for the Arabiye boats recorded by Hornell on the Kinneret in the thirties. There is no reason to assume that this optimum size changed *in the interim*.
- b. Second, it required a large stern deck on which to load the net. Hornell notes this structural detail in relation to the Arabiye boats. The Kinneret boat was not preserved to deck high at stem or stern; however, Steffy believes that it must have had a stern deck.

On sleeping in the stern on the ‘cushion’ in Mark 4

This may clarify a passage in the New Testament. All three Synoptic Gospels refer to Jesus sleeping during a boat trip with his disciples. Mark, however, adds two details:²³

“And a great storm of wind arose, and the waves beat into the boat, so that the boat was already filling. But he was in the stern (Gr. *he prumne*), asleep on the cushion (Gr. *epi to proskephalaion*); and they woke him, ‘Master, do you not care if we perish?’”

Why did Jesus chose to sleep at the stern? One possible explanation relates to the large stern deck for the seine net. Anyone sleeping upon the stern deck of a boat like ours would have been at the mercy of the weather and in the way of the helmsman. But, on the other hand, the area beneath this deck afforded the best shelter in the entire boat.

And what of the cushion? Already in the last century it was noted that the definite article used in relation to the pillow indicated that this was part of the boat’s equipment. The most likely explanation for ‘the cushion’ is one I heard from a

veteran Arab Christian fisherman from Yaffo, Mussa Shibli, who has fished with the seine net on sailing boats on the Mediterranean Sea. He explained to me that the boats would normally carry sand bags for ballast. There were two types of these bags: one weighing 50-60 kgs was called *kîs şābūra*—which means 'balance, or ballast sack;' alternateley, a pair of sandbags, each weighing about 25 kgs, were carried. These were called *meḥadet şābūra*, which in Arabic means 'balance or ballast, cushion'.

The sandbags were used to trim the boat when under sail. When not in use, they were stored beneath the stern deck where they could be used as cushions for crew members resting there.

Conclusions

Virtually all the historical and iconographical sources relating to seafaring on the Kinneret in the first century AD refer to a large boat type. This normally had a crew of five and could accommodate as many as fifteen men, inclusive of crew. Relatively expensive, boats of this size were normally owned and operated by a family. When family members were insufficient to crew the boat, additional workers were hired.

Boats of this class were primarily used for fishing, adapted specifically for use with the seine net. This was apparently the factor that defined the size of the class—it had to be large enough to employ this net and to transport the large crew required to work the net. The boats had large stern decks on which the net was carried and from which it was spread. To judge from recent ethnological parallels on the Kinneret, they probably had a smaller deck at the bow, but were open amidships.

The boats were also used for the transport of men and supplies. In times of war they could be pressed into service for battle conditions, mainly as rapid transpors; with their shallow draft they were ideally suited for swift commando attacks on the shelving coasts which predominate in the Kinneret. They were apparently not unlike boats used for coastal piracy in the Mediterranean at that time. The Kinneret boat and the Migdal mosaic suggest that boat of this size had a cutwater and they could move under both square sail and oars.

Finally, the Kinneret Boat a represents the type of boat used by Jesus and his apostles in the Gospel stories as well as by the Jews in the Battle on Migdal.

Acknowledgements

I would like to take this opportunity to thank Professor Steffy and Mr. Mendel Nun, whose comments have greatly helped clarify various aspects of the boat's study for me.

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NOTES

1. Steffy / 1990:41
2. Carmi / 1990.
3. Adan-Bayewitz / 1990.
4. Gitler / 1990.
5. War III: 531-542.
6. Steffy / 1990:47
7. Wachsnann / 1990.
8. War II: 635.
9. War II: 641.
10. Mark 1: 19-20.
11. John 21: 2-3, Peters boat is mentioned specifically in Luke 5:3.
12. Mark 3:13; Luke 6:13; Acts 1: 21-22.
13. Life 32: 164.
14. War II: 639.
15. Zias / 1990.
16. MacGregor 1870: 353.
17. Ibid., 357-358.
18. My italics—S.W.
19. Presumably, MacGregor refers here to the Maltese dgaisa. This is a double ended creft with a flat bottom that lacks a rudder (Tilley 1969; 1973; Basch 1975: 234-238; Johnstone 1980: 96-97).
20. Hornell 1935:48, 72-73, fig. 11.
21. Nun 1989: 16-21.
22. Nun 1989: 22; Matt. 13: 47-48.
23. Mark 4: 37-38.

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ILLUSTRATIONS

- Fig. 1 The Kinneret boat in its conservation tank. Photo: D. Syon
- Fig. 2 Preliminary hull lines of the Kinneret boat by J.R. Steffy.
- Fig. 3 The Migdal boat mosaic. Photo: D. Syon.
- Fig. 4 Fishing with th seine net as portrayed in the tomb of Antefoker, XIIth Dynasty. From Davies and Gardiner 1920: pl. V.



Fig. 1

THE KINNERET BOAT

PRELIMINARY LINES
LENGTH AT CAPRAIL - c.8.8M
BREADTH - c.2.5M
DEPTH - c.1.25M

NOTE: LINES TO OUTSIDE OF PLANKING

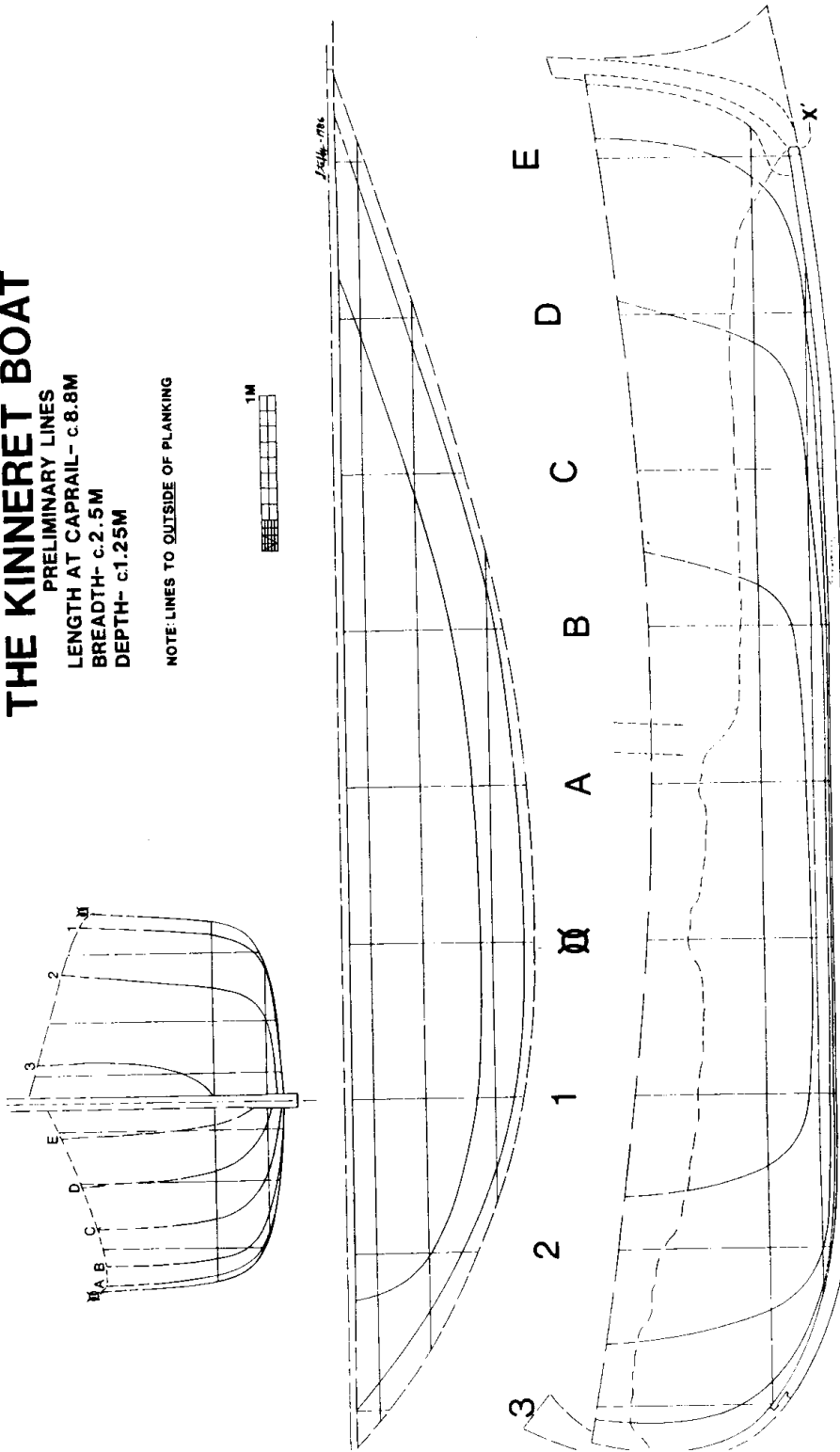


Fig. 2



Fig. 3

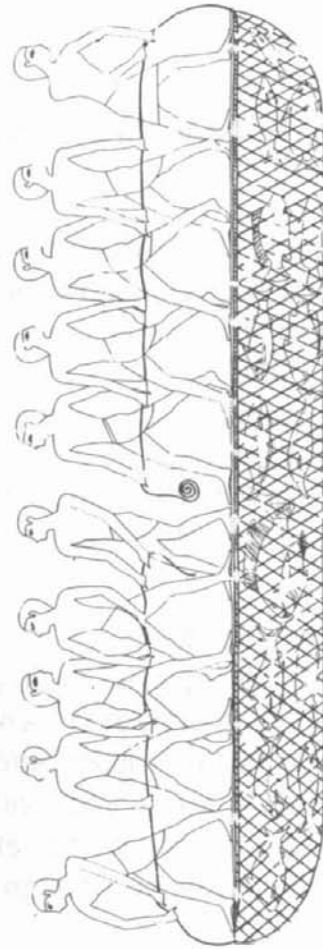


Fig. 4

BOW AND STERN IN EARLY AEGEAN BRONZE AGE SHIP IMAGERY A RE-ANALYSIS

Knowledge of Aegean Bronze Age ship architecture depends almost exclusively on the pictorial record. To decode this system, a rigorous application of methodological principles is imperative to compensate for vital information lost in the artistic execution and the subsequent transmission across the centuries. Although at times implicitly, and imperfectly, present in the analytic process evidenced by various scholars' writings, such rules have not previously been formulated. The task this paper has set itself is to sketch the theoretical standpoint, suggest a method towards identifying bow and stern in the earlier Bronze Age, and test this against the available data.¹

There can be no claims to absolute knowledge : all statements offered in this paper are to be understood in terms of probability. It will be suggested that groups of data argue for a specific interpretation and do so more coherently than a counterargument. All that can be hoped for is a tentative reconstruction, open to revision when a future data assemblage warrants this. For the sake of clarity, and brevity, the discussion will be limited to documents admitting to inclusion in a group, leaving aside statistically insignificant exceptions, as well as most fragmentary representations.

The text will employ a number of terms demanding definition. The terms to be defined are cluster, master-type, type, group, and internal indicator. Typological studies show that objects of a similar kind tend to be restricted in shape to a limited number of possibilities. Objects behaving in such a manner may be said to form a cluster, that is, to gather around a common form. There may be observed a certain amount of variation between any two members, but the cluster as a whole may be said to conform to a single master-type, the ideal shape shared, to varying

degrees, by all the individuals. This shape is the idealized form present in the mind of the artist as he creates an image according to his temperament. As such, it may be called an Urbild. The cluster must subsequently be tested against the data: the appurtenance of each member must be scrutinized and falsely included individuals eliminated; the independence of the cluster must be established through contrasting with other clusters, and with unclustered representations. If shown not to partake as a subdivision of any other cluster, it may be called a type and be supplied with a name or number, according to the system employed. The word group is a more general term, and does not carry the semantic weight of either cluster or type. It is used in the nonspecific sense of "a group of ...", to permit reference to documents of a yet to specified nature. Thus these four terms stand in a hierarchical relationship to one another: group, cluster, type, master-type, in ascending order. At each subsequent level there is greater specification of content, and a higher hermeneutical resolution.

The final term, internal indicator, used, in this text exclusively, in the expression "internal stern indicator", refers to an element within the image under consideration permitting the identification of the stern. Although a number of elements would, theoretically, warrant such a designation, the size of the documents and the resulting lack of detail restrict the range. The present paper will accept only one such indicator. The major effect of adopting this concept as a rigid principle is the exclusion of all other arguments, such as those generated from considerations regarding trends observed in ethnographic material, functional aspects, and general ship building practice. As draconic as this might seem, it has the advantage of focusing the analysis, and in reality, only the first-mentioned may deviate from results obtained by this approach, whereas the latter two, not to be treated here, tend to support the conclusions arrived at in this paper.

A single principle, applicable to all imagery, is advocated: typological clustering. The concept is by no means new, since virtually all major relevant discussions have made use of it to some degree.² The implications involved, however, have been disregarded with the ensuing breakdown in the logical structure of the arguments. If typological clustering is employed, it must follow that:

1. all statements are made on the basis of several cognate documents, not on single items;
2. analogies are drawn with temporally and spatially related objects;
3. all analogies drawn must be based on primary features, not on secondary traits.

Cognate documents are defined as representations clustering around a master-type, all sharing a number of major structural features. To constitute a valid cluster, they must be dated and provenanced in close proximity to each other, that is, they must belong to a single time period or the immediately preceding or following phase, and be of Aegean origin.³ Since images are not cut from templates, a certain amount of variability is to be expected. Quantification of differences observed cannot yield the results that have been obtained with ceramics, spearheads and stonetools, for instance, but similar phenomena of clear-cut types, borderline cases and midfield scatter between clusters are to be expected. A maximum of individuals should be accounted for if the typology is to be assigned any validity - with allowance made for the state of conservation and degree of schematization exhibited by certain documents.

The most obvious consequence inherent in accepting this approach is the complete rejection of the "single item solution fallacy", which attempts to solve the bow/stern problem by reference to single representations or to unrelated documents scattered in time and space.⁴ All statements must be buttressed by reference to a type, not to a single entity, to a credible pattern rather than to a possible exception. A further consequence is the critical relationship entertained with the various levels of analogy. The greatest number of analogs will be found within a type, confirming the attribution of each member. From the nucleus of the master-type extend three axes, time, space, and form, and the further a comparandum distances itself from point zero on any or all three axes, the less relevant is the purported parallelism.

Intercultural analogy is thereby not rejected, but must be placed at a proper level within a hierarchy of comparanda. This ordering of the sources for comparative material may possess the following strata, each representing an accumulative loss of verisimilitude as it moves away from the first, and uppermost level:

1. internal correlations within a type;
2. data from separate but temporally and spatially contiguous or near-contiguous types;
3. comparanda from contemporary cultures/areas shown to be in sufficient contact;
4. later developments within the cultural sphere under study;
5. arguments from plausibility and from hypothetical isomorphisms based on later foreign, as well as ethnographical, evidence.

In each case, the suggested comparandum must be shown to partake in a type. The major consequence envisaged is the rejection of analogies drawn from a lower level in the hierarchy if sufficient parallels can be established with an upper level. The approach does not exclude diffusion from external areas, but tempers it if there is cause for postulating an internal development.⁵

The primary features alluded to above are hull shape, bow and stern morphology, and relative differences in the height of the extremities. To identify bow and stern, reliable means are necessary: such means can only be provided by the individual ship representation. It must be contained within the image and be readily recognizable as exclusively associated with the one or the other extremity. It is here argued that the steering-oar constitutes the only acceptable internal indicator, and that all other elements customarily linked with either extremity depend on it for their identification.⁶

A definition of the steering-oar in pictorial terms may include all or some of the following statements:

1. a line crossing, or descending from, the hull at one extremity, not repeated at the other;
2. a line, as in (1), with a thickening at the lower end;
3. an oblique line, orientated at about 90° to a collection of oblique parallel lines below the hull, understood to depict oars;
4. two, possibly three, lines answering to (1), (2), or (3).

The definition leans heavily on a limited number of representations and remains, therefore, open to modification. The database may be widened if a "best fit" approach is employed: certain documents gain in clarity when analyzed in conjunction with more eloquent individuals. To avoid a circular argument, these latter comparanda must not depend on the former for their interpretation. The "best fit" approach also enters the analysis when individuals lacking in representational clarity are assigned to clusters: certain images, incapable of yielding to decisive statements, can be clustered when interpreted as "best understood to represent X". As was stressed above, no single image suffices to prove or disprove any given point, and this applies particularly to the bow/stern question.

In statistical terms, steering-oars are rare. The corpus of Aegean Bronze Age ship representations, the 284 individuals upon whom the research here reported is based, may be classified in three categories:

1. complete representations admitting to clustering;
2. incomplete representations permitting tentative clustering;
3. complete and incomplete representations falling without the limits established by the various clusters.

The final category, comprising 29% of the material, will not be discussed here. The remaining 71% can, with an acceptable degree of probability, be assigned a type affiliation. Steering-oars are presented in 25 complete and 14 fragmentary cases, being 14% of the total.⁷ Due to their rarity, greater hermeneutical stress must be concentrated on them.

Within the present limits, all 39 cases exhibiting a steering-oar will not be passed on review. It may be affirmed that there are, among the 25 complete documents, no instances of steering-oars at both extremities, nor of steering-oars associated, on separate but typologically related individuals, with either the one or the other end. It will be assumed that the same obtains for all the fragmentary cases, as the contrary cannot be shown to be in force. Arguments for bidirectionality will be considered unsupported by the evidence currently available and/or inapplicable to Aegean navigational conditions.⁸

The analysis will have three stages:

1. steering-oars define a restricted range of bow and stern morphology variants;
2. each thus defined variant is contrasted with the corpus in the aim of establishing a cluster around it;
3. typological variants are analysed in the hope of directionally determining clusters devoid of members with a steering-oar.

Before commencing the analysis, a final terminological problem remains to be discussed: the nomenclature of the types. The ideal situation would be to apply names derived from the most eloquent member or members of the cluster constituting the type, thus creating a "handle" susceptible to immediate recall. The material under consideration here does not easily admit to such an approach. For although three types may be named after the Syros "frying pans", the Akrotiri Miniature Fresco, and the Tragana pyxis respectively, a further two cannot be so readily associated with any one document. Even if the one could answer to a name chosen after the Kolonna pithos, several of its members come from Malia, the site most appropriate to the baptism of the other type.

Similar problems are encountered when attempting to name the types after the chronological period in which they are prevalent: an Early Minoan type continues, in actual fact, into the Middle Minoan period, while the type dated to Late Minoan times appears already in Middle Minoan III. Only the Early Cycladic and the Late Mycenaean types allow an unproblematic use of a nomenclature based on the temporal extension for each type. Thus, in choosing Roman numerals, a compromise is adopted. For greater clarity, the most typical member is cited in brackets when each term is introduced, or conversely, the numeral, if the geographical terminology is used.

An illustration is included for reference (Fig. 1). Thereby it is hoped that the formlessness of Type I, II, III and so on, is compensated for, while retaining its neutrality, and thereby avoiding the problems alluded to above.

Steering-oars are essentially associated with three different hull-shapes. Two, those best associated with the Akrotiri Miniature Fresco and the Tragana pyxis respectively, are well established and directionally determined by several cases with a steering-oar. A definition of these two types, IV and VI, will therefore not be undertaken here. The third is less familiar and less well documented. Its main interest lies in the position it occupies in the development of Minoan ship architecture and in the light it appears to shed on the problem involved in identifying bow and stern on the earliest Aegean vessels.

This Early Cycladic cluster, the "frying pan" boats from Syros, and related craft from Naxos, Orchomenos and Palaikastro (Fig. 2a-d), the earliest tangible evidence for ship-building in the Bronze Age Aegean, numbers at least 18 individuals, and holds pride of place in the bow/stern controversy, despite the fact that it cannot be directionally determined on internal criteria. A designation as type, here Type I, is assured by the coherency of the cluster and by the confrontation with the corpus.

The main argument in favor of a high bow interpretation has been formulated around the fish ensign, present on 14 members. The parallel drawn with the Naqada II craft is erroneous on two counts.⁹ Firstly, the key formal characteristics of the Syros hull shape is the relationship between the extremities: the raised part extends at an angle of c. 70° upwards and attains a height equal to 35 to 60% of the overall length, unmatched by the opposite end.¹⁰ Cluster analysis, as understood here, stipulates that any comparanda must duplicate the significant difference in height as well as the general shape. The Naqada II craft brook no comparison with the Syros vessels. Secondly, it can be shown, using the same method as is

advocated here (Fig. 3), that the fish ensign on the single Naqada craft thus equipped (Fig. 3d) is affixed aft of amidship and thus in clear association with the stern. It may also be noted that the appeals to ethnographic parallels have not been accompanied by arguments justifying their use.

A comparable misuse of evidence becomes apparent when the well-known putative parallels adduced to favor a high-bow interpretation are confronted with the Syros type (Type I). Whether it be the Naxos lead boat, the Mitsotakis model, the Akrotiri or the Dramesi ships, or the graffito from Enkomi (Fig. 4a-e), the evidence falls on its total irrelevance to this question.¹¹ If all but the last mentioned representation can be directionally determined in a satisfactory manner, either due to the presence of a steering-oar (Akrotiri), to arguments from hullshape as viewed in plan (Naxos, Mitsotakis), or to clustering (Dramesi), none duplicate the shape, and only the first can be said to respect the hierarchy of comparanda. If a final "parallel", the Hal Tarxien graffito (Fig. 4f), constitutes a good approximation of the Syros shape, its connection with the Aegean craft has yet to be convincingly argued on archaeological grounds.¹² That the representation is devoid of any means to a bow/stern identification has been overlooked.¹³

These examples illustrate an insufficient grasp of the theoretical and practical implications involved in comparative formal analysis. An improved database and a carefully reasoned methodology renders it possible to propose a directional determination based on typological clustering and on the steering-oar as internal indicator. It will be argued that clusters containing one, or more, individual with a steering-oar can be directionally determined on its testimony, provided the supposed members do in fact constitute a coherent cluster congruent with a designation as a type. As will be seen, the two clusters to be analysed below conform to this criterium as well as to those stipulated above concerning spatial and temporal contiguity.

Three of the four earliest completely conserved representations with a steering-oar date to the Middle Bronze Age: the pithos from Kolonna,¹⁴ the sealing from Hieroglyphic Deposit at Knossos,¹⁵ and a seal in the Philadelphia University Museum¹⁶ (Fig. 5a-c). In unison, they designate a bifurcated extremity as the stern. Based on the criteria employed here, no contradictory data can be found in the corpus. Around these three documents, a further four ships on seals cluster, all sharing the cleft stern and pointed bow (Fig. 5d-g)¹⁷. A further seven members, albeit of less consequence to the argument presented here due to the loss of the stern through breakage or schematization, can be assigned to the cluster on the

basis of the arrow-headed extremity.¹⁸ This hull-shape is here described as having extremities of equal height, the stern being bifurcated, the bow either pointed or equipped with an arrow-head device. Its relationship to the Akrotiri type (Type IV) is obvious, particularly apparent in the ship on the Kolonna pithos.

The bifurcated extremity is also found on three members (Fig. 6a-c) of a group dated somewhat earlier, essentially Early Minoan III to Middle Minoan I, as opposed to Middle Minoan I to Middle Minoan II/III. This cluster numbers eleven individuals (Fig.6), exhibiting a greater variability than the previous cluster, but the discrepancies in hull shape and in bow and stern morphology may be adequately explained if the former are seen as advances in construction techniques within an evolutionary vision of Aegean Bronze Age ship architecture, the latter as variants, later to be standardized into the bifurcated form. A global interpretation, consonant with typological clustering, identifies the raised, variously furcated extremity as the stern. The seal in the Haifa Maritime Museum (Fig.6k), depicting a ship having, it is argued here, three steering-oars, supports this view.¹⁹

At this point a test against the corpus of Aegean Bronze Age ship representations will reveal that the documents discussed do, in fact, belong to the clusters to which they have been assigned. Internal variations do not appear sufficient to warrant fragmentation into smaller units. The differences are primarily located in the secondary traits, such as the three possible variants in bow morphology exhibited by the later cluster, pointed, pointed with arrow-head, pointed with auxiliary elements interpreted as a bowsprit (Fig. 5b, c and a respectively). These variations concern only the bow decoration, not the structure of the bow itself. Concerning the earlier cluster, there is no evidence favoring an interpretation of the bi-, tri-, or quadri-furcated end as the bow. A designation as type may now be employed: Type II being the early Minoan shape, Type III being the "Kolonna group".

The postulated affiliation between these two types is based on an argument from "best fit": the presence of angular and rounded hulls within the earlier cluster (Type II) suggests both whence the type came and where it is heading. It cannot be denied that chronological scatter within the cluster, and the appearance of hypothetical earlier variants at late stages, and equally hypothetical later variants at the inception of the type, detract from the clarity of the argument. Three alternatives may go some way towards an explanation:

1. the later type (Type III) developed out of the earlier (Type II) which continued to evolve parallel to its offspring;

2. the later type is an independent, locally developed hull shape, possibly connected with Malia;
3. the latter type is of extra-Aegean derivation, unrelated to the earlier type, and the foreunner to the Akrotiri type (Type IV).

For the third possibility, while the relationship to the Akrotiri type is to be regarded as probable, there is little evidence for a foreign involvement due to the almost total lack of ship representation from the crucial area of the Syro-Palestinian coast, as well as the absence of suitable parallels from Egypt.

Concerning the first possibility, the basis for the common directional determination is the secondary trait of stern decoration, and as such not sufficient to tie the later to the earlier type in terms of generic affinity, although shown by the Haifa seal to be congruent with a common bow/stern identification. If the bow morphology of the chronologically early ship from Malia (Fig.6g) and the appreciably later one on the stamp seal from Mochlos Grave III (Fig.6j) do not constitute the necessary formal links to the later type, then the corpus is not forthcoming in providing the missing link.

A single representation, on a clay nodule from Malia (Fig.7a), combines the elements to be expected of such a putative transitional type. Yet without further examples to form a cluster, the combination of curved, bifurcated stern, and curved bow, related to the earlier but manifestly pointing to the later type, remains too ephemeral to carry convincing argumentative force. Thus the first alternative remains based on the secondary similarity and an evolutionary view of Aegean Bronze ship architecture.

If the second possibility, an independent Malioite (?) development, is to be adopted, it must be recognized for what it is: speculation. The presence of almost 60% of the members of this type in Malia (plus one in Knossos) must be weighed against 30% being of unknown, Cretan, provenance, as well as against the particular find circumstances at Malia, where a stonecutter-workshop has been excavated.²⁰ An independent, spatially unspecified, development would divorce Type III from earlier Minoan shapes, and render it necessary to postulate either an ex nihilo creation or an unknown prototype. Although the question cannot be laid to rest, this paper advocates an evolutionary view and derives Type III from Type II.

The master-type implicit in all the members belonging to the early Minoan Type II, and the directional determination which the above analysis has suggested as the most likely, is of particular interest when attention returns to the starting

point, the cluster baptized Type I (the Syros type). Type II may be seen as a significant isomorphism to Type I. By identifying the raised extremity on a Cycladic vessels as the stern, the Syros type is firmly placed in an Aegean ship-building tradition which culminates in the Akrotiri ships (Type IV).

Testing for verisimilitude against the entire corpus generates no counterarguments. Among the fragmentary representations with steering-oar, on the other hand, appears a sherd from Phylakopi I (Fig. 7b), contemporary with the Syros boats, depicting a craft with a raised stern drawn in the same technique as the "frying pan" vessels, incision, and employing the same pictorial means to invoke the crew, many short parallel strokes representing paddles, in a similar opposed manner as on five of the "frying pans", although, on the image from Melos, the upper row points forward, the lower aft, not the converse as is the case on Syros. The bow is completely lost, making the parallel drawn tentative.

A further, equally fragmentary, representation appears to argue in a related sense. On a seal-stone, of which half is extant, from the stonecutter-workshop in Malia, a ship is depicted, having a post rising obliquely from a flat keel-line (Fig. 7c). The post is crowned by a device which resembles the fish-ensigns on the Syros craft. If this document may be related to the earliest Minoan type (Type II) - the loss of the opposite extremity demands circumspection - then an interpretation as stern is plausible. How this stern (?) - device is to be compared with that observed on the Phaistos Disc ship representation remains unclear (Fig. 7d).²¹

An argument against the clusters presented in this paper, and raised to the status of type after testing, on grounds of statistical inadequacy may be conceded in absolute terms, but once they are compared with the populations of the various types into which the available data can be organized, this objection loses its validity. Abstraction made of two exceptionally large constellations numbering over forty individuals each, and of the four Naxos lead models, for the time being placed in a group of their own, the mean for the remaining six types is fourteen representations. The calculations do, it must be noted, include some fragmentary cases, and reject some ninety as unclassifiable (the 29% referred to above).

The conclusions reached in this paper may be summarized as follows. A lattice of interpretational statements, being:

1. an internal stern indicator,
2. a comparison of general hull shapes,
3. secondary typological similarities, and
4. a speculative argument from evolution,

is brought to bear on the problem of bow and stern identification in the earlier Aegean Bronze Age ship imagery. When a significant difference in the relative height of the extremities is detected, the data briefly discussed agree to designate the higher end as the stern.

These results are only applicable to the representations discussed and illustrated, or mentioned in this paper. They cannot be transferred to documents that have not been analysed in the above manner. A blanket interpretation of all data as equipped with either a high bow or a high stern is rejected. Each individual must be separately studied in the company of its immediate typological relatives. The corpus indicates the presence, in the Bronze Age Aegean, of craft with a higher bow, but these constitute a minority²² that cannot be employed, as has previously been attempted, to impose a high bow interpretation as a diagnostic feature of all vessels presenting a significant difference in relative bow/stern height in ignorance of the methodological fallacies involved.²³

Loutropyrgos
31 December 1989

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NOTES

1. Space precludes an exhaustive treatment and restricts bibliographical references to a strict minimum. The author's doctoral dissertation, in progress at the Universität Mannheim under the supervision of Prof. Wolfgang Schiering, contains a detailed analysis. An earlier statement concerning the method employed here can be found in *Hydra. Working Papers in Middle Bronze Age Studies* Nr. 7 (1990). Perceptive criticism by Prof. Schiering and Mrs Ethel Wedde has been most useful in improving on the text. Faults and errors remain the responsibility of the author. Abbreviations used:

AJA American Journal of Archaeology

CMS Corpus der minoischen und mykenischen Siegel

IJNA International Journal of Nautical Archaeology and Underwater Exploration

LMM Laviosa, Clelia, "La marina micenea", *Annuario della Scuola Archaeologica di Atene* 47-48, 1969-1970, 7-34.

MCM Marinatos, Spyridon, "La marine créto-mycénienne", *Bulletin de Correspondance Hellénique* 57, 1933, 170-235.

MIMA Basch, Lucien, *Le musée imaginaire de la marine antique*, Athens, 1987.

SSAW Casson, Lionel, *Ships and Seamanship in the Ancient World*, Princeton, 1971.

2. *MCM* 212ff, although not in conjunction with the bow/stern question; most recently *MIMA* 94-140, with major differences to the typology employed here, see diss. (n.1).
3. The present paper does not take issue with the established Aegean Bronze Age chronological system, despite its deficiencies. All dates employed are the conventional relative dates used in ceramic and glyptic studies. Their relationship of mutual relativity will not alter significantly, whatever their true absolute dates may be.
4. The "single item solution fallacy" receives detailed treatment in the above-mentioned dissertation (n.1). The major items thus employed are listed in nn.11-12.
5. Subsequent to this paper's completion, it was noted that M.A.S. Cameron called for a similar hierarchy of comparative pictorial analogy in the restoration of frescoes. See his "On Theoretical Principles in Aegean Bronze Age Mural Restoration", *Temple University Aegean Symposium* 1, 1976, 20-41, on p.29.
6. These include figure heads, decorative elements, bow projections, stern appendages, elements of the superstructure etc.
7. Due to breakage, models generally constitute an inadequate data base for analytical statements. No such individual can aid in defining a type, exception made of the Naxos lead boats, which are tentatively classed as a type in their own right. In many cases stem and stern posts are damaged, all additions rising above the gunwale are lost, and steering-oars appear not to have been indicated.
8. The major statement in favour of bidirectionality (Raban, Avner, "The Thera Ships. Another Interpretation", *AJA* 88, 1984, 11-19) is based on the misconception that the stern appendage on the Akrotiri ships is a ram, and a vision of riverine navigation alien to the Aegean. The ram is not an Aegean Bronze Age invention, nor does it appear elsewhere in the contemporary Eastern Mediterranean. As the stern appendage is confined to the Akrotiri ships and a sealstone in the Stathatos Collection (*CMS* I. Suppl. 167) - contra *MIMA* 102-103, 127-130 - and since these cases show ships in exceptional situations, this view has little universal validity.
9. Tsountas, Christos, "Kykladika II", *Ephemeris Archaologike* 1899, cols. 91-92; Evans, Arthur, *The Palace of Minos II*, London, 1928, 240-242.
10. As calculated by Johnstone, Paul, *IJNA* 2, 1973, 9 and his *The Seacraft of Prehistory*, London, 1980, 64. The mean for a database of 12 cases is 44%. It is significant that far more eloquent parallels, such as the "black ship" on the Hierakonpolis Tomb 100 wall painting, have been ignored.
11. Naxos lead boat: Renfrew, Colin, "Cycladic Metallurgy and the Aegean Early Bronze Age", *AJA* 71, 1967, 1-20, on p.5; *SSAW* 41.
Mitsotakis model: Davaras, Kostis, "Minoiko kiriophoro ploiario tis Syllogis Mitsotaki", *Archaologike Ephemeris* 1984, 55-95, on pp. 59, 67-72.
Akrotiri ship: Casson, Lionel, "Bronze Age ships. The evidence of the Thera wall paintings", *IJNA* 4, 1975, 3-10, on pp.7-9.
Dramesi ship and Enkomi graffito: *SSAW* 31.
12. Hal Tarxien graffito: *SSAW* 31-32.
The line of thought adducing extensive contact between the Cyclades and the Western Mediterranean in the Early Bronze Age from similarities in fortification techniques, housing, tombs, pottery, figurines, tools etc. is here considered as unproven. Before such widescale diffusionism can be shown to have taken place, the physical aspects of long distance travel at this early stage must be satisfactorily analysed. Cyprian Broadbank ("The Longboat and Society

in the Cyclades in the Keros-Syros Culture”, *AJA* 93, 1989, 319-337, particularly pp. 332-337) suggests that population sizes in the contemporary Cyclades may have precluded large-scale and long-distance travel. Only frequent contact or colonization appear viable explanations for the phenomenon perceived by the pro-diffusionists.

13. The line across the hull at the right extremity of the Hal Tarxien hull (Fig.4f) is not sufficiently defined to permit a designation as steering-oar. If it were then *SSAW*31-32 would stand refuted on this point.
14. The breaks do not hinder a satisfactory reconstruction of the image. The only problem to arise involves the vertical line at the left extremity. An interpretation as a steering-oar/bifurcated extremity is strengthened by a further two sherds from the same pithos, and by the Hieroglyphic Deposit and Philadelphia representations (Figs. 5b-c). A possible explanation may be provided by the Palaikastro and Ashmolean ships (Figs. 6a and e), where a pole appears, as will be argued below, at the bow.
15. *MCM* 176n.1 and pl.XV.39 corrects Evans, Arthur, *Scripta Minoa I*, Oxford, 1909, 161 pl.63a but notes damage to the seal surface at the crucial place where the two steering-oars are depicted. The present interpretation sees no reason to doubt the compound testimony of these two scholars.
16. It is not clear what, exactly, the artist intended to depict at the bow. The treatment suggests more than a mere pointed extremity, but the pictorial means remain as truncated as those employed for the bifurcation at the stern. The interpretation as an arrowhead is not impervious to criticism, but has the support of several members of the cluster.
17. The ships on the Kolonna pithos, the Hieroglyphic Deposit sealing and the Berlin seal are included in the cluster on the strength of their stern morphology. Little is gained by forming a separate group due to secondary differences in bow morphology.
18. Not illustrated here. They are: *MCM* pl.XVI.60 (Knossos) and pl.XV.34 (Olous), *CMS* II.2.100a, 163c and 177b (all Malia), Poursat, Jean-Claude/Godart, Louis/Olivier, Jean-Pierre, *Fouilles exécutées à Mallia. Le Quartier Mu. I. Introduction générale. Ecriture hiéroglyphique crétoise (=Etudes crétoises XXIII)*, Paris, 1978, 84 and 88 (both Malia). For a discussion of these individuals, see the forthcoming dissertation (n.1).
19. The above analysis was undertaken without knowledge of the Haifa seal (see the Hydra paper mentioned in n.1).
20. Further thoughts on this subject will be presented in a paper to be read at the “*troisième Rencontre égéenne internationale de l’Université de Liège*” in April 1990.
21. Lucien Basch (*MIMA* 137, 138 fig.286) suggests that the device is at the bow, commenting, as the first scholar to do so, on the similarity in hull shape between this ship, without the device, and the earliest Minoan ships. Such an interpretation does not appear applicable to the Malia fragment (Fig. 7c) due to the lack of projection, common, although variously represented, to all the members of this cluster, at the base of the post. Understanding the Phaistos craft on line with the suggested interpretation of the Malia fragment creates a hull-type otherwise unknown.
22. The individuals in question are the Mitsotakis model (Fig.3b), the Piazzale dei Sacelli model from Agia Triada (*LMM* 28 fig.27a-d, with restoration; unrestored: *MCM* pl.XIV.23) and the marble model from Agia Triada (*LMM* 22 fig.16). It is not to be excluded that further models may have been equipped with a higher bow, now lost. On the aggregate of the entire corpus, however, the higher bow remains rare.
23. The author is grateful to Mr John Coates, Prof. Thomas C. Gillmer, and Dr André W. Sleswyk for encouraging comments subsequent to the presentation of the oral version of this paper.

ABBREVIATIONS

CMS, MCM, and MIMA as in n. 1. Further:

EESS Bowen, Richard LeBaron Jnr, "Egypt's Earliest Sailing Ships", *Antiquity* 34, 1960, 117-131.

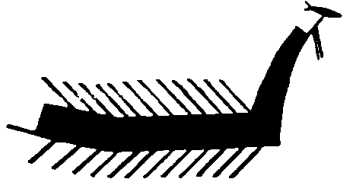
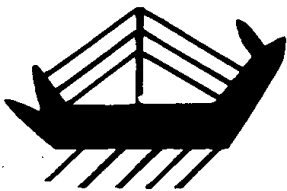
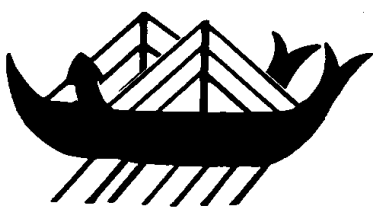
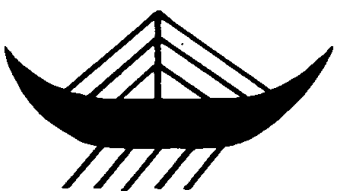
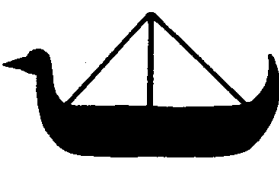

"Naqada" Petrie, W.M.F./Quibell, J.E., Naqada and Ballas, London, 1896.

"Seewesen" Gray, Dorothea, Seewesen. *Archaeologia Homerica*, Band I, Kapitel G, Göttingen, 1974.

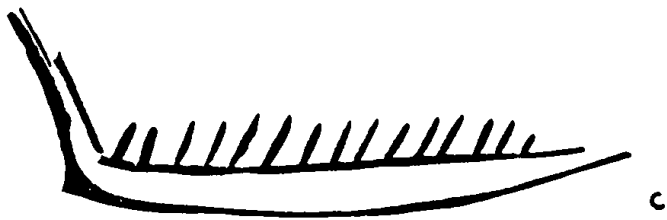
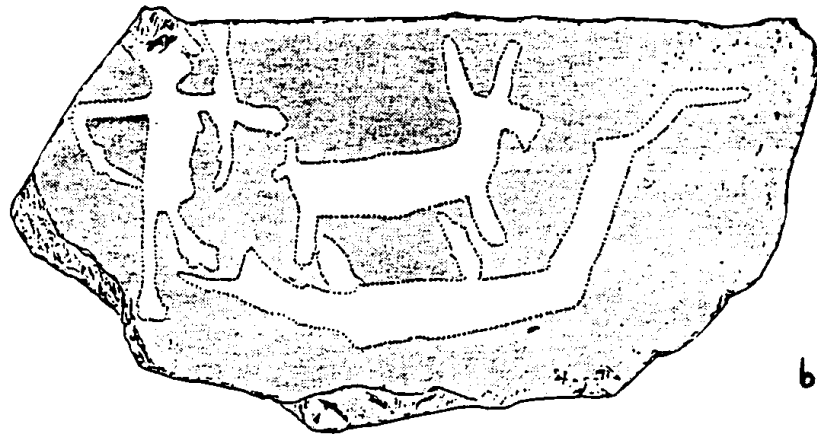
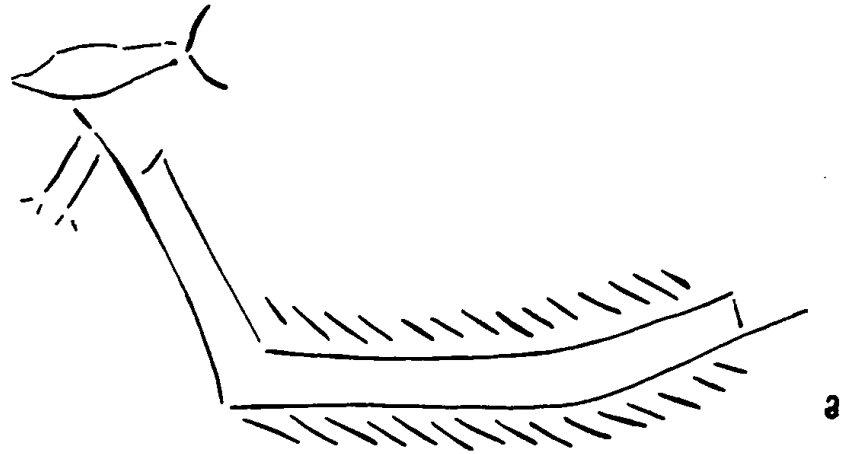
ILLUSTRATIONS

- Fig. 1 Typological chart, drawings by the author.
- Fig. 2
- a Chalandriani, Syros: clay frying pan, ECyc II; National Museum 4974; drawing by the author from Papathanasopoulos, G., *Neolithika Kykladika*, Athens, 1981, 102-103.
 - b Korphi t' Aroniou, Naxos: marble slab, ECyc II; Apeiranthos Museum, Naxos; Doumas, Christos, "Korphi t' Aroniou: mikra anaskaphiki erevna en Naxos", *Archaologikon Deltion* 20, B, 1965, 49 fig.4.
 - c Orchomenos, Boiotia: sherd, EH II (?); Chaironeia Museum; drawing by author from Kunze, Emil, Orchomenos III. *Die Keramik der frühen Bronzezeit*, München, 1934, pl.29.3.
 - d Palaikastro, Ta Ellenika ossuary: clay model, EM II; Iraklion Museum; Bosanquet., R.C./Dawkins, R.M., *The Unpublished Objects from the Palaikastro Excavations, British School at Athens Suppl. Paper 1*, 1923, 7 fig.4.
- Fig. 3
- a Naqada II vase, Pre-Dynastic; Ashmolean Museum 1895.584; *EESS* 119 fig.3 (right).
 - b Naqada II vase, Pre-Dynastic; British Museum 36326; *EESS* 118 fig.2.
 - c Naqada II vase, Pre-Dynastic; drawing by the author from *Naqada* pl. LXVII.13 (left).
 - d Naqada II vase, Pre-Dynastic; drawing by the author from *Naqada* pl. LXVI.4 (left).
- Fig. 4
- a Naxos: lead model, ECyc III; Ashmolean Museum 1929.26; Renfrew (see n.11) pl. I
 - b Provenance unknown (Crete): clay model, MM; *Mitsotakis Collection* π 50; Davaras, (see n.11) 56 fig.1.
 - c Akrotiri Miniature Fresco, LM Ia; National Museum; Marinatos, Spyridon, in *Seewesen* 140 fig.26.
 - d Dramesi-Hyria, Boiotia: stone stela, LH III; Schimatari Museum; *MIMA* 145 fig.302B.
 - e Enkomi, Cyprus: graffito, LC III; lost; drawing by the author from Westerberg, Karin, *Cypriote Ships from the Bronze Age to C.500 BC*, Gothenburg, 1983, 87 fig.13.
 - f Hal Tarxien, Malta: stone stela, *EBA*; drawing by the author from Woolner, Diana, "Graffiti of Ships at Tarxien, Malta", *Antiquity* 31, 1957, 62 fig.1 nr.9.
- Fig. 5
- a Kolonna, Aigina: clay pithos, MH II; Aigina Museum; drawing by the author from Hiller, Stefan, "Pax Minoica Versus Minoan Thalassocracy. Military Aspects of Minoan Culture" in Hägg, Robin/Marinatos, Nanno (eds), *The Minoan thalassocracy. Myth and Reality*, Stockholm, 1984, 29 fig.2 (reassembled to constitute a single ship).
 - b Knossos, Hieroglyphic Deposit: sealing, MM II or III; Iraklion Museum; *Seewesen* 41 fig.6q.

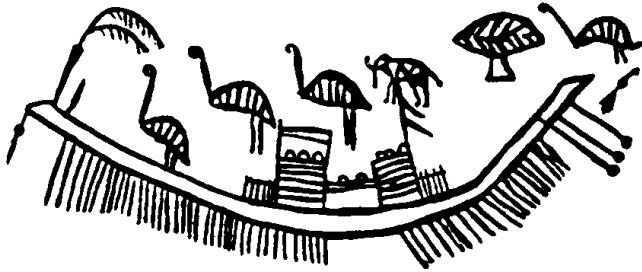
- c Provenance unknown (Crete): sealstone, MM; Philadelphia University Museum MS 4791; CMS XIII.90a.
- d Provenance unknown (Crete): sealstone, MM II or III; Berlin, Staatlichen Museen Preussischer Kulturbesitz, *Antikenabteilung* FG 56; *Seewesen*" 41 fig.6o.
- e Provenance unknown (Crete): sealstone, MM I; Ashmolean Museum 1938.760; *Seewesen*"41 fig.6i.
- f Malia: sealstone, MM I; *MCM* 235 fig. 16.
- g Provenance unknown (Crete): sealstone, MM 11a; Liverpool City Museum 8211; *CMS* VII.254a.
- Fig. 6 a Palaikastro: sealstone, EM III; Iraklion Museum 566; *CMS* II.2.261b.
- b "Adromyloi": sealstone, EM III; Iraklion Museum 588; *CMS* II.2.276b.
- c Malia: sealstone, MM I; Ashmolean Museum 1941.86; *MCM* pl.XV.36.
- d Provenance unknown (Crete): sealstone, EM III-MM I; *Seewesen*" 41 fig.6e (top).
- e as Fig.6d (bottom).
- f Malia: sealstone, EM III-MM I; Ashmolean Museum 1938.761; *Seewesen*" 41 fig.6c.
- g Malia: sealstone, EM III or MM I; Giamalakis Collection 3043; *Seewesen*"41 fig.6d.
- h Platanos Tholos B: sealstone, MM I; Iraklion Museum 1079; drawing by the author from *Seewesen*" 43 fig. 8b.
- i Provenance unknown (Crete): sealstone, MM II or III; National Museum; *Seewesen*" 41 fig.6n.
- j Mochlos Grave III: sealstone, MM III; Iraklion Museum 748; drawing by the author from *CMS* II.2.249.
- k Provenance unknown: sealstone, MM II; Haifa Maritime Museum; drawing by the author from MIMA 102 D4.
- Fig. 7 a Malia, Quartier Mu: sealing, MM II; Iraklion Museum 1503; Poursat / Godart / Olivier (see n.18) 83.
- b Phylakopi I, Melos: sherd, ECyc II; National Museum 11440; drawing by the author from Atkinson, T.D. et al, *Excavations at Phylakopi in Melos*, *Journal of Hellenic Studies* Suppl. vol.1, London, 1904, pl. V.8c.
- c Malia: sealstone, MM IIb; Iraklion Museum 2467; *CMS* II.2.195c.
- d Phaistos Disc sign nr. 25, MM IIb; Iraklion Museum; *Seewesen*" 43 fig. 8a.

	Type	Paradigm Case
	I	Syros
	II	Platanos
	III	Kolonna
	IV	Akrotiri
	V	Skyros
	VI	Tragana

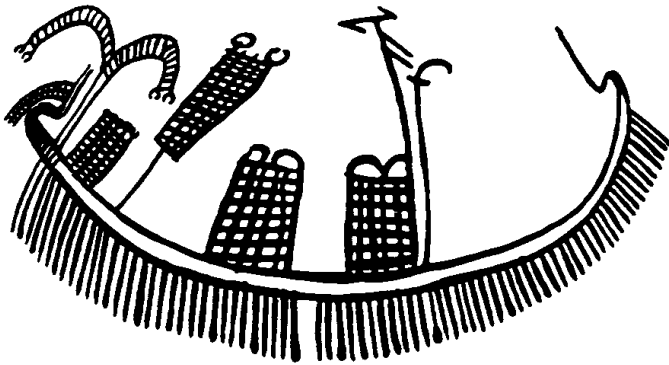
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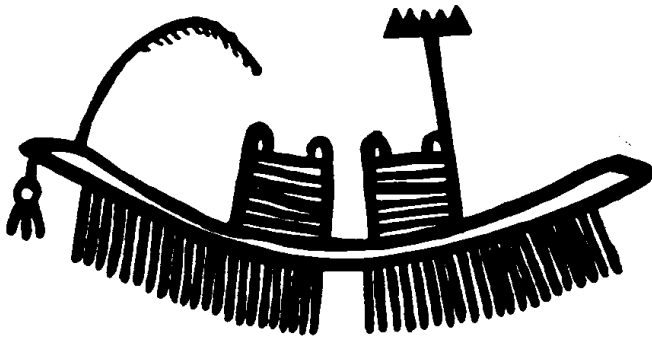
Fig



a



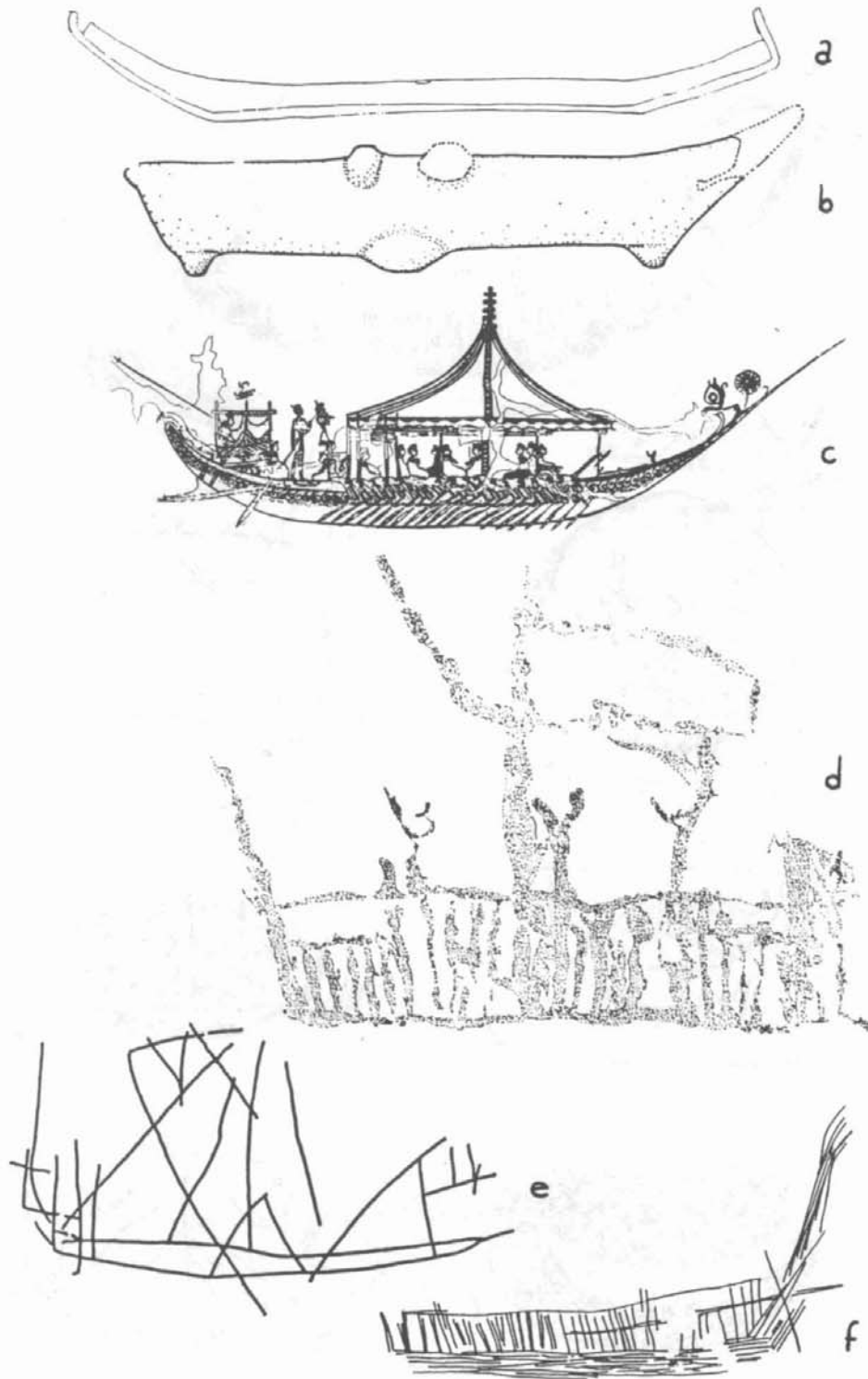
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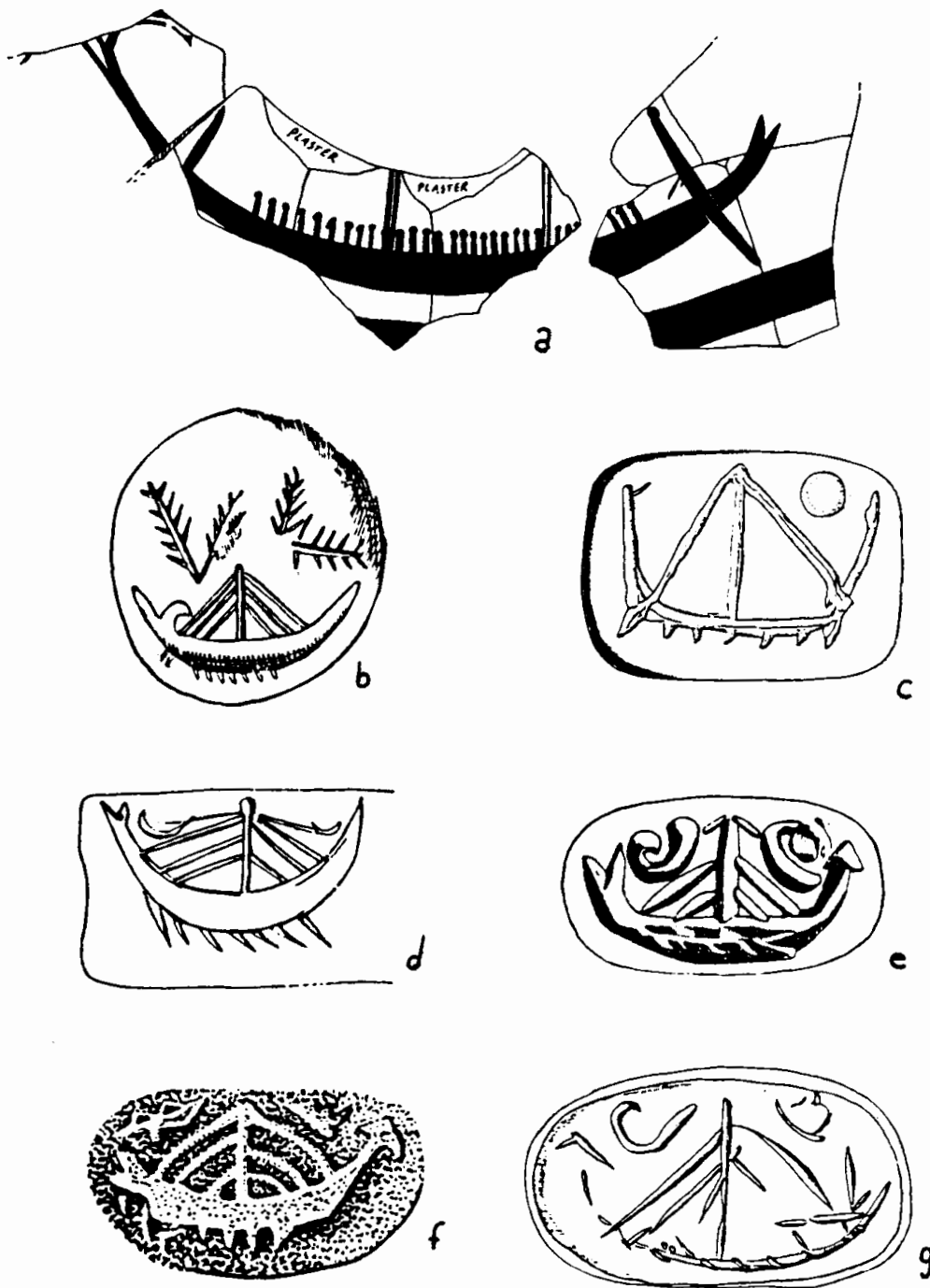
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d



Fig



5

BOW AND STERN IN EARLY AEGEAN BRONZE AGE SHIP IMAGERY

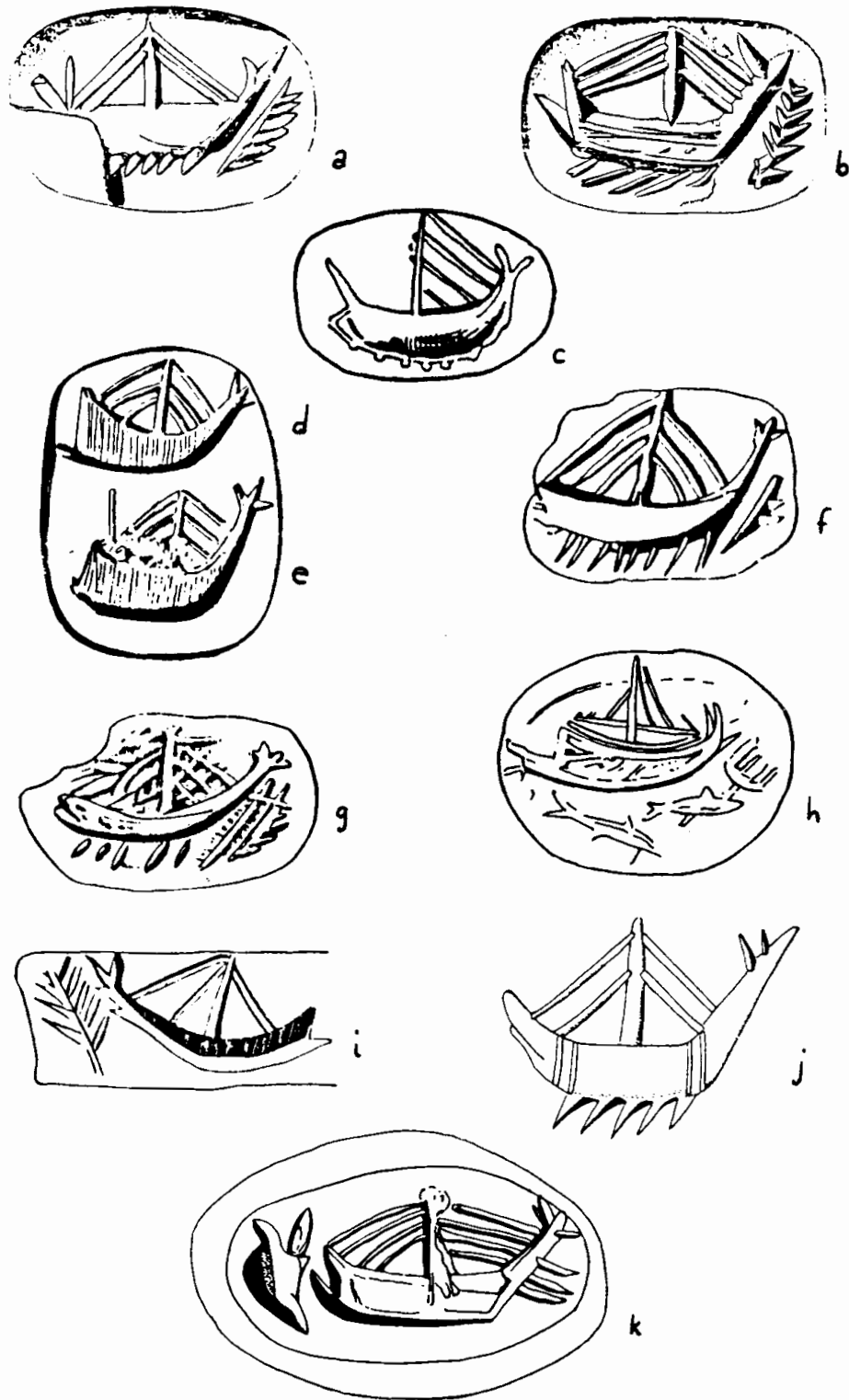
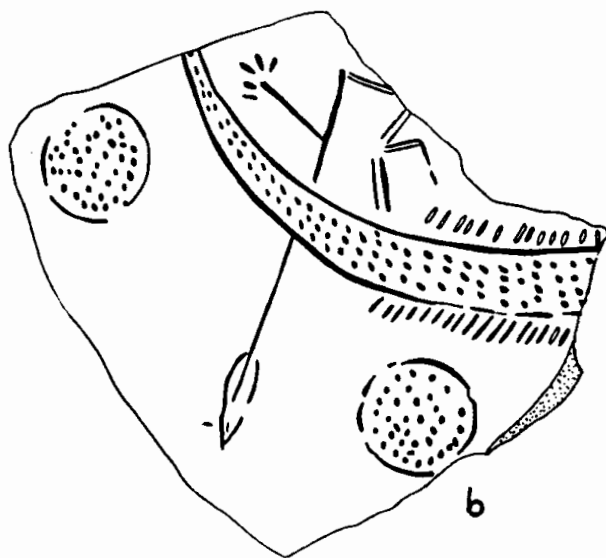


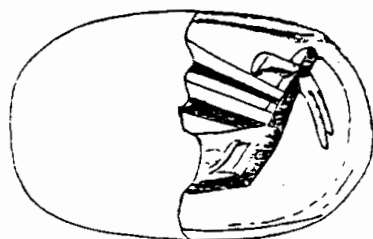
Fig.



a



b



c



d

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TOWING AND BALLAST IN ANCIENT SHIPS

Underwater archaeology has given us an enormous amount of information about the construction of ancient ships in the last thirty years and the study of representations in art, long known newly discovered, of Greek and Roman vessels continues to enlarge our knowledge of their actual appearance. There are some areas, however, where most of our information still comes from a study of ancient literary and epigraphic sources. Two of these areas, towing and the use of ballast, are the subject of this paper. While both are touched on in standard works like *Williams and Morrison* or *Casson* there has still not yet been a systematic analysis of ancient references and terminology, a project made much simpler now by the development of research tools like the *Ibycus* system for computerized word search of Greek and Latin authors. The Greek words for “shipwreck”—*nauagia*—and “a wreck but afloat”—*nauagion*—for example appear over 600 times in the corpus of authors included on a CD-ROM (nearly all, including the Church fathers; St. John Chrysostom particularly liked the image) in a variety of contexts. The computer generates the line of text before and after the line in which the word appears so that one can almost always see it in context. It can search most of extant Greek literature in under half an hour and print the texts out instantly with a laser printer.

Scenes of towing are in fact very rare and the only one said by *Williams and Morrison* (p. 109, pl. 19) to be of warships towing—on a well known black figure cup of the late 6th c. BC in the British Museum—upon examination shows no sign of such activity. One smaller vessel simply overlaps the stern of a larger under the handle of cup; the scene is certainly unusual, however as the overlapping ship is a miniature version of a warship, complete with ram. This cup also contains one of the few illustrations of a *holkas* or merchant ship in Greek art. As has been noted by many authors this term means a “towed vessel” and probably refers to the need for tug boats on occasion to move it into and out of harbour. More frequent of course are scenes of Roman merchant ships towing small boats behind and little need be said about them (see *Casson* 1970, fig. 144, 147, 154; *Torr* 1890,

103-4). Such boats no doubt accompanied Greek merchant ships too although we know of no representations of them. It is worth noting that one term for such a boat is *epholkion* or *epholkis*, words derived from the same root as *holkas*, presumably because they were towed behind a larger ship although one might speculate etymologically that the name rather indicates that they were tow boats (rather than towed boats), intended to haul the *holkas* when required. A word from the same root *parolkos* appears in papyri and in scholia on Thucydides as the word for a "tow rope." Such specially thick ropes may be meant in Aristophanes' *Peace*, II. 36-7, where "thick ropes for *holkades*" are mentioned. The Athenian naval inventories record substantial stern cables on warships of "six fingers" (i.e. 4.4 inches circumference) that would have been both convenient and strong enough for towing while anchor cables reached "eight fingers" (5.8 inches circumference). A separate class entirely were towed along the banks (Casson 1970, fig. 193). An unusual scene that has not been noticed in studies of ancient ships as far as we know appears on the remarkable glass panels from Kenchreai, eastern port of Corinth, that were recovered from beneath the sea some twenty-five years ago; they probably were intended to aborn an Isis temple on the south mole of the harbour and were buried in an earthquake around AD 365 or 375 (Ibrahim 1976, 95ff.; fig. IX, XVIII and pl. 97, 98a, 101). There are a number of scenes of ships on them but of interest here is one of a large vessel under sail which is joined to smaller ship, also under sail, by a thick rope from stern post to bow (Fig. 1). Such a method would not have been very practical since tow boats work best with their tow lines attached at least a third of the way forward from the stern arranged in a sort of yoke but accuracy was rarely of concern to the artist on such representations; another panel depicts a ship apparently being towed by a large sea creature of uncertain species—perhaps a *cetos* or sea monster (Ibrahim 1976, fig. XVII, pl. 91)—while a third seems to show a ship towing what looks like a trawl net, another topic passed over by students of maritime antiquity.

Three types of towing are of particular concern to us in this paper: warship towing merchant ship, warship towing warship, and warship towing disabled warship. We can set aside divine intervention like that of Glaucus and later Triton speeding the *Argo* on its way in Apollonius of Rhodes' Hellenistic epic, the *Argonautica* (I. 1314), although he does present us with the term *holkaion* (by which the sea gods grasp the ship) which has caused trouble for translators who have taken it variously as "keel" or "stern post" whereas as Professors Casson and Morrison have pointed out that it is undoubtedly the same as the *epholkaion* in Homer or the *epotides*, i.e. the catheads near the prow, in later writers, eminently suitable places for tow ropes or divine hands (Morrison 1968, 1998; Casson 1970,

46 n. 20). The awkward character of the holkas was no doubt compensated for by its much larger capacity but it was clearly at the mercy of the winds and it is not surprising to find references to holkades being towed on occasion by escorting warships, a practice not unknown in convoys in later days of sail. Demosthenes (50.32), for example, refers to Athenian warships towing grain ships from the northern Aegean island of Thasos to the Thracian coastal town of Stryme, a distance of some fifty miles—he uses the verb *helkein*—while Thucydides (7.23) mentions an Athenian holkas escaping a fast Syracusan trireme, presumably because it was towed by accompanying galleys, a remarkable accomplishment if true. Other occasions include Antigonus' invasion of Egypt when his warships took troop transports under tow (Diodorus XX.74) and the battle of Economus in the Punic wars when a Roman fleet was hampered by the horse transports that it was towing. The kind of disaster that could happen when towing was not available is demonstrated during the Roman Civil Wars of the first century B.C. when becalmed troop ships of Domitius Calvinus "were delivered by some god into the hands of their enemy", a fleet of 130 oared vessels on the other side (Appian IV.15.115). Wherever towing was undertaken it is likely that the towed vessel was stern first (at least if it was an empty warship), which made control much easier. Tacitus refers to this procedure even in the case of river towing when German vessels successfully cut out a number of Roman warships of the Rhine in a night time surprise attack (Histories 5.22).

It is evident from numerous references in ancient authors from the fifth century BC to Roman times that the victors of trireme battles were often able to tow away vanquished vessels if they had not broken up. It is a point that does not seem to have been made in studies of ancient shipping that the Greeks in fact apparently used two words for ship wrecks as we mentioned earlier: *nauagia* (feminine singular) for a wreck that went down and *nauagion* (neuter singular) for ships that suffered damage but were recoverable. The light build of these ships generally meant that, if rammed, they did not actually sink but continued to bob around in the water in their shattered state until washed up on some nearby shore by wind or currents, like the defeated Persian ships at Salamis on Cape Kolias. Indeed Herodotus (VIII.90) tells of one occasion when Samothracian soldiers on such a foundering vessel successfully used their javelins to overwhelm an attacker and to take his ship. The ability to claim the *nauagia* (neuter plural) was often used to support a claim for victory in battle and for the right to set up a trophy, something that happened after battle of Sybota in 433 BC during the fights between Corcyra and Corinth that were one of the principal immediate causes of the Peloponnesian War. On this occasion both sides claimed victory, the Corinthians because they

Unfortunately ballast was too mundane to receive much treatment by authors, Greek or Roman, and indeed the Greek word *herma* — which can also mean “props” or “reef” — and its compounds only appears a handful of times with reference to ships. Curiously enough it occurs as early as Aristophanes (*Birds* 1428-9) and Aristotle (*Historia Animalium* 8.12.5; 9.40.21) with reference to birds and bees taking on pebbles and sand to stabilize them in their flight, a conceit that we also find in Roman writers like Vergil (*Georgics* 4. 194-6) and Pliny the Elder. A fragment of Euripides uses the verb *hermatizo*—to take on as ballast—in the context of taking a bride and presumably settling down but its first use in a nautical context seems to be at Plato’s *Theaetetus* 144A where the simile “like unballasted ships” is found. A very clear use of the term with a war ship is to be found in the third century BC in that most difficult of Greek poems, Lycophron’s *Alexandria*, at l. 618: Diomedes throws out ballast stones, once part of Troy’s walls, from his vessel which has come to Italy after the Trojan War while later in the poem *Medea* is described figuratively as ballast for the *Argo*.

It is, we hope, evident from what we have said that there are further opportunities to examine such topics in greater detail than has been hitherto possible. It is slow laborious process and indeed access to the Ibycus system for us was limited to a few afternoons in London and Athens and we did not have time to search all terms or analyze all material recovered. In the end, however, we think that it will put our knowledge of many aspects of ancient maritime affairs on a firmer footing.

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