(GREEK) SAILING MERCHANT-SHIPS, *c.* 500-330 BC

A Preliminary Research

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Introduction

Trade may, I think, be ranked—like war—among the oldest activities of mankind. From very early date we have evidence that part of this trade took place over water, be it by floats or by boats.

In this search for evidence present at the moment I want to limit my research basically to the period 500-330 BC and the Greek world. It sometimes will, however, also be necessary to go beyond the limits I have set for the sake of argument and clarity. Another limit I have set is that I will confine myself to sailing merchantmen. Apart from the sailing merchantmen quite a number of types of oared merchantships existed.[1] Though these oared ships also served as merchantmen, these ships were essentially hybrids or all-purpose ships.[2] In my opinion both the space needed for rowers and the costs involved with rowers would deter any merchant to employ them if he could avoid it. Only for cargoes requiring quick transport oared merchantmen would have been preferable. I think these hybrids may be compared with the so-called Drakkars of the Norsemen. Like these, the crew of the oared merchantmen may sometimes have combined peaceful trade with missions of another kind. Also excluded from the review are the transports for troops and horses. They mostly were (derived) types of the *trireme*.[3]

In this preliminary research I intend to combine the data obtained from the traditional historical and archaeological sources with the data obtained by maritime archaeological and experimental archaeological research. Limited as the subject is, it can nevertheless only be a prelimi-

[1] *Cf.* Homer, *Od.*, ix.322-23; also Casson 1986: 157-168; some writers, like Meijer 1990: 149 (Meijer 1986: 77-8, however clearly distinguishes between merchant galleys and sailing ships) seem to state that all merchantmen were oared ships: I think that this idea is based upon a too literally translation after Homer (cf. also *infra* n. 7 and n. 8).

[2] *Cf.* Casson 1986: 158, 446 *ad* p. 158 and *ad* p. 162.

[3] *Cf.* Casson 1986: 93-4.

nary research since the number of data generated both by maritime and experimental archaeology is increasing almost daily. At the same time also the traditional historical and archaeological sources quite often appear to offer alternative interpretations, apparent only in combination with the results of the research of maritime and experimental archaeologists.

The common denominations of sailing ships in Greek are πλοῖα στρογγύλα (round ships),[4] πλοῖα φορτηγικά (ships of burden),[5] ὁλκάδες (towed ships)[6] or just πλοῖα (ships). In my opinion its context makes the use of *ploia* as sailing (merchant)ships probable in Xenophon's *Anabasis* VI.vi.1, 5. Casson rightly states that many seagoing sailing ships were nevertheless indicated as "twenty-ers". He supposed this term may have been derived from Homer (*Od.*, ix.322-23). Homer may, according to Casson, very well have had in mind a merchant galley powered by that many rowers, but thereafter it was applied indiscriminately to sailing ships of all sizes.[7]

Iconographic material

Pottery

Both arthistorical material and historical evidence for (Greek) merchantmen in the period between c. 500-330 BC is rather limited, but more widespread for the periods before and after.[8] The paucity of materials also extends to other information regarding maritime activity in the classical period. I think that the information from the periods before and after the classical period may be used as evidence for our research. Both the iconographical and historical materials show a strong continuity in the appearance and construction techniques of the (mer-

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[4] *Cf. e.g.* Hdt. I.163 and Thphr., *HP*, V.vii.1.

[5] X., *HG*, V.i.21.

[6] *Cf.* Hdt. III.135; Th. VII.vii.3; as Casson 1986: 169, n. 2 states, the word *holkas* comes from a root meaning "tow" (ὁλκάζω); the *holkas*, powered solely by sail, had to be towed in and out of harbour; *cf.* also *GEL*, *s.v.* The towing of the *holkas* occurred, probably, by the ship's boat. The presence of such boats is attested by Nicander (*Ther.*, 266-70) and the story of Hegesander and Zenothemis as related by Demosthenes (*Against Zenothemis*, 4-6). I think this word is the origin of the type of ship known as "hulk".

[7] Casson 1986: 169, n. 5.

[8] *Cf.* also Johnston 1985: 75; Wallinga 1993: 35 *sqq.* tries to explain this by minimalising the importance of the sail in general and sailing ships specially. From this study it will become obvious that I completely disagree with him on this point: I think that throughout the history of seafaring the sail has been a constant and important factor in the propulsion of ships.

chant) ships. This observation is supported by maritime archaeological evidence, as we will show below.

Generally speaking, there exist still much less illustrations of transport ships in (Greek) vase paintings, graffiti etc. than of ships of war or oared ships generally. All, or at least most of the, available material has been collected by Basch.[9] The best known vase painting of a Greek merchantship is to be seen on an Attic black-figure *kylix*.[10] It shows a merchant vessel encountered by a warship or a privateer, probably a *hemiola*. The *kylix* belongs to the Leagros-group and is dated around 510 BC (Pl. 1).

Other vase-paintings showing sailing merchantships are a *krater* from Caere/Cerveteri, a *pinax* from Pentheskouphia and a vase from Vulci. The *krater* was signed by Aristonothos. Morrison and Williams suppose that the *krater* probably was of West Greek origin.[11] It shows an oar-propelled warship attacking a ship with raised bow and stern, defended by four armed men, protected by shields. Morrison and Williams describe the ship as having a downpointing ram, which I am unable to see. The *krater* is kept in the Palazzo dei Conservatori at Rome. The picture on this krater is closely paralleled on a fibula from Sparta dated to the 8th century BC.[12] There, however, a line of men is visible below the—in this case three—defenders of the ship: it might suggest an origin as oared ship.

The fragmentary terracotta *pinax* which was found at Penteskouphia shows the stern of a big cargo-ship. The mast stands with shrouds and the yard with a belayed sail is lowered. Five *amphorae* may indicate the nature of the cargo. The *pinax* is depicted in Halldin, fig. 71. The *pinax* may be dated about 600-550 BC and is Greek.[13]

A vase from Vulci, dating from the 6th century BC[14] and kept in the British Museum,[15] a.o. shows a merchantman with curved stern with steering-oar and a wedged bow. One part of the bow is curved, first upward and inwards but at the top to the outside, the other part protrudes somewhat. The ship carries a mast and the sail is set. Partially due to the rather primitive way the ship is depicted the setting is not quite clear. The impression I get is that we are dealing here with a sailing ship carrying troops and (their) animals, probably horses. Hagy suggests that the ship

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[9] Basch 1987.

[10] British Museum, BM B 436.

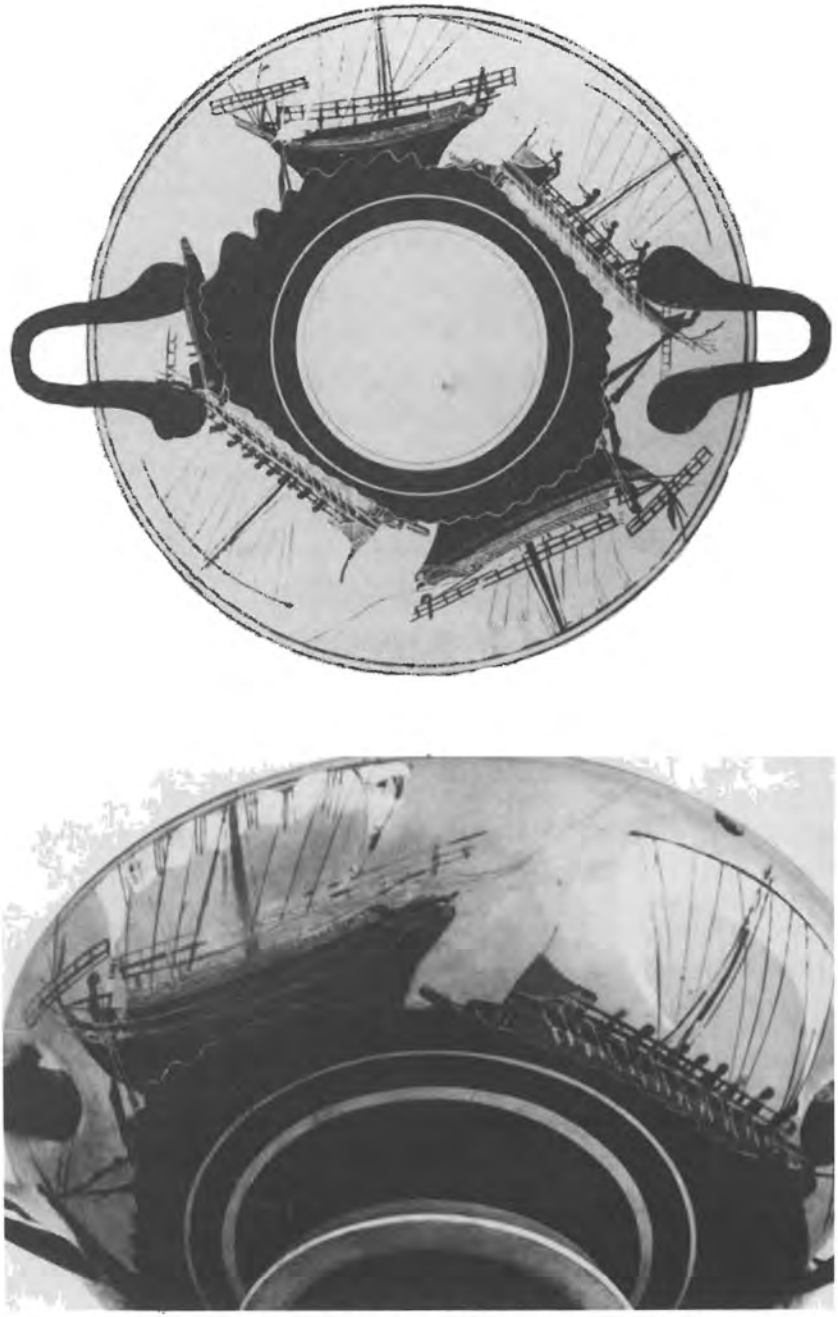
[11] Morrison/Williams 1968: 74-5.

[12] Hagy 1986: 235, fig. 19.

[13] Ericsson 1984: 26.

[14] For Greek influence in the region of Vulci at this period *cf. e.g.* Boardman 1980: 203.

[15] British Museum, BM H 230. The vase is known as the Polledrara vase.



Pl. 1. Attic black-figured *kylix*, *c.* 510 BC, British Museum BM B 436.

was a hybrid one, but since in the picture itself no oarholes are visible I dare not confirm his suggestion.[16]

The material assembled by Morrison and Williams still shows another ship propelled by sail.[17] It is an Attic black-figure cup, signed by Exekias, now in München[18] and dating from *c.* 550-530 BC. Though the ship shows (except the steering-oars) no oars, oar-holes or tholepins I hesitate to look upon this ship as a merchantman. First, because of its "cargo", the god Dionysus, second because of the ram. Moreover, the construction of the hull, including the ram, corresponds so closely with the ship depicted on a black-figure *dinos*[19] that I cannot but conclude that this ship was no sailing merchantman.

Paintings & graffiti

From the "Tomba della nave" in Tarquinia originates a painted large-sized cargo-ship with a mainmast well stayed and carrying a sail and a foremast slightly tilting forwards. The hull is shown completely, as if the ship is beached. Though Etruscan, the work was probably influenced by Greek-Ionian technique.[20] The mural painting, dated about 490-480 BC, is now in the Tarquinia museum.[21]

Lucien Basch presented two graffiti from *hypogeum* no. 2 at Anfouchy (Alexandria).[22] The dating of each of these graffiti—each depicting a merchantman under sail—is fairly uncertain. The time limits that can be set are the construction of the *hypogeum* (about 270 BC) and its abandonment (the beginning of the reign of Augustus). The interesting aspect of these two graffiti is the position of the sail. Though carrying square sails, the brailing of the sails is such, that we witness a step in the development of the lateen sail.

Models

The last group of objects revealing evidence on (Greek) sailing ships are the models. The Metropolitan Museum of Art in New York keeps a clay model from Cyprus, dating from the 6th century BC.[23] Both stern and bow are curved, the bow ending in the shape of a head looking into the

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[16] Hagy 1986: 232.

[17] Morrison/Williams 1968: 93 and plate 13.

[18] München 2044, *cf.* Beazley *ABV* 146/21 with bibliography.

[19] Wien 3619; *cf.* Beazley *ABV* 140/3 and Morrison/Williams 1968: 92 and plate 14a/b.

[20] *Cf.* Ericsson 1984: 26.

[21] *Cf.* Casson 1991: plate 27; for Greek influence in tomb painting *cf. e.g.* Boardman 1980: 206.

[22] Basch 1989.

[23] *Cf.* Casson 1986: plate 94.

Pl. 2. Clay model from Cyprus, 6th century BC, Metropolitan Museum of Art.

ship. The wales of the ship are clearly shown as are the pins for the steering-oar. The ship is fairly round bottomed with only the keelbaulk or even the false keel protruding clearly (Pl. 2).

From tomb 17a in Spina comes an *askos* in the form of a ship's hull, fitted with a handle, in black Campanian or Etrusco-Campanian ware.[24] It is dated in the early half of the 4th century BC and kept at the Museo Archeologico Nazionale of Ferrara. The hull shows a curved stern profile but a bow with a ram-like beak, somewhat similar to the lower part of the vessel depicted on the Vulci vase.

From Gela, the Museo Archeologico Nazionale,[25] we have the model of an undecked vessel, possibly a merchantman, manufactured locally of reddish clay. The deep articulated keel is strongly rockered, at the stern rising into a single-branched *acrostolion*. Its proportions are wide and beamy, suggesting its origin as a merchantman. The dating of this model rather varies: from 400 to 300-280 BC. The model is depicted in Johnston[26] where also the relevant literature is mentioned.

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[24] For Spina as a 'Greek' city *cf.* Boardman 1980: 228-9.
[25] Inv. nr. 3733.
[26] Johnston 1985: 98-9.

The oldest known merchantman-model was a votive of the mid 7th century BC from the Heraion at Samos. Its present location is unknown.[27] It is (was?) a built wooden model, of which the major part of one side is preserved in several fragments. A short section of the keel is also preserved. In section, the hull is of deep-V configuration, with slightly convex sides. The preserved keel section is pegged at regular intervals to the hull by means of round wooden dowels set at slightly sloping angle to the bottom of the keel. The keel itself is rectangular in section.

Apart from the models mentioned above, there exists a limited number of models that might have represented sailing merchant vessels or small crafts. These models, however, are too damaged to serve as evidence: they might as well belong to models of warships.

Reviewing the arthistorical material from archaic, classical and early Hellenistic periods we can but conclude that an overwhelming majority—of the material connected with maritime affairs—is related with oared vessels or, more precisely, predominantly with warships.[28] Merchantmen have hardly left traces in art history. The material we do have shows rather deep vessels, curving upwards at bow and stern to increase their carrying capacity. They generally have one mast—one graffito shows a ship with two masts—amidships and a single broad rectangular sail. Apart from the steering-oars the pictures show no oars. The sail was connected with the yard but was left practically loose-footed, except for some lines to keep the sail in the desired position. Some pictures clearly show the brails, by which the amount of sail that was set could be arranged. The function of the keel is to serve as a base or junction piece for stern and stern posts. Obviously the shipbuilders did not consider the keel necessary, as we do today. By increasing the thickness of the false keel, that protected the keel against wear by friction when the ship was beached, the sailing capacity of the ship was improved. The enlarged false keel acted as a factor of resistance against leeward drift and thereby improved the ship's capacity to keep course in a cross wind. By the increase of the false keel's thickness it also served as a permanent stabiliser.[29] Personally, I think that also the steering-oars contributed to the stability and somewhat protected against leeward drift, very much acting like the lee boards of later round-or flatbottomed sailing (working)ships.[30]

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[27] Johnston 1985: 59-60.
[28] Cf. Basch 1987.
[29] *Cf.* Laures 1985.
[30] *Cf.* also Roberts 1993: 33.

General

Quite a number of writers presents us with some amount of information concerning ships, shipbuilding, naval techniques etc. Unfortunately not all of their information is—at present—useful or understandable. Another part of the information is more or less useless, since its function was largely ornamental, like many of the *epitheta ornantia* we find in Homer, and not instructive. Nevertheless, one of the best accounts of the construction of a ship is to be found in Homer.

In the *Odyssey*, v.244-262, the story is told how Odysseus built himself a boat when he was allowed to leave the island of Calypso. Important elements are: the boring (or drilling) of all planks, the fitting of the planks and the hammering of mortises (joints, ἁρμονίαι) and tenons (dowels, γόμφοι), and afterwards inserting the frames (ribs) and setting up decks. He stepped a mast and yard (ἐπίκριον) and added a broad oar to steer with. He fenced the hull about with plenty of brush. He fashioned the sail and rigged braces (ὑπέραι), brails (κάλοι), and sheets (πόδες) (Fig. 1).

To show the continuity of ship construction techniques a very late source may be quoted. It is a text from the 3rd century AD, where in an unspecified year a number of men works on a boat.[31] Several shipwrights (varying from 3 to 7) work on a ship, while two sawyers take care that a sufficient amount of (persea)wood is present. At a given time the sawyers are ordered to cut (acacia)wood for the frames. When the boat is near completion, the scaffold on one side of the boat is dismantled, the day after also the scaffold of the other side. Though the text does not specify how the planks were joined, it makes clear that the shell-first method, with later insertion of frames, was still in use. It might perhaps be inferred from this text that to shape the ship an exterior scaffolding was used, but I think that the evidence is far too scanty for a conclusion.[32]

I think we now may return to Homer. In *Odyssey*, ii.418-428 Telemachus, accompanied by the goddess Athena, sails out (in an oared ship). Athena takes care of a good wind and Telemachus orders his men to raise the fir mast. The men put the mast in the mast step (μεσόδμη), fastened the (two) forestays (προτόναι) and drew up the sail (I think the yard with sail attached to it is meant) with well twisted ropes of oxhide (βοεύς). Elsewhere[33] Homer also mentions the (single) backstay, the ἐπίτονος.

From his accounts Homer emerges as a man who clearly was well

[31] *P. Flor.* I 69, republished Casson 1990.

[32] *Cf.* also Casson 1986: 203 and n. 13.

[33] Homer, *Od.*, xii.423.

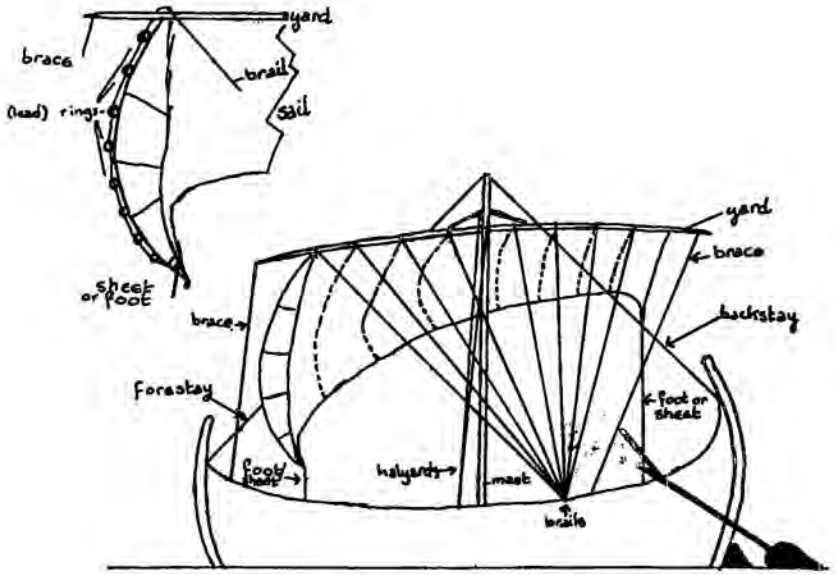

Fig. 1. Main standing and running rigging of Greek sailing ship.

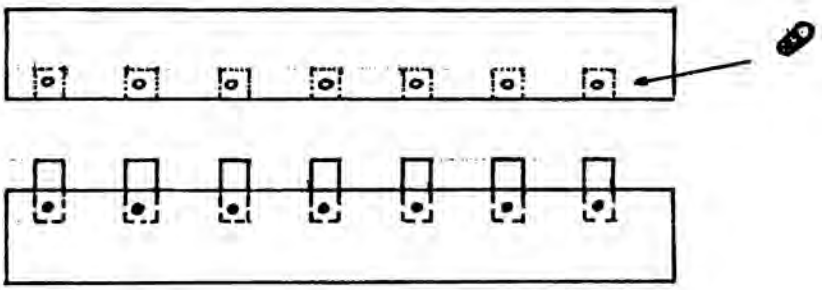

Fig. 2. Stakes to be joined by mortising and tenoning.

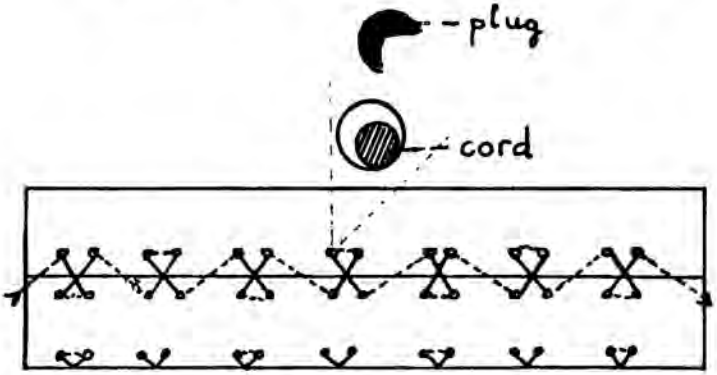

Fig. 3. Strakes joined by sewing.

informed about nautical matters. The same verdict does not hold good for Hesiod as well. In the *Works and Days* Hesiod warns Perses to, at the end of October: "Haul up your ship upon the land and pack it closely with stones all round to keep off the power of the winds which blow damply, and draw out the bilge-plug so that the rain of heaven may not rot it. Put away all the tackle (χείμαρος) and fittings in your house, and stow the wings of the seagoing ship neatly, and hang up the well-shaped rudder over the smoke".[34] Somewhat further, in line 660, Hesiod remarks, telling he crossed from Boeotia to Euboia, "Such is all my experience of many-pegged ships (νηῶν....πολυγόμφων)". In between these fragments Hesiod warns Perses against the dangers of maritime trade generally and going out at sea in person specifically. He gives advice for the right time to go out at sea (from the end of July to the end of October), because then the winds are steady and the wind is harmless.[35] There are people who go out in spring, but "such a sailing is snatched, and you will hardly avoid mischief".[36] Remarkable in the account of Hesiod is the pegging and the presence of a bilge-plug to get rid of water inside the ship, when the ship is beached.

Plutarch gives additional information about mortising and tenoning, remarking about the (mortises and) tenons that they were to be made of not too green (= wet) wood, and that they were greased before placing them in the slots (Fig. 2).[37]

The material needed for the construction of ships is mentioned by the so-called Old Oligarch: "These are just what I need for ships—wood from one, iron from another, and copper, flax and wax from others".[38]

Of the wood Theophrastus tells us:[39] "In shipbuilding, because bending is necessary, wood which is rather green must be used. Of course, where joining is involved, somewhat drier wood is in order". After the ship has been finished, it is dragged down to the water "and then it closes up and becomes watertight,—unless all the moisture has been dried out of it, in which case the joining does not fit or not so well". For the joining Theophrastus here uses the term κόλλησις, normally a.o. translated by gluing or fitting closely. Casson argues that it should be translated here differently, *e.g.* by "piecing together".[40] Joining seems to me a good neutral term.

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[34] Hes., *Op.*, 618-28.
[35] Hes., *Op.*, 670.
[36] Hes., *Op.*, 684.
[37] Plu., *Mor.*, 321d.
[38] [X.], *Ath.*, II.11.
[39] Thphr., *HP*, V.vii.4.
[40] Casson 1986: 205 n. 21.

Theophrastus[41] also mentions the types of wood preferred for shipbuilding: fir, cedar, and pine, for merchantmen preferably fir for planking and for the keel, but providing the latter with an underlayer of oak if these haul out. Keels of small craft are made of beech, as are false keels. In Plato[42] we read: "There is no fir to speak of nor pine and not much cypress; nor could one find much larch or plane, which shipwrights are always obliged to use for the interior parts of ships". Also Homer stated[43] that pine-trees were fit for shipbuilding.

Oak is considered unfit for planking of seagoing vessels by Theophrastus: "ἐν δὲ τῇ θαλάττῃ σήπεται" (it rots in the sea).[44] Elsewhere[45] Theophrastus mentions that black acacia is used for the construction of ship's ribs or frames (ἐγκοίλια). In Greek we have two words for the ribs, the *stamines* (σταμῖνες) and the *enkoilia*.[46] Casson supposes[47] that the *stamines* were the standing part of the ribs, the *enkoilia* the part fitted into the curve of the bilge. There, always some water would collect (that is why Odysseus put plenty of brush on the bottom of his ship, to keep dry feet) and rot-resistant wood is therefore preferable. All wood, used for the construction of ships, had, according to Vitruvius,[48] to be cut from the beginning of autumn or in the winter. This seemingly strange detail was confirmed by research on some English men of war of the 17th and 18th century AD.[49]

As from Homer's "black ships" might be concluded, it was usual to smear the seams or even the whole hull with tar, pitch, or with pitch and wax. The use of wax is confirmed by Arrian,[50] discussing the shortage of naval supplies in the Black Sea: "Even the wax was scraped off".

For the construction of ships there exists, finally, a report by one Moschion, quoted by Athenaeus.[51] It is the story of a supercarrier, constructed on the orders of King Hiero II of Syracuse under supervision of Archimedes. The materials mentioned were wood (of Mt. Etna) and unspecified rot-proof wood, for cordage esparto from Spain, and hemp and pitch from the Rhone valley. After six months half of the ship was finished, down to the sheathing of each area, as it was completed, with lead sheets. The hull was pinned together with copper spikes (made fast

[41] Thphr., *HP*, V.vii.1-2.
[42] Pl., *Lg.*, 705c.
[43] *E.g.* Hom., *Il.*, XIII.390-1, XIV.483-4.
[44] Thphr., *HP*, V.iv.3.
[45] Thphr., *HP*, IV.ii.8.
[46] *Cf.* Ath., V.206F.
[47] Casson 1986: 221.
[48] Vitruvius, II.9.
[49] White 1879: 424.
[50] Arr., *PPE*, 5.
[51] Ath., V.206D-209B.

to the ribs) and covered by an underlayer of tarred fabric and overlayer of lead sheeting. A good translation of the whole story is given by Casson.[52]

Finally we return to Homer. Up to here we have, discussing the construction of ships, seen that generally the planks were joined by mortising and tenoning. For this practice Homer also seems to offer an alternative. In the *Iliad*[53] Agamemnon remarks that the ship's planks are rotten and the cords (σπάρτα) are loosening. Homer seems to describe a ship of which the planks had been sewn together.

So far for the construction of the ship, for the moment. Also for the use of the steering-oar and the sails the classical sources give some information. Aristotle, or better someone of the peripathetic school,[54] explains how the steering-oar (πηδάλιον) functions in such a way that it is sufficiently powerful for a single man to steer a heavy ship. The steering-oar acted as a lever and the fulcrum was the point at which the steering-oar was attached to the ship. By the ingenuity of its design it was possible that "one tiny little old man, who turns those great steering oars with a tiller (κάμαξ) that is no more than a stick, was responsible for its [= the grainship Isis, JPS] safety".[55]

As we have stated from the beginning our main interest in this research lies with sailing ships. It is, therefore, fit to pay some attention to the sailing capacities of the (Greek) merchantmen. In the *Knights* Aristophanes gives some clues for the handling of the sail during a following storm.[56] In lines 436-7 the chorus states: "Look out, and slack the sheet away, I hear a loud Nor'Easter and Sycophanter blow". Some lines later, in line 440, it remarks: "Relax the ropes from the end of the sail-yard" (= the τέρθριος, used for reefing). The yard is lowered, the sheets loosened in order to reduce the influence of the wind by shifting downward the centre of pressure of the sail towards the hull. In the *Frogs*[57] Aristophanes says: "Brail the sails and only use the sail's edges...and wait for the moment you'll receive a prosperous and constant wind". The same metaphor Aristophanes used both in the *Knights* and the *Frogs* is also to be found in Euripides' *Medea*, lines 523-6.

A very interesting passage on sailing is given in Aristoteles' *Mechanics*.[58] It runs as follows: "Why, when people want to run across with the wind's help, although the wind is not favourable, do they reef up (the part

[52] Casson 1986: 194-9.
[53] Hom., *Il.*, II.135.
[54] Arist., *Mech.*, 5.850B-851A.
[55] Lucian, *Nav.*, 5-6.
[56] Ar., *Eq.*, 430-41.
[57] Ar., *Ra.*, 999-1000.
[58] Arist., *Mech.*, 7.851b.

of) the sail near the helmsman, and let go the part near the bow, making a foot? Is it because the rudder cannot act against the wind when it is stormy, but can when it is weak and so they furl in the sail? In this way the wind carries the ship forward, but the steering-oar turns it into the wind, acting against the sea as a lever. At the same time the seamen also fight against the wind; for they lean themselves in the opposite direction." I think this passage is interesting for several reasons. First, the way the sail is brailed resembles the pictures of the ships in *hypogeum* no. 2 at Alexandria. The sail is more or less shaped like the later lateen sail. Typical for the lateen sail, apart from its triangular shape, is that using such a sail you can take a relatively high course against the wind. The second element of interest in this text is the activity of the men. Here, too, a parallel may be drawn with later sailing (working)ships as we have seen them until this century. In situations as described in this passage, the men lean out of the ship, mostly in a kind of trapeze, to balance it. Of course, this can only be done if the ship is not too big (up to about 15 m) and top-heavy, with a crew up to 7-8 men. The practice considerably contributes both to the speed and the increase of the angle in relation to the wind in which can be sailed, the latter the better if also the connection between yard and mast is sufficiently flexible to allow different positions of the sail. In fact, by tacking one can, and could as may be read from Nicander,[59] set a course almost against the wind.

Generally we may say of the *holkas* that it was not an oared ship. Aristotle's remark[60] that certain insects fly clumsily and weakly as if a *holkas* were to attempt to move by means of oars is, I think, a sufficient illustration for this conclusion. The *holkas* was broad and deep,[61] and probably did not beach like a long ship (= warship) but was moored in deep water.[62] Its sailing capacities enabled it to go wherever wanted or needed.

Dimensions

The problem of the dimensions, or, to be more exact, the carrying capacity, of the Greek merchantmen has been a topic of discussion over the years. Especially Wallinga has written an influential article on the topic.[63] The key passage, as I see it, for the discussion is Thucydides' rendering of the terms of the truce between Sparta and Athens in 423

[59] Nic., *Ther.*, 266-70.
[60] Arist., *IA.*, 710A.
[61] *Cf.* Arr. Fr. 19 *ap.* Suidam *s.v.* ναῦς.
[62] Th. II.xci.3.
[63] Wallinga 1964.

BC:[64] "Καὶ τῇ θαλάσσηι χρωμένους, ὅσα ἄν κατὰ τὴν ἑαυτῶν καὶ κατὰ τὴν ξυμμαχίαν, Λακεδαιμονίους καὶ τοὺς ξυμμάχους πλεῖν μὴ μακρᾷ νηί, ἄλλῳ δὲ κωπήρει πλοίῳ ἐς πεντακόσια τάλαντα ἄγοντι μέτρα (As to the use of the sea, in so far as they use it along their own coast and along that of their confederacy, the Lacedaemonians and their allies may sail, not with a ship of war, but with any vessel furnished with oars up to five hundred talents of burden)". As a talent measures 26.196 kg, this would mean that oared ships up to 13 tons were the maximum the Lacaedemonians and allies were allowed to use. Sailing ships obviously were left out of the treaty, though from the context we may infer that the vessel furnished with oars also could serve as a merchant vessel: it clearly was a hybrid ship. Gomme[65] rightly remarks that a ship of 500 talents was a very small one. I completely agree with this view. But was it "absurdly small" as Wallinga[66] tries to show?

I doubt that we may read "μέτρα" as anything else than a *limitationis* of "τάλαντα", "with respect to weight". The search for other units by Wallinga seems to me, therefore, rather unconvincing. I think that, by the terms of this treaty, the category of smallest ships is determined: ships up to 500 talents. Such categories we also find elsewhere in Greek literature. We find τρισχιλιοφόροι ὁλκάδες,[67] the χιλιοφόρος πλοῖον,[68] and the μυριοφόροι or μυριαγώγοι ὁλκάδες.[69]

As I see it now, we may divide the ships into six classes: ships up to 500 talents (13 tons), ships between 500 and 1,000 talents (26 tons), ships between 1,000 and 3,000 talents (78 tons), ships between 3,000 and 5,000 talents (130 tons),[70] ships between 5,000 and 10,000 talents (260 tons), and ships over 10,000 talents. The size of the ships of some of these classes seems rather small, certainly if we compare them with the large supercarriers we know from the Hellenistic and Roman periods. By then, however, the character of trade had changed. The state had, directly or indirectly, partly taken over the role that previously had been played by private investors. The risks involved in such investments is clearly

[64] Th. IV.cxviii.5.

[65] Gomme, *CoT.* III, *ad loc.*

[66] Wallinga 1964: 36.

[67] Dion. Hal. III.44.

[68] D.C. LVI.27.

[69] Th. VII.xxv.6, Ctesias Fr. 57.6 (= *Indica* 6), Str. III.iii.1, also Philo Judaeus (i. AD), Pollianus (ii. AD) and Themistus (iv. AD): we have, however, no information on their sources.

[70] Both the categories of 3,000 and 5,000 talents are described in *IG* XII Suppl., no. 348 (= *SEG* XVII 417): ...πλοῖον..[.φόρτον ἄγον τρ]ισχι[λ]ίων ταλάντων, ... ἄγο[ν] πεντα[κ]ισχ[ιλίων] τα[λάντω]ν.

shown in a number of trials.[71] The larger the ship, the larger the risk for the investors if anything happened. Though we may infer from the classical sources that also in the classical period quite sizeable merchant ships existed,[72] I think that the emergence of the Hellenistic states also marks the beginning of the increase of the general size of merchant ships, just like the beginning of the Byzantine era witnessed the return of small-scale ships.[73] The text of *IG* XII Suppl. no 348 (= *SEG* XVII 417), a port regulation issued by the authorities of Thasos, clearly demonstrates that by then (2nd half of the 3rd century BC), next to the large carriers which were admitted in one of the harbour basins, smaller carriers also played their part.

Maritime archaeological research

Since archaeologists discovered the use of the SCUBA several wrecks of the archaic and classical periods have been investigated. The oldest wrecks found, at Cape Gelidonya and at Ulu Burun even date from the Bronze Age. The length of the Cape Gelidonya ship had been about 9 to 10 m, its cargo about 1 ton and it had been able to trade anywhere in the Eastern Mediterranean and the Aegean.[74] Also the still earlier Ulu Burun ship transported an international cargo. Both ships had been constructed according to the shell-first method, the strakes being set in carvel-like fashion and connected by mortising and tenoning. An interesting detail, keeping Odysseus' boat in mind, is that under the cargo of the Cape Gelidonya ship brushwood dunnage was found.

From the 4th century BC a wreck has been reported at Dattilo (Panarea, Aeolian Islands).[75] At the moment the only thing that can be said is that the area where the ship was wrecked is identified as the crater of a submerged vulcano. This offers specific problems, for the divers, for the work, and for the artifacts. As far as can be said at this time the cargo

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[71] *Cf.* Dem., *Against Apaturius, Against Lacritus, Against Zenothemis, Against Phormio.*

[72] *E.g.* used to transport troops: to move the *c.* 8,600 soldiers who had survived the expedition of Cyrus the Younger about 100 ships were thought to be needed (X., *An.*, V.vii.8), while the Carthaginian general Hannibal prepared in 409 BC some 1,500 transports to move his army of about 100,000 men (D.S. XIII.liv.1-2, 5; X., *HG*, I.i.37) to Sicily. About 80 soldiers, plus equipment plus part of the camp-followers, on each ship means—even if we accept that part of the transport was done by oared ships or "old trieres" specially used to transport troops and their equipment—that also sailing ships involved in these undertakings must have been quite sizeable.

[73] *Cf.* Eiseman 1979: 212.

[74] Bass 1967: 142, 163.

[75] Bound 1989a, 1989b.

seems to have consisted almost completely of black painted finewares. The way the ship was constructed is still obscure, if it will ever be clear at all.

Kazianes, Simossi and Haniotes reported in 1990 on three so-called amphora-wrecks.[76] The first, at Seriphos, is believed to have been an early Hellenistic wreck. The authors think it possible that the hull is preserved under the seabed. The second ship, found at Agios Ioannis Theologos, Phtiotis, was from the late Byzantine period. The third ship, at Kavo Vodi, Rhodes, contained amphorae dating from the middle of the 5th century BC. Unfortunately, no remains of the hull are reported.

In 1991 Bound reported on research near Zakynthos, where he has found fragmented amphorae and pottery, originally transported on a wreck dating from the late 6th to mid 5th century BC.[77] Further details are, up till now, not published.

From the 5th and 4th centuries BC four merchantmen have been found in the Mediterranean and Black Sea. These are the Kyrenia ship,[78] the Strait of Messina or better the Porticello ship,[79] the Ma'agan Michael ship[80] and the Donuzlav ship.[81]

Katzev concluded that the Kyrenia ship had employed a fore-and aft rig. So much of the hull had remained that Steffy has been able to create an (almost) 1:1 replica of the ship (Pl. 3).[82] All four ships had been constructed in carvel-like fashion according to the shell-first method, with a secondary insertion of frames, in which the strakes were connected by thorough mortising and tenoning. The Ma'agan Michael ship not only showed the use of mortise and tenon joints, but also the practice of lashing the planks to the endposts. The hulls of the Kyrenia, the Porticello, and the Donuzlav ships had been sheathed with lead to protect the pine hull (a.o. against teredo).

The length of the Porticello ship had been about 20 m, that of the Kyrenia ship about 17 m, and of the Ma'agan Michael ship *c.* 12.50 m: from the Donuzlav ship only a curved fragment of frame and a few pieces of the side planking have remained. The average length-width ratio of all ships is *c.* 3:1.

The load capacity of the Ma'agan Michael ship has been estimated at about 15 tons (somewhat over 500 talents), that of the Kyrenia ship about

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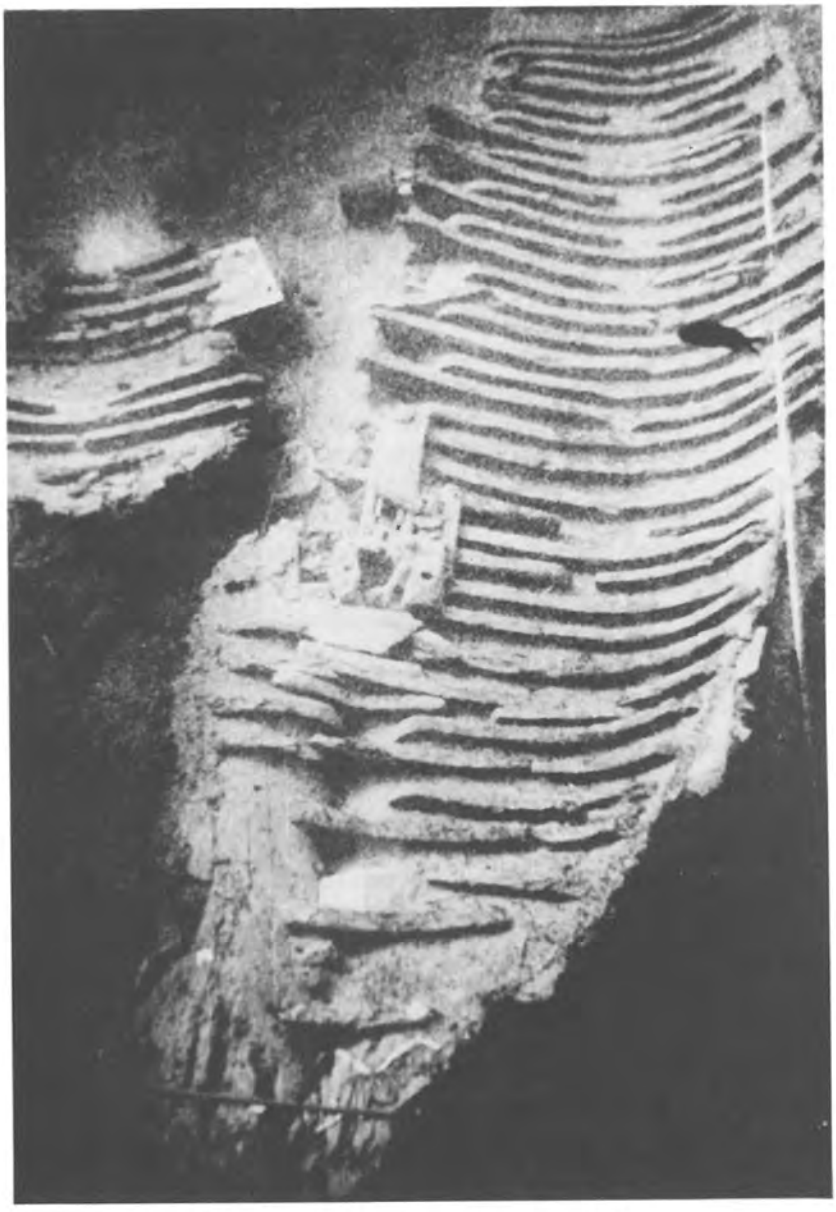
[76] Kazianes/Simossi/Haniotes 1990.
[77] Gibbins 1991a.
[78] Katzev 1972, Katzev 1970, Steffy 1987, Wylde Swiny/Katzev 1973.
[79] Owen 1970, Owen 1971, Eiseman 1979, Gill 1987.
[80] [Linder/CMS], 1989, 1990, 1991; [Linder] 1991.
[81] Blavatsky/Peters 1973.
[82] *V. infra*, experiments.



Pl. 3. Kyrenia ship: the hull on the seabed
[original photograph by Robin Piercy].

28 tons,[83] while Eiseman supposes that the Porticello ship could carry about 30 tons[84] (both ships slightly over 1,000 talents).

Ship I of the Bon Porté (near St.Tropez) site[85] was wrecked in the 2nd half of the 6th century BC, as may be concluded from its cargo, consisting of amphorae both of Archaic and Etruscan type. It was, according to Joncheray, a small ship of maximally 10 m length. It was constructed of "une essence de conifère".[86] At the outside there was no protective layer: "Aucun doublage, métallique ou organique, n'a été observé. L'intérieur, par contre, était abondammant poissé, la résine employée obturent les cavités tétraèdriques de départ des chevilles obliques".[87] That it had been a sailing ship is confirmed by the mast step, which was manifestly present. Also this ship had been constructed, most probably, according to the shell-first method. The strakes, however, were not connected by mortises and tenons, but had been sewn together. The holes necessary for the sewing had afterwards been plugged with wooden pegs to prevent leaking (Fig. 3).[88] Remarkable is, finally, that the strakes had been connected with the ribs by wedge-shaped treenails.

Off the Tuscan Island of Giglio a wreck of the Archaic period was found.[89] Of this ship only one substantial timber fragment remains, according to the excavator the after end of the keel, "oblong in section, rabbated along its arrises and .... slightly rockered".[90] Unfortunately this piece of keel was not drawn (at least no drawing is published), nor is there any mentioning of its preserved length. The planks of this wreck had been laced on, in a shell-first technique, paralleled at the Bon Porté wreck. According to Bound the finds make a date of the wreck about 600 BC possible.

Though both the Bon Porté ship and the Giglio ship date from the Archaic period, finds have also shown that the practice of sewn ships was known in the Roman period. I therefore see no obstacle to conclude that also the technique of sewn ships showed a considerable continuity, going back to as far as the 3rd millennium BC in Egypt (the 43 m long ship of Cheops) and being practised in some parts of the world even till the present day.[91]

As far as available evidence goes for the moment we may say that the

[83] Steffy 1975: 87.
[84] Eiseman 1979: 210.
[85] Joncheray 1976, Basch 1976, Pomey 1981, Basch 1981.
[86] Joncheray 1976: 26.
[87] Joncheray 1976: 31.
[88] Basch 1981: 244.
[89] Bound 1991, Gibbins 1991b.
[90] Bound 1991: 31.
[91] *Cf.* Pomey 1981, *passim* and Basch 1976.

typical ancient merchant ship was a sailing ship between 8 and 40 m long.[92] Though merchant galleys certainly existed, no proven example has been excavated. Casson, however, argues[93] that a pair of Punic wrecks of the 2nd century BC—so in fact outside of our period of research—found off Marsala in Western Sicily actually have been merchant galleys. There certainly will have been quite sizeable ships in the period 500-330 BC, as also the literary evidence indicates. They even may have been, according to Casson,[94] not uncommon. In my opinion, however, ships between 1,000 and 3,000 talents were the most common ships. They could carry between 26 and 78 tons. Casson thinks that "The ordinary workhorse freighter of the Mediterranean" probably could carry about 80 tons. According to Wallinga the ships of 1,000 talents were "absurdly small", little more than fishing vessels. The cargoes found of all wrecks demonstrate, however, that these "absurdly small" vessels could sail considerable distances when conditions were good—as could the Cape Gelidonya ship that, being only 9-10 m, appears to have had the potential of trading anywhere in the Eastern Mediterranean and the Aegean. I therefore think that for typical port to port trade even the τρισχιλιοφόροι ὁλκάδες were more than sufficient of size.

Experiments and further (archaeological) research

As already indicated, much of the hull of the Kyrenia ship has been preserved. On the basis of these remains Steffy was able to create an almost 1:1 replica, the Kyrenia II.[95] During the research on the ship it became clear that the Kyrenia I had been sailed by four men—be it slaves or free men. It appeared that the Kyrenia I was sunk due to an attack by pirates,[96] as *may* have been the case with the Porticello ship.[97] During the replication process it appeared that the shell-first technique was "Outrageously wasteful of wood and labor by modern standards, although both were cheap in antiquity".[98] During the construction period the wood dried and caused openings in the strake seams. Since no evidence of caulking had been found on the Kyrenia I, the reconstruction team had surmised that the ancients had soaked new ships in the sea for several weeks to close the seams (as we have seen with the historical evidence,

[92] *Cf.* Parker 1992: 89.
[93] Casson 1985: 17.
[94] Casson 1991: 114.
[95] Katzev/Katzev 1986.
[96] Katzev/Katzev 1986: 5.
[97] Eiseman 1979: 219.
[98] Katzev/Katzev 1986: 7.

Theophrastus indeed advises to put the ship in the water to make it watertight). A period of slightly over 24 hours proved to be sufficient.[99]

When the Kyrenia II had been finished, it was 13.76 m long and had a beam of 4.2 m. It could carry about 25 tons. According to available evidence and experience a standing rigging was devised consisting of forestay, backstay and two shrouds to both starbord and port. The running rigging consisted of brailing lines, halyard, two topping lifts, braces and sheets. The sail measured 11 to 6 m and was made of linen. During the excavation of the Kyrenia 176 lead brail rings have been found in her "sail locker", together with some spare parts for the rigging. These rings, sewn to the leeward side of a square sail in vertical rows, guided the brail lines that raised the lower skirt of the sail in the fashion of a modern Venetian blind (cf. Fig. 1 above). The hull was protected with a mixture of soot, pine-pitch and pig fat, giving the effect of Homer's "black hulled" ships, to reduce weed growth.[100] The mixture had the required effect.

From Athens, where the Kyrenia II had been constructed, she sailed (after a show session in New York) in 1986 to Cyprus. After visiting the harbours of Southern Cyprus she returned the following year to Greece. "Its performance was outstanding: under a strong favourable wind it reached speeds as high as eleven knots, and without difficulty it came through stormy weather in which the wind rose to gale force. It triumphantly demonstrated the ability of the ancient shipwright to design a hull that was seaworthy and massively strong and a rig that was efficient, safe, and easy to handle".[101] Roberts, however, remarks that the bows of the Kyrenia II turned away from the wind, due to the fact that her lines failed to match the original and therefore was trimmed aft too much. The problem was solved by raking the mast aft and thus shifting the sail aft in a beam wind.[102] The maximum speed reached by the Kyrenia II is higher than the speed assumed by Landels.[103] Landels thought that for an ancient sailing ship a speed of 6 knots is "exceptional, but not impossible in ideal conditions".

Landels states[104] that eighteenth and nineteenth century AD square sailed vessels have been reported to have been able to sail "six points off the wind" or "two points into the wind". The latter expression means that the ship could be sailed in a constant course with a wind blowing at an

[99] Katzev/Katzev 1986: 8.
[100] Katzev/Katzev 1986: 11.
[101] Casson 1991: 114.
[102] Roberts 1993: 33.
[103] Landels 1978: 156.
[104] Landels 1978: 158.

angle of about 22°30' forward of a line at right-angles of the keel. Since people assumed that Greek (and Roman) sailors would have been less competent than those eighteenth or nineteenth century AD seamen, it is usually believed that they could only manage "one point into the wind", *i.e.* with the wind blowing at an angle of about 11°15' forward. Personally, I am inclined to respect the competence of Greek sailors, and shipwrights, no less than that of their later colleagues.

If the wind was too far ahead the ships could resort to tacking, in various ways depending on the direction of the wind, the space available to tack and the visibility.[105]

Though not intended for a sailing merchant ship but for a full-size model of a *triere*, the construction of the sailing rig of the *Olympias* offers interesting data.[106] Roberts showed that by slightly drawing up the middle brails the sail functioned better. During the sailing trials of the *Olympias* it appeared that she could sail up to 60° off the wind, that is with the wind from 30° ahead of the beam, making about 7° of leeway. Indeed a performance that justifies respect for the sailing possibilities of ancient ships.

Conclusion

Certain aspects, like a.o. the frapping of ships in inclement conditions by the use of the so-called *hypozomata*, have been left out of this research. As stated in the introductory paragraphs I have tried to confront in this research the results of modern investigation with the traditionally obtained data.

Reviewing the evidence I think we may use the material from the archaic age and hellenistic period as relevant sources of information. The main conclusion to be drawn from this evidence is that the scale of the ships constructed was enlarged, but that methods of construction basically remained unchanged. Both historical evidence and maritime archaeological research confirm that the ships were constructed by the shell-first method. The strakes were joined in a carvel-like fashion, *i.e.* strake against strake. Both the methods of joining by mortising and tenoning and by sewing are attested, both in historiography and by archaeological finds of wrecks.

It also appears from records and finds that (most) ships were protected against *teredo navalis* (naval borers) by lead sheathing, above the water line by pitch.

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[105] Landels 1978: 158-9.
[106] Roberts 1993.

For the sailing qualities we may combine traditional archaeological material, historical evidence and the results of experiments with sailing models of ancient ships. Experiments show that the sailing qualities of Greek merchantmen have been quite good and that the ships were able to deal with quite unfavourable winds.

From the historical sources we know, and can infer, that in the period between 500-330 BC quite sizeable sailing merchantmen have crossed the seas. Underwater archaeological research up till now, however, has only revealed relatively small vessels. That these ships, and their crews, had been able to cover quite considerable distances might be argued on the basis of the recovered cargoes.

I think that the economical conditions of at least the 5th century BC favoured (next to the exploitation of some large ships) the existence of a class of small merchants, going from port to port, selling and buying as opportunity offered. Relatively small ships, like the Porticello ship or the Kyrenia ship, matched the needs of these merchants—and fitted the financial possibilities of a group of investors.

Of course, interdisciplinary research into the merchant marine of classical Greece (and its contemporaries) still is in its infancy. Due to improved techniques new data will become available and alter—or add to—positions taken. Even now, I think, available evidence may provoke discussion on its interpretation, meaning etc. I hope that this study may serve as a contribution to that discussion.

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