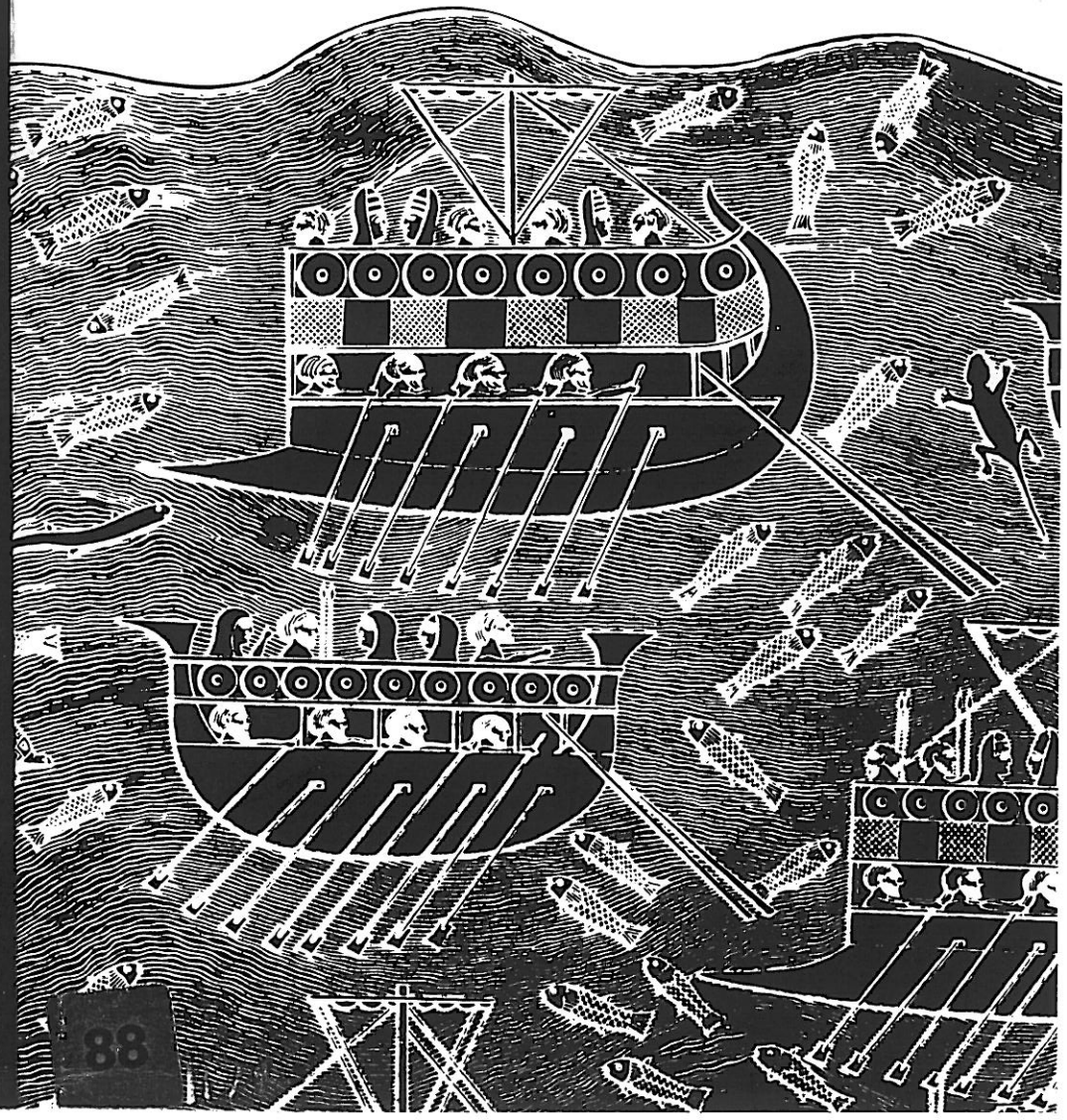
# *Ships and Seamanship in the Ancient World*

BY LIONEL CASSON



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*To Judy, Gail, and Andi*

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ried somewhere in the bows.[97] Furthermore, projecting at an angle from the tip of the prow was a spar, resembling a bowsprit, to which lines such as braces and brails could be made fast (Fig. 105).[98] The sternpost ends in the traditional Phoenician horse's head (cf. 66 above) instead of the Greek fanlike *aphlaston* (64 above).[99]

[97] Herodotus remarks (3.37) that the Phoenicians "carry around on the prows of their triremes" (*ἐν τῆσι πρῴρῃσι τῶν τριηρέων περιάγουσι*) likenesses of their dwarf-sized divinities called *Pataikoi*. This has generally been taken to refer to figureheads but could equally well apply to tutelary statues carried in the bows. It has been suggested (G. Perrot and C. Chipiez, *History of Art in Phoenicia*, translated by W. Armstrong, London 1885, p. 18) that such figureheads are depicted on Phoenician coins, and this has been generally accepted; see, e.g., Babelon 523, 527 and pls. 116.23-24, 117.4 (coins of Aradus, 350-322 B.C.).

[98] Cf. Basch 228. The fastening of the lines is clearest in his pl. 10a.

[99] Clearest in Basch pl. 10a.





# *The Warships of the Hellenistic Age: 323-31 B.C.*

FOR OUR PURPOSES, the Hellenistic Age embraces the three centuries opened by the death of Alexander in 323 and closed by the Battle of Actium in 31 B.C. Its naval hallmark was the adoption of larger units as the ship of the line, galleys big enough to relegate triremes to the light craft in a fleet.

## I *TETRereis, PENTEREIS, POLYEREIS*

IN 399 B.C., Dionysius, ruler of Syracuse, began to build *tetrereis* "fours" and *pentereis* "fives." The second was his own invention;[1] Carthage perhaps gets the credit for the first.[2]

The new ships took some time to gain acceptance but, within half a century, they were in all navies, both Greek and Phoenician. By 330, Athens had 18 "fours" (as against 492 triremes).[3] Six years later the number had gone up to 43, and 7 "fives" had been added.[4] By 351 B.C., there were "fives" in the fleet of the city of Sidon.[5] In 332 B.C., during Alexander's siege of Tyre, "fours" and "fives" were in ac-

[1] Diodorus 14.42.2: *ἤρξατο δὲ ναυπηγεῖσθαι τετρήρεις καὶ πεντηρικὰ σκάφη, πρῶτος ταύτην τὴν κατασκευὴν τῶν νεῶν ἐπινοήσας* "[Dionysius] began to build 'fours' and vessels fitted as 'fives,' the first to design the construction of such ships." Cf. 14.41.3: *διενοεῖτο γὰρ . . . κατασκευάσαι . . . ναῦς τετρήρεις καὶ πεντήρεις, οὐδέπω κατ' ἐκείνους τοὺς χρόνους σκάφους πεντηρικοῦ νεναυπηγημένου*: "And he designed and constructed . . . 'fours' and 'fives' at a time when no vessel fitted as a 'five' had as yet been built"; 14.44.7: *ἀπέστειλεν . . . πεντήρη πρῶτον νεναυπηγημένην* "He dispatched a 'five,' such being built then for the first time."

[2] Pliny, *NH* 7.207: *quadriremum Aristoteles [auctor est fecisse] Carthaginiensis* "Aristotle [states] that Carthage invented the 'four' "; Clemens Alexandrinus, *Strom.* 1.75.10: *Καρχηδόνιοι γὰρ πρῶτοι τετρήρη κατεσκεύασαν* "Carthage was the first to build a 'four.' "

[3] *IG* II² 1627.275-78; cf. *GOS* 249.

[4] *IG* II² 1629.808-11.

[5] Diodorus 16.44.6: *τριήρεις καὶ πεντήρεις εἶχε πλείους τῶν ἑκατόν* "[Sidon] had over 100 triremes and 'fives.' "

tion,[6] and Alexander had both types in the contingents he collected at Babylon.[7] Dionysius II (367-344 B.C.), going his father one better, introduced "sixes" into the Syracusan navy.[8]

When Alexander died, the fight for the spoils of his empire raged on the water as well as on land. Ptolemy I of Egypt inherited the lion's share of Alexander's fleet. Antigonus the One-Eyed, who had a keen appreciation of sea power, together with his son Demetrius, a brilliant tactician and bold designer of ships, set out to match it, and this touched off the greatest naval arms race in ancient history, as each side launched bigger and bigger *polyereis* or polyremes, as we call these oversize galleys which required veritable regiments of rowers to drive them.[9]

In 315, Antigonus set about constructing a naval aggregation that included up to "sevens" at least. By 301 Demetrius had "eights," "nines," "tens," "elevens," even a "thirteen." A dozen years later he added a "fifteen" and a "sixteen"; Lysimachus, his enemy, and Antigonus Gonatas, his son, both launched ships that were equal to or more powerful than these; and Ptolemy II topped them all with first a "twenty" and then two "thirties." Toward the end of the third century B.C., Ptolemy IV built a brobdingnagian "forty," but this was intended for display not action.

The superdreadnoughts were short-lived, having all but run their course by the middle of the third century. At the Battle of Chios in 201 B.C., Philip V, though he had Demetrius' "sixteen" at his disposal,[10] did not bother to use it and put his flag aboard a "ten";[11]

[6] Arrian, *Anab.* 2.22.3-5. [7] See App. 1.

[8] Aelian, *Var. Hist.* 6.12: *ναῦς μὲν ἐκέκτητο οὐκ ἐλάττους τῶν τετρακοσίων, ἐξήρεις καὶ πεντήρεις* "[Dionysius II] had no less than 400 ships, 'sixes' and 'fives.'" Conformably, Pliny, *NH* 7.207, gives the credit for the "six" to Syracuse.

[9] See App. 2.

[10] It was in his navy in 197 B.C., for the terms of the peace treaty Rome made him sign at that time included the provision "to hand over . . . to Rome . . . the cataphract vessels except . . . the 'sixteen'" (*ἀποκαταστῆσαι . . . Ῥωμαίοις . . . τὰς καταφράκτους ναῦς πλὴν . . . τῆς ἐκκαιδεκήρους* Polybius 18.44[27].6). Livy 33.30.5 renders this *Romanis . . . naves omnes tectas tradere praeter . . . regiam unam inhabilis prope magnitudinis, quam sedecim versus remorum agebant* "hand over . . . to Rome . . . all the cataphracts . . . except the king's one personal ship of almost unmanageable size, which was powered by 16 files of oars." In the loose usage of





moreover, he inaugurated a new era of naval tactics by emphasizing the use of destroyers (*lemboi*; see 125 below).[12] At Actium in 31 B.C., Antony had nothing bigger than "tens," and Augustus nothing bigger than "sixes."[13] The heaviest unit in the Roman navy thereafter was the Imperial flagship, a "six."[14]

## II THE OARAGE OF THE *POLYEREIS*

How galleys larger than a trireme were oared is a puzzle on which as much ink has been spilled as on the trireme problem. For long it was held that they were all extensions of the trireme, i.e., powered by superimposed banks of rowers each of whom pulled but one oar; this system might work for "fours," "fives,"[15] even "sixes," but thereafter it produced vessels that could stay afloat only on a drawing board.[16] Naval historians frequently pointed out the practical shortcomings,[17] and the classical scholar, W. W. Tarn, gave it the coup de grâce by demonstrating that it could not be reconciled with the ancient evidence.[18] A later theory held that the ships were rowed with but a single bank of multiple-rower sweeps and were named according to the number of men assigned to pulling each sweep.[19] This was a considerable improvement, since it had in its

Roman writers, *remi* "oars" and *remiges* "oarsmen" were interchangeable; see Tarn, "Warship" 205. On the meaning of "file of oarsmen," see 113-14 below.

[11] Polybius 16.3.3, cited in note 118 below.

[12] Polybius 16.2.9, 4.8-12 (cited in notes 109, 111 below).

[13] Plutarch, *Ant.* 64.1: *τὰς δὲ ἀρίστας καὶ μεγίστας ἀπὸ τριήρους μέχρι δεκήρους ἐπλήρου*: "[Antony] manned his best and biggest ships, from trireme to 'ten'"; cf. Dio Cassius 50.23.2. Augustus had at Actium the fleet with which he had crushed Sextus (Dio Cassius 50.19.3), and this included up to "sixes" (Florus 4.11.6). Sextus, too, had been content with nothing greater than a "six," for he came to the meeting with the triumvirs in a "six" (Appian, *Bell. Civ.* 5.71, 73), presumably his most impressive unit.

[14] Starr 53; cf. SEVEN, note 1.

[15] Cf. Smith 196-98.

[16] For a résumé see Tarn, "Warship" 137, note 1; Cook in Torr² 197-201 = *CR* 19 (1905) 371-73.

[17] Cf. Jal, *Flotte* 104; Anderson 22.

[18] "The Greek Warship," *JHS* 25 (1905) 137-56, 204-218 (= Torr² 154-89).

[19] This was, e.g., L. Weber's theory (*Die Lösung des Trierenrätsels*, Danzig 1896); cf. Tarn, "Warship" 137. It is followed, with variations, by Tarn himself (*Hell. Dev.* 136-38).

favor the example of the seventeenth and eighteenth century galleys, some of which used as many as—but not more than—eight men to an oar; yet this very same example set the limit beyond which the system could not in all reasonableness be carried.[20] The solution lies in combining the two systems, i.e., reconstructing these oversize ships with superimposed banks of multiple-rower sweeps.[21] Except for the monster galleys bigger than a "sixteen," which are discussed separately below, this solution produces results that are both feasible and in accord with whatever evidence is available.

Polyremes—to use the convenient term for all sizes larger than the trireme—seem to have developed in three stages: first, from the trireme to the "six," by the first half of the fourth B.C.; second, from the "six" to the "sixteen," between 315 and 288 B.C.; third, certain still more powerful types culminating in Ptolemy II's "thirty," between 288 and 246 B.C.[22]

Treating these stages individually will help clarify the line of development.

### From the Trireme to the "Six"

The sole facts available to go on are these: that the Rhodian navy used "fours" the way the Athenians used the trireme, as a swift and highly maneuverable vehicle for attacks with the ram; that the

[20] In order to help explain the very large warships of the Hellenistic Age, the upholders of this theory casually assume the common use in the 17th and 18th centuries of as many as 10 men to an oar (e.g., Rodgers 254, 261; Tarn, *Hell. Dev.* 135-36). Actually the standard number was 5 or 6 (cf. Guglielmotti, *Vocab.*, s.v. *galera*); flagships went up to 7 (Masson 201); galeasses 8 (Pantera 152: *galeazze . . . non si deveno armare a meno d'otto huomini per remo* "Galeasses ought to be manned by no less than 8 men to the oar"). To my knowledge there are no examples of units commonly used in action that put more men than this to an oar; cf. A. Jal. *Archéologie navale* (Paris 1840) 1 392: "deux, trois, quatre, et même huit hommes . . . s'asseyaient sur le banc." On the French *La Royale* with its reputed 19 to the oar, see now Anderson 79-81; it may possibly have had nine, but Anderson considers even that excessive.

[21] Both naval experts and scholars are agreed on this. Cf., e.g., Bauer 462-64; Rodgers 256; Morrison, *GOS* 291 and "Trireme" 43; Anderson 24-25, 28-29. Jal, *Flotte* 204-11, offers a variant: multiple-rower sweeps in superimposed banks but set on occasion in clusters of two sweeps.

[22] See App. 2.





Carthaginians in the Punic Wars used "fives" in the same way[23] (on the Roman "five," a heavy ship designed for boarding, see note 41 below); that an Athenian "four" of the fourth century B.C. very likely had fewer oars than a contemporary trireme.[24]

In sum, certain "fours" and "fives" were very like triremes save that they had a reduced number of oars. Could not such ships have been created simply by "double-banking," to use the modern term, i.e., assigning two men to an oar instead of one?[25] In this fashion we can explain the development from a trireme right up to a "six." The reduced number of oars would be the inevitable consequence of using longer oars to accommodate two men: the inboard part, describing a greater arc, would need more room. From the ancient point of view, increasing the oar-power in this particular way had one great advantage: with only two men to an oar, the traditional system of rowing from a seated posture could be maintained. Still another tradition that it would help maintain would be the use of oars of the same length, with the convenience for manufacture and stocking of spares that this afforded. A "five" with two thranites, two zygites, and one thalamite, would necessarily have to break with tradition and use shorter oars in the lowest bank (although even in this arrangement, two of the banks would have oars of the same length), but a "six" with three banks of two-man oars, or a "four" with two banks of two-man oars, would very nicely carry on the tradition.

The argument thus far has been based solely on development, on the consideration that the system described above is the easiest way

[23] Cf. *AM* 162-63, 165, 168-72.

[24] See Morrison, *GOS* 290-91. He points out that a set of oars for a trireme cost at least 1,000 drachmas in the 5th B.C., whereas a set for a "four" in 325/4, when the purchasing power of the drachma was assuredly less, cost but 665 (*IG* II² 1629.684-85, cited in Five, note 37). That a "four" had fewer oars is the sole possible explanation.

[25] This is what Anderson (23) suggests. The evidence that one man used one oar (Five, note 22) applies only to the trireme and smaller units; there is no justification whatsoever for applying it to any of the larger galleys. The statement, so often repeated (Bauer 461; Tarn, *Hell. Dev.* 131; Anderson 22) that the oars of a trireme were interchangeable with those of a "four" or "five" is based on a misunderstanding; see Morrison, "Nautical Terms" 132-35.

a "four" or "five" could have evolved from the trireme. But there are two scraps of evidence, admittedly far from conclusive, that can be adduced in support.

The first concerns the "five." It is very likely that a "five" of the fourth century B.C. measured only about 10 feet or so across the outrigger at its forward end.[26] Now a trireme of that period was 16 feet amidships (82 above). It would appear, then, that the two types ran about the same width—as we could have gathered from the fact that both were stored in the same boathouses.[27] A single line of five-man sweeps could not possibly fit into so narrow a hull, nor could an upper line of three-man sweeps. Only by assuming the three levels of a trireme with the thranite and zygite oars double-banked can we arrive at an arrangement of five rowers that would fit.

The second concerns the "four." The famed statue of the Winged Victory of Samothrace stands on a ship's prow. This monument has often been connected with the naval victories of Demetrius or his son Gonatas and interpreted as showing the prow of some oversize galley.[28] We now know that it was a dedicatory monument erected by Rhodes between 200 and 180 B.C.[29] Since the ship par excellence of the Rhodian navy at the time was the "four,"[30] this is what should be portrayed. The outrigger shows two oarports, one staggered slightly higher than the other. If we assume that the higher port carried a two-man thranite oar and the lower a similar zygite oar, and that there were no thalamites,[31] we reach a solution that fits both the monument's dimensions and its reason for being. This solution presupposes that naval architects had made a significant innovation in rowing arrangements, that they had taken the zygite oars, which in a fifth century trireme worked through ports, and repositioned them to work through an oar-box at a level just below the thranite oars. Representations of a somewhat later date (Figs. 114, 116) reveal an important change in the nature of the outrigger that supports this presupposition. In them, instead of an outrigger which follows the curve of the hull and serves only one bank of oars, there is an oar-box which makes a straight line from prow to stern and accommodates all the oars on a side (118-19 below).

[26] Diodorus 17.115.1-2: for Hephaestion's funeral Alexander "built a square pyre, a stade long on each side. . . . He adorned the entire periphery, where gilded quinquereme prows, 240 in all, made up the lowest layer. Each had upon its outrigger cheeks two kneeling archers 6 feet high and armed male figures 7 1/2 feet high" (ᾠκοδόμησε τετράπλευρον πυράν, σταδιαίας οὔσης ἑκάστης πλευρᾶς. . . . περιετίθει τῷ περιβόλῳ παντὶ κόσμον, οὗ τὴν μὲν κρηπῖδα χρυσαῖ πεντηρικαὶ πρῷραι συνεπλήρουν, οὖσαι τὸν ἀριθμὸν διακόσιαι τεσσαράκοντα, ἐπὶ δὲ τῶν ἐπωτίδων ἔχουσαι δύο μὲν τοξότας εἰς γόνυ κεκαθικότας τετραπήχεις, ἀνδριάντας δὲ πενταπήχεις καθωπλισμένους). The total of 240 means that there were 60 such prows to a side, and a stade being roughly 600 feet, this would make each prow 10 feet wide. It was Morrison (*GOS* 285-86) who drew attention to this significant passage.

[27] Cf. Morrison, *GOS* 286 and 364 below.

[28] Notably by Tarn, "Warship" 208, *MM* 19 (1933) 70. Others have, more properly, taken it as a much smaller craft; see the résumé of reconstructions in Anderson 25-27.

[29] M. Bieber, *The Sculpture of the Hellenistic Age* (New York 1961²) 125-26.

[30] *AM* 152, 168-71 At the Battle of Side in 190 B.C., "The Rhodians had 32 quadriremes and 4 triremes" (Livy 37.23.4: *Rhodiorum duae et triginta quadriremes et quattuor triremes fuere*).





### From the "Six" to the "Sixteen"

One feature above all others governs this stage of development: boarding now became an important naval tactic, and galleys more and more ceased being man-propelled missiles to become carrying platforms for fighting men and—a new naval weapon—catapults.[32] Seaworthiness, never very important in a warship, counted for less than ever; the new floating platforms rarely ventured out of sight of land—and certainly never voluntarily spent a night on the water.

The moving spirit in the great advance in naval architecture and a pioneer in the use of catapults on ships was Demetrius, Besieger of Cities. Demetrius' starting point was the trireme with its superimposed three banks—we have sure evidence that no ship ever went beyond that number.[33] His revolutionary move was to substitute the

[31] Reconstructing it thus puts it well within the possibilities suggested by those who have most recently studied the monument. E.g., Anderson (27) concludes that its oars were "worked by one man each or by several," while Morrison (*GOS* 286) suggests it was either a "four" or a "five."

[32] See note 88 below. Tarn has no grounds for arguing (*Hell. Dev.* 120-22) that catapults were not used in Hellenistic naval warfare.

[33] Over a century ago, Jal (*Flotte* 109) had pointed this out. The greatest galley ever launched, the "forty," had only three banks; see 108-109 below, and cf. Aristides *Or.* 25(43).4, cited in note 55 below.

multiple-rower sweep for the one-man or two-man oar used hitherto. This involved one clean break with tradition: to operate such sweeps, rowing in the traditional seated fashion necessarily gave way to a stroke in which the oarsmen rose to their feet to dip the blade and fell back on the bench for the pull.[34]

One particular advantage of the multiple-rower sweep is that it reduces drastically the number of trained men needed, for only the rower at the tip of the loom has to be skilled;[35] the others supply just muscle. This factor was unquestionably of importance to Demetrius, who had to fill the benches of a vastly expanded fleet at a time when experienced oarsmen were in short supply.[36] A parallel can be drawn with the seventeenth and eighteenth centuries; at that time, when most of the rowers were totally untrained, largely poor unfortunates who had fallen afoul of the law, the preferred arrangement for galleys was a single bank of oars with five men to each oar, while heavy

[34] Cf. FOUR, note 67. The multiple-rower sweep is generally referred to by scholars as a *remo scaloccio* "big-ladder oar," the technical term for it in the Italian fleets of the 17th century. To operate a *remo scaloccio*, the rowers climbed, ladderlike, on to the *pedagna*, then higher to the *banchetto*, and then fell back on the *banco*, highest of all; see Guglielmotti, *Vocab.*, s.v. *remo* and *scaloccio*. Lucan seems to be referring to this kind of stroke when he writes (3.542-43): *tunc caerula verrunt / atque in transtra cadunt et remis pectora pulsant* "[The rowers] sweep the blue sea and fall back on the benches and bring the oar[looms] against their breast." Tarn, "Warships" 150-52, makes much of Appian, *Bell. Civ.* 4.85, as evidence for a standing stroke, but with scant justification. The passage describes the difficulties inexperienced crews had when caught amid the rips and currents of the Strait of Messina: "Salvidienus' crews were thrown into confusion, neither standing securely because of their inexperience, nor any longer able to pull the oars, nor keeping the steering oars under control" (*οἱ δ' ἀμφὶ τὸν Σαλουιδιηνόν, οὔτε ἑστῶτες βεβαίως ὑπὸ ἀηθείας οὔτε τὰς κώπας ἔτι ἀναφέρειν δυνάμενοι οὔτε τὰ πηδάλια ἔχοντες εὐπειθῆ, συνεταράσσοντο*). Tarn misinterprets the passage, for it says nothing about oarsmen operating from a standing position. Appian simply points out, in highly condensed language, that each element in the crew had a special difficulty—the steersmen in keeping control of the tiller, the oarsmen in handling the oars, the marines (not the rowers) in keeping their footing.

[35] The *vogue-avant* of the French galleys, *vogavante* of the Italian. Cf. Pantera 133: *questi* [*vogavanti*] *bisogna che siano de i migliori vogatori della galea, perche guidano il remo, et fanno la maggior fatica, però commandano à tutti gl'altri dal banco i servitii della galea* "These [*vogavanti*] have to be from the best oarsmen aboard the galley because they guide the oar and do the most work; for that reason they are in charge of the ship's services for all the others on the bench."

[36] On the shortage of rowers from the mid-4th B.C. on, cf. *AM* 124-25.





galeasses had as many as eight.[37] Obviously ancient "fives" to "eights" could have been rowed in the same way.[38] In the fourth century B.C., a "five," as suggested above, may have had two banks of two-man oars and a third bank of one-man oars; however, once the ancients had turned to the multiple-rower sweep at the end of the century, there is no reason for their not designing a "five" which simply put five men on each oar—or even a "four" with four men on each. We have almost certain evidence that "fours" and "fives" were oared in this fashion from 100 B.C. on,[39] while the Roman quinqueremes of the First Punic War (264-241 B.C.), which were thrown together in a frantic hurry and shoved into the water with green crews,[40] very likely had their oars arranged in the same fashion (they had ca. 270 rowers,[41] which would come out to 27 five-man oars a side).[42]

[37] Standard French galleys of the 16th century used 24 sweeps per side with three men on each (Masson 58-59); of the first half of the 17th century, 24 sweeps with five men on each (Masson 141); of the last half, 26 sweeps with five men on each (Masson 202). Galeasses, heavy craft which were a mixture of galley and sailing ship, had up to eight men to an oar (Pantera, cited in note 20 above).

[38] But it is a mistake to assume, as, e.g., Tarn does (*Hell. Dev.* 136), that "nines" and "tens" were; cf. note 20 above.

[39] See SEVEN, App. Basch (239-40) claims, perhaps rightly, that the Phoenicians from the outset, the beginning of the 4th B.C. on, used a single bank of multiple-rower sweeps on their "fours" and "fives," basing his argument on a coin of 373 B.C. (cf. his pl. 11 and pp. 234, 239) which shows a single-banked galley that is most likely a quinquereme.

[40] See note 82 below and TWELVE, note 32.

[41] Polybius 1.26.7: *τῆς ναυτικῆς δυνάμεως περὶ τέτταρας καὶ δέκα μυριάδας ὡς ἂν ἑκάστης νεὼς λαμβανούσης ἐρέτας μὲν τριακοσίους, ἐπιβάτας δ' ἑκατὸν εἴκοσιν* "The total naval force [was] about 140,000, so that each ship took 300 crewmen and 120 marines." Though Polybius literally says "300 rowers," his method of calculation shows that this is a loose expression for the entire crew. A trireme carried 30 officers, ratings, deck hands, etc. above the 170 oarsmen (305 below). Since a Roman quinquereme very likely had the same rig (235-38 below), it should have had roughly the same number of nonrowing personnel.

This fleet of "fives" was patterned upon a captured Carthaginian cataphract (Polybius 1.20.15). Since the Roman ships were specially designed to use as their principal weapon an oversize complement of marines and were consequently markedly clumsy and slow whereas the Carthaginian ships, specially designed to use the ram as their principal weapon, were consequently markedly maneuverable and swift, the conclusion is inescapable that Rome's shipwrights simply followed the basic lines and otherwise freely adapted; cf. Thiel, *History* 171-77, esp. 176-77. One way in which they adapted, I would suggest, was in foregoing the two or three banks of their model in favor of a single bank of five-man sweeps, a change that would in great part explain why the Roman version was so much slower. Toward the end

On the other hand, there is no reason for assuming that the ancients would give up their predilection for superimposing rowers. Indeed, since the experience of the seventeenth and eighteenth centuries indicates that 8 men to an oar was just about the practicable maximum, anything larger than an "eight" would necessarily have more than one level of rowers.[43] However, for anything smaller, there very likely were single-banked and double-banked models in use, depending upon a navy's preference. Alongside the single-banked "five" just mentioned, there could well have been a two-banked type with 3 men on the upper oars and 2 on the lower.[44] "Sixes" could be single-banked, or they could be two-banked, either with 4 men on each upper oar and 2 on each lower or with three on all oars. Similar single-banked and two-banked versions may have existed in the case of "sevens" and "eights" as well. But a "nine" certainly had at least two banks with, say, 5 men to each upper oar and 4 to each lower. And Demetrius' great "sixteen" either had two banks, each using elongated 8-man sweeps, or three, with 16 men distributed over a thranite-zygite-thalamite set (cf. 84 above). Each increase in oar-power resulted, to be sure, in an increase in a vessel's

of the war, Rome again built a fleet after the model of a Carthaginian prize, this time of crack quinqueremes patterned exactly upon the blockade-runner of Hanno the Rhodian (Polybius 1.59.8).

[42] This would make a Roman quinquereme a close parallel to a French galley of the late 17th century, which carried 26 five-man sweeps on each side. The dimensions of such galleys were: overall length including ram and stern overhang 55 m. (180½′), along the keel 47 m. (154 1/6′), of the rowing space ca. 33 m. (108¼′), width from gunwale to gunwale 6 m. (19¾′), from outrigger to outrigger 8 m. (26¼′). See Masson 202-203; G. la Roërie and J. Vivielle, *Navires et marins, de la rame à l'hélice* 1 (Paris 1930) 103; Anderson 68.

[43] See notes 20 and 37 above. Some writers (e.g., Rodgers 254, 258), to fit in more rowers to a sweep, assume it was worked on a push-pull system, i.e., with oarsmen on both sides of the loom, those on the fore side pulling, those on the other pushing. Anderson (79-81) has demonstrated that the *La Royale*, contrary to what is often asserted, was not rowed in this way, and, indeed, that there is not a single well-substantiated instance from the 17th or 18th centuries. His own reconstruction of the largest Hellenistic galleys with oars so manned, as he himself admits (81, note), was a solution born of desperation.

[44] Cf. Seven, App. This is the arrangement preferred by Anderson (24) and Morrison (*GOS* 291).





beam[45]—but this was all to the good: a wider ship meant more stability for firing catapults and broader decks to accommodate more marines.

### Polyremes Larger than a "Sixteen"

With Demetrius' last effort, we reach a point in the development that gives every indication of marking a radically new departure in naval architecture. For one, the next galley in the progression, the challenger of the "sixteen," is called an "eight." For another, the facts reported about it and the still larger types that followed it, make abundantly clear that the oarage systems suggested above, which explained all types up to the "sixteen," will not do for its big sisters.[46]

[45] By using data from the multirower galleys of the 17th and 18th centuries, we can deduce in a general way, the impressive dimensions these oversize warships must have reached. Let us take, for example, any powered by eight-man sweeps, whether a single-banked "eight" or a two-banked "sixteen." In 17th century galleys using multiple-rower sweeps, 4 feet of space was left between the tholepin and the nearest rower, and each rower was allotted just under 2 feet (Anderson 69). Thus, an eight-man sweep had an inboard length of just under 20 feet (8 x 2′ + 4′). Double this for port and starboard and add 4 feet or so for a catwalk down the center, and we arrive at a beam of ca. 44 feet from outrigger to outrigger. The length would be at least five times the beam (cf. the table of dimensions of 17th and 18th century galleys in Anderson 68), or a minimum of 220 feet.

[46] Tarn (*Hell. Dev.* 136-38) suggested that these big ships were rowed by up to 10-man sweeps gathered in clusters, e.g., of two 10-man sweeps in the "twenty," of three in the "thirty," and of four in the "forty." Since this suggestion seemed to make some sense out of the numbers involved, it has received general, though half-hearted, acceptance; cf. Starr in *CPh* 35 (1940) 372, Anderson 30. But there are three unanswerable objections to Tarn's arrangement.

1. It flies in the face of the evidence. It takes no cognizance whatsoever of the fact that the thranite oars of the "forty" were singled out for mention because they were longer than the others—yet, in Tarn's arrangement, all oars are the same length. It takes no cognizance of the fact that there *were* thranite oars—which would imply the existence of zygite and thalamite, but not of a fourth group. Lastly, it takes no cognizance of the fact that the "forty's" thranite oars, the longest known, would just about take 10 men, whereas all the other oars, presumably smaller, could not.

2. There are no parallels for a 10-man sweep; see notes 20 and 37 above.

3. It has no purpose. Tarn posited sweeps in clusters by analogy with his conception of a trireme as having, like a Venetian *a zenzile* galley (cf. 53-54 above), its oarsmen in clusters of three. Clusters of 1-man oars make excellent sense—the men can thereby be seated all along the same bench. Clusters of multiple-rower sweeps make no sense whatsoever, and this is why there is no demonstrable instance of them in the history of oared warships. There is nothing to be gained by putting

In tackling the problem, the best starting point is the "forty," the showpiece launched by Ptolemy IV, because its specifications, being so utterly extraordinary, became public knowledge and were recorded and have come down to us:[47]

| | *cubits* | *feet* |
|---|---|---|
| length | 280 | 420 |
| beam | 38 | 57 |
| height from waterline to tip of stern | 53 | 79½ |
| height from waterline to tip of prow | 48 | 72 |
| draft (when empty)[48] | under 4 | 6 |

two or three great sweeps close together; indeed, they are far more effective spread evenly apart (cf., e.g., Anderson 30).

The only other solution offered has involved the push-pull system (e.g., Anderson 29; cf. Morrison, "Trireme" 43). On such a system, see note 43 above.

Bauer, who realized that Greek galleys never had more than three superimposed banks (462), and who was aware that the largest-sized oar one should reckon on is an 8-man oar (464), could only offer the desperate solution of assuming four superimposed banks for the "thirty" and five for the "forty" (464).

[47] Athenaeus 5.203e-204b: *τὴν τεσσαρακοντήρη ναῦν κατεσκεύασεν ὁ Φιλοπάτωρ τὸ μῆκος ἔχουσαν διακοσίων ὀγδοήκοντα πηχῶν, ὀκτὼ δὲ καὶ τριάκοντα ἀπὸ παρόδου ἐπὶ πάροδον, ὕψος δὲ ἕως ἀκροστολίου τεσσαράκοντα ὀκτὼ πηχῶν. ἀπὸ δὲ τῶν πρυμνητικῶν ἀφλάστων ἐπὶ τὸ τῇ θαλάσσῃ μέρος αὐτῆς τρεῖς πρὸς τοῖς πεντήκοντα πήχεις. πηδάλια δ' εἶχε τέτταρα τριακονταπήχη, κώπας δὲ θρανιτικὰς ὀκτὼ καὶ τριάκοντα πηχῶν τὰς μεγίστας, αἳ διὰ τὸ μόλυβδον ἔχειν ἐν τοῖς ἐγχειριδίοις καὶ γεγονέναι λίαν εἴσω βαρεῖαι κατὰ τὴν ζύγωσιν εὐήρεις ὑπῆρχον ἐπὶ τῆς χρείας. δίπρῳρος δ' ἐγεγόνει καὶ δίπρυμνος καὶ ἔμβολα εἶχεν ἑπτά· τούτων ἓν μὲν ἡγούμενον, τὰ δ' ὑποστέλλοντα, τινὰ δὲ κατὰ τὰς ἐπωτίδας· ὑποζώματα δὲ ἐλάμβανε δώδεκα· ἑξακοσίων δ' ἦν ἕκαστον πηχῶν . . . γενομένης δὲ ἀναπείρας ἐδέξατο ἐρέτας πλείους τῶν τετρακισχιλίων, εἰς δὲ τὰς ὑπηρεσίας τετρακοσίους· εἰς δὲ τὸ κατάστρωμα ἐπιβάτας τρισχιλίους ἀποδέοντας ἑκατὸν καὶ πεντήκοντα* "The 'forty' was built by Philopator [Ptolemy IV, 221-203 B.C.]. It was 280 cubits long, 38 from gangway to gangway, and 48 high to the prow-ornament [*akrostolion*]. From the stern-ornament [*aphlaston*] to the part where the ship entered the water was 53. It had four steering oars that were 30 long, and thranite oars—the longest aboard—that were 38; these, by virtue of having lead in the handles and being heavily weighted inboard, because of their balance were very easy to use. It was double-prowed and double-sterned, and had seven rams. Of these, one was the chief ram and the others subordinate, and, [of the latter], certain were on the outrigger cheeks. It had 12 horizontal undergirds, each 600 cubits. . . . During a trial run it took aboard over 4,000 oarsmen and 400 other crewmen and, on the deck, 2,850 marines."

[48] Athenaeus 5.204c: *τοὺς θεμελίους κατῳκοδόμησε λίθῳ στερεῷ πρὸς πέντε πήχεις τὸ*





| | | | |
|---|---|---|---|
| steering oars (4) | | 30 | 45 long |
| thranite oars (the longest aboard) | | 38 | 57 long |
| personnel | | | |
| oarsmen | 4,000 | | |
| officers, ratings, deckhands | 400 | | |
| marines | 2,850 | | |

To the above must be added the vital piece of information that the ship was "double-prowed" and "double-sterned."

The mention of thranite oars implies the existence of zygite and thalamite; the ship, in other words, was an overblown trireme. However, if we attempt to distribute 40 rowers over a thranite-zygite-thalamite set, we immediately run into an impasse. We are specifically told that the thranite oars were the longest; each, therefore, would have to accommodate at least 14 of the 40. We are further specifically told what the length was, namely 57 feet, and the writer clearly conveys the impression that he felt this to be a truly remarkable size. Yet a 57-foot oar, which would permit an inboard length of no more than 19 feet, will barely accommodate 10 rowers, to say nothing of 14. As a matter of fact, it is not too much longer than the oars that were handled by 6 or 7 men in the galleys of the seventeenth and eighteenth centuries.[49]

*βάθος, καὶ διὰ τούτων φάλαγγας ἐπικαρσίας κατὰ πλάτος τῆς τάφρου διώσας συνεχεῖς τετράπηχυν εἰς βάθος τόπον ἀπολειπούσας* "He set up a bottom stratum of hard rock [along the launching canal] at a depth of 5 cubits [7½']. Transversely across the whole length of this [bottom stratum], running the width of the canal, he put in a line of rollers, leaving a depth of 4 cubits [6']." The rollers, therefore, were 1 cubit in diameter, and the vessel's draft when empty—presumably when launched the hull was but a shell—was about 6 feet. Its loaded draft, of course, must have been a good deal more. The steering oars were 45 feet long; assuming they were carried at a 45° angle and had one-third their length immersed, the draft when loaded would be in the neighborhood of 12 feet.

[49] The five-man oar on a French galley was ca. 11.83 m. long (38¾'), of which ca. 8 m. (26¼') was outboard (la Roërie, *op. cit.* note 42 above, 1, 112); the six- or seven-man oar was 2 m. (6½') longer, or 13.83 m. in all (Jurien de la

There is yet another impasse. We are told that the ship had 2,850 marines and 400 deckhands, officers, ratings and the like. The fighting deck, which covered more or less the part of the hull given over to the rowers, would provide a surface of, say, 350′ x 70′ (overall length of 420, less 70 to allow for the projections at bow and stern; breadth of 57, plus the lateral projection of the outrigger on either side). Such a surface would accommodate 3,250 persons only if they were lined up as if on parade—30 men abreast in lines three feet behind each other—with no room at all for maneuvering the men and certainly none for the operation of catapults. Yet the whole point of this ship, as of any supergalley, was to plow into clusters of smaller craft with its catapults volleying stones and darts, its archers firing arrows, and boarding parties readying at given points to hurl grapnels and eventually leap.

All who have studied this vessel have, to my mind, overlooked a clue of the highest importance: that it was "double-prowed" and "double-sterned." This is sometimes interpreted to mean that the ship was double-ended like a canoe, so it could be rowed in either direction without having to have its huge bulk turned all around.[50] However, such an interpretation not only mistakenly takes "double-prowed and double-sterned" to mean "double-ended," but completely overlooks the features that very definitely distinguish the two ends: the prow was marked by the *akrostolion*, and the stern by the *aphlaston*; the latter was, as traditional on Greek ships, somewhat the higher; and there was but a single principal ram at the prow, whereas a double-ended ship would have one at each end. In a word, we are dealing with a mammoth version of what today is called a catamaran

Gravière, *Les derniers jours de la marine à rames*, Paris 1885, p. 190). Smith (201) mentions that a 57-foot oar is not much longer than those used on the galleys of Malta.

[50] Smith 200, Torr 74. The author of the description of the "forty" goes on to tell of Philopator's vast river barge (cf. FOURTEEN, note 67). This too he characterizes as "double-prowed and double-sterned" (Athenaeus 5.204e), and the details that follow show clearly that the two ends were distinct. Tarn was aware of the special nature of the "forty's" hull ("Warship" 143, note; *Hell. Dev.* 141-42), but failed to appreciate its significance for the rowing arrangements.





(Figs. 112-113). There were two hulls, each 53 cubits wide—the specifications include four steering oars, so each hull had the customary pair, one to port and one to starboard. A vast platform—sufficient to accommodate the mass of marines and hands—must have yoked the two hulls. Now, *if we assume that both sides of both hulls were supplied with oars*—and the two hulls need be only 30-odd feet apart (Fig. 112) to enable the inner oars to work freely—a feasible system of oarage emerges. There was a total of 4,000 oarsmen. This would mean 2,000 in each hull, or 1,000 a side. The vessel was 420 feet long, which would allow ample space for 50 multiple-rower sweeps (Fig. 113).[51] And, with not 40 men but only 20 to distribute over a thranite-zygite-thalamite set (50 x 20 = 1,000), there are a number of workable alternatives. The best would be to assign 8 men apiece to the thranite oars; this would observe the limit of men per oar attested in the seventeenth and eighteenth centuries, and is just about the right number for a 57-foot oar. Then 7 could be put on the zygite, and 5 on the thalamite. Other arrangements are equally possible. The essential point is to recognize that we are dealing with a double-hulled vessel. Once this is done, everything falls into place. We are enabled to reconstruct a fighting craft which provides the proper deck space for the huge number of marines reported as well as a stable platform for them and the catapult battery to operate from; and, by assuming there were rowers on both sides of each hull, we arrive at a system of oarage that is well within the bounds of credibility and squares in every respect with the evidence.

It may be objected that such a vessel is structurally impossible or that oarsmen could never be taught to row with the precision that those on the interior benches would have to have. For any con-

[51] On galeasses of the 17th century, which could run to eight men per oar (see note 20 above), the distance from thole to thole was 1.75 m. (ca. 5′ 9″); see Jal, *Flotte* 197.

Figs. 112 and 113 reconstruct this overblown trireme with an outrigger for the thranite oars. A reconstruction with oar-box for all banks (see 118 below) could probably be worked out as well.

vinced by such arguments, I have an alternative theory to offer: that the "forty" was a catamaran with the hulls side by side, like two ships lashed together, and that the interior benches were fully manned by rowers who had no oars but were stationed there to serve as a spare crew. The exterior oarsmen would drive the vessel up to the field of action, and the fresh crew would take over as soon as battle was to be joined; in this way, a lumbering catamaran had a chance of keeping up with its more agile adversaries. The deck of such a craft would still be ample enough to accommodate the 3,250 marines and nonrowing personnel.

Since Ptolemy IV was no innovator but merely a builder of showpieces, there is no reason to credit him with the design of the catamaran supergalley. It is far easier to assume that examples were right under his eyes—in Ptolemy II's "twenty" and two "thirties." If we try to explain these as single-hulled ships, we run into the same impasse we did with the "forty": a three-banked "thirty" would have to have at least 11 men on its thranite oars—yet these oars were presumably even shorter than the 57-foot sweeps singled out for mention in the description of its much larger successor. Assume, however, that it was double-hulled with rowers to port and starboard of each hull, and all becomes easy: we need distribute only 15 men over a thranite-zygite-thalamite set; it might even have been two-banked, with 8 men on each upper oar and 7 on each lower. Similarly with the "twenty"; that might well have been a two-banked catamaran with 5 men to each oar.

THERE remain but two more of these largest of all ancient galleys to discuss.

The first is the *Leontophoros*, the ship "remarkable for its size and beauty" that Lysimachus built to meet the challenge of Demetrius' fleet led by a "fifteen" and a "sixteen."[52] The only detail we

[52] Memnon 13 = Jacoby, *FGH* no. 434, 8.5, vol. III B, p. 344: ὀκτήρης μία ἡ Λεοντοφόρος καλουμένη, μεγέθους ἕνεκα καὶ κάλλους ἤκουσα εἰς θαῦμα· ἐν ταύτῃ γὰρ ἑκατὸν μὲν ἄνδρες ἕκαστον στοῖχον ἤρεττον, ὡς ὀκτακοσίους ἐκ θατέρου μέρους γενέσθαι, ἐξ





have is the size of the crew—but it is enough to put us on the right track: "In each file, 100 men rowed so that there were 800 in each part [of the two parts], 1,600 in both; those assigned to fight from the decks [totalled] 1,200; and [there were] 2 helmsmen." Nobody has so far made any sense of any of the figures reported for this ship. It was an "eight," yet it could lock horns with a "sixteen." A contemporary "five" carried a maximum of 300 rowers, any ordinary "eight" would presumably carry only proportionately more, say 500 or so—yet this "eight" had 1,600, fully two-fifths of the number carried by the mammoth "forty." A contemporary "five" carried 120 marines,[53] yet this "eight" had 1,200, fully two-fifths of the number carried by the "forty." And the arrangement of the rowers as described seems incomprehensible.[54]

The significant hint lies in the way the totals are far more closely related to a "forty" than to any ordinary "eight." If we assume that this vessel, too, was built as a catamaran, everything falls perfectly into place. There were two helmsmen—naturally, one for each hull. There were 1,200 marines—far too many for the fighting deck of even the biggest ordinary polyreme, but easily accommodated on a spacious platform yoking two hulls. And, if we assume that there were two banks of 4-man oars—a legitimate arrangement for an "eight"—and 50 oars in each bank, the arrangements cease being incomprehensible and work out exactly:

a) "In each file 100 men rowed"—i.e., taking a bird's-eye view of

ἑκατέρων δὲ χιλίους καὶ ἑξακοσίους· οἱ δὲ ἀπὸ τῶν καταστρωμάτων μαχησόμενοι χίλιοι καὶ διακόσιοι· καὶ κυβερνῆται δύο.

[53] For the crew and marines of a quinquereme, see Polybius 1.26.7, cited in note 41 above.

[54] Jal (*Flotte* 195-96) decided that either Memnon had made a mistake or the Byzantine encyclopedist, who has preserved his words for us, somehow made alterations as he copied. Tarn originally did not attempt to extract sense from the passage: "whatever Memnon's description exactly means" was his earliest comment ("Warship" 208, note 93; cf. "Ded. Ship" 211). Ultimately he decided it was a "sixteen" which Memnon had misreported as an "eight" (*Hell. Dev.* 136-37, 141). This hardly helps, since it explains neither the rowing arrangements as described nor the extraordinarily high number of marines. The same objections can be made to Anderson's suggestion (29) of an "eight" in three levels.

each hull, in each bank there were 50 oarsmen in the file nearest the port tholes, and another 50 nearest the starboard, for a total of 100; similarly for the file of rowers one inboard from the tholes, and so on. If we translate this Greek phrase into the terminology of seventeenth and eighteenth century galleys, we would say that each bank of each hull had 100 *vogavanti*, 100 *posticci*, 100 *terzaroli*, 100 *quartaroli*.[55]

b) "so that there were 800 in each part (of the two parts)"—i.e., in each of the two hulls (the Greek word used is *meros* "part," and not *toichos* "ship's side"). Reverting to the terminology of the seventeenth and eighteenth centuries, there were, including both walls of a hull, 200 *vogavanti*, 200 *posticci*, 200 *terzaroli*, and 200 *quartaroli* for a total of 800.

c) "1,600 in both"—i.e., the two hulls together give a grand total of 1,600.

Many years ago, Tarn characterized the *Leontophoros* as a "new or abnormal development of some sort,"[56] a judgment I repeated at the beginning of this section when I pointed out that this ship gave every indication of signalizing some radical new turn in naval architecture. The new turn, I suggest, was the debut of the catamaran supergalley.

It is not hard to imagine where the idea originated. From the fifth century B.C. on, and no doubt even earlier, commanders often, for one reason or another, lashed two vessels together.[57] It simply

[55] The Greek word for "file" is *stoichos* and the Latin *versus* (see Livy, cited in note 10 above and in App. 2, note 12). Thus, Aristides (*Or.* 25 [43].4), in recalling the naval glories of Rhodes, says that in her harbor "it was possible . . . to see warships [*triereis*] of two banks [*dikrotoi*] and of three banks [*trikrotoi*] and up to seven and nine files [*stoichoi*]" (*τριήρεις δὲ . . . ὑπῆρχεν ἰδεῖν δικρότους καὶ τρικρότους καὶ εἰς ἑπτὰ καὶ εἰς ἐννέα στοίχους*). In a ship with, say, seven files, the seven men in each rank would be distributed over one, two, or three benches, depending upon whether the ship was single-, double-, or triple-banked.

[56] "Ded. Ship" 211.

[57] Polyaenus gives three instances in which commanders lashed galleys in pairs and raised but one sail on each pair to trick the enemy into mistaking the size of the force by half: Thrasylus at the end of the 5th B.C. (1.47), Chabrias in the first half of the 4th (3.11.3), Diotimus in the 4th (5.22.2). Marcellus used quinqueremes yoked in pairs at the siege of Syracuse (Polybius 8.4[6].2 = Livy 24.34.6-7).





remained for some imaginative officer or shipwright to conceive of yoking a pair permanently, either side against side or far enough apart so that the inner oars could still be used. The credit, it would seem, does not go to the great innovator, Demetrius; though we cannot be sure, one gets the feeling that his mightiest effort, the "sixteen," was single-hulled. The *Leontophoros* was built in a shipyard of Heracleia on the Black Sea, probably at the orders of Demetrius' bitter enemy, Lysimachus; perhaps one of his admirals deserves the credit or some anonymous naval architect of Heracleia.

If the first great catamaran galley was launched ca. 280 B.C., then such ships stayed in use at least down to the time of Ptolemy IV (221-203 B.C.), the builder of the "forty." In other words, they should not have been unique rarities, and there is some evidence to confirm this.[58]

The last ship we have to deal with is the galley designed by Antigonus Gonatas, Demetrius' son, that led his fleet to victory over Ptolemy II, whose aggregation included units up to a "fifteen" and very likely the *Leontophoros* as well. Gonatas' vessel seems to be identical with one described by Pausanias as having "as many as nine rowers from the decks"[59] and by Pollux as being *triarmenos*,[60] which should mean "three-masted" but in this case may mean "three-leveled."[61] It somehow must have gone the father's "sixteen" one better. If we assume that the latter had two banks of eight-man oars, then the son's improvement may have been the addition of some provisional nine-man sweeps worked from the fighting deck.

[58] Homer attributes to Nestor a very special bowl for mixing wine, one with a set of two handles parallel to each other, on either side; see *Il.* 11.632-37 and the explanation, derived from Aristarchus, in the scholium to 11.632. Now, Athenaeus describes it (11.489b) as a bowl "with handles set alongside each other, just like the ships that have double prows" (*παρακειμένως ἔχοντα τὰ ὦτα, καθάπερ αἱ δίπρῳροι τῶν νεῶν*). Obviously such ships must have been familiar enough to his readers to enable him to use them in a simile.

[59] See App. 2, notes 14 and 15.

[60] Pollux 1.82: *Ἀντιγόνου τριάρμενος*. Tarn argues convincingly ("Ded. Ship" 209-210) that this Antigonus can only be Gonatas.

[61] For *triarmenos* "three-masted," see ELEVEN, notes 74, 75. Anderson (28) has suggested that it be taken to mean "three-leveled" here.

# APPENDIX 1

## SHIPS IN SECTIONS FOR TRANSPORT

ARRIAN reports (*Anab.* 7.19.3) that, of the fleet Alexander collected at Babylon, "a part had been brought from Phoenicia, namely 2 quinqueremes from the Phoenician navy, 3 quadriremes, 12 triremes, and up to 30 triaconters; these, cut up into sections, were transported from Phoenicia to Thapsacus on the Euphrates and there reassembled" (*τὸ δὲ ἐκ Φοινίκης ἀνακεκομισμένον, πεντήρεις μὲν δύο τῶν ἐκ Φοινίκων, τετρήρεις δὲ τρεῖς, τριήρεις δὲ δώδεκα, τριακοντόρους δὲ ἐς τριάκοντα· ταύτας ξυντμηθείσας κομισθῆναι ἐπὶ τὸν Εὐφράτην ποταμὸν ἐκ Φοινίκης ἐς Θάψακον πόλιν, ἐκεῖ δὲ ξυνπηχθείσας αὖθις*). The story is repeated by Strabo (16.741) and by Quintus Curtius (10.1.19), who typically inflates the contingent into a fleet of 700 "sevens" (cf. Tarn, "Warship" 150).

According to Arrian (*Anab.* 5.8.5), the fleet of small craft and triaconters Alexander had on the Hydaspes had also been brought overland, from the Indus: "The ships were cut up into sections and transported to him, the shorter divided into two sections, the triaconters into three; the sections, loaded on yoked teams, were carried up to the bank of the Hydaspes. There the craft were reassembled" (*καὶ ξυνετμήθη τε τὰ πλοῖα καὶ ἐκομίσθη αὐτῷ, ὅσα μὲν βραχύτερα διχῇ διατμηθέντα, αἱ τριακόντοροι δὲ τριχῇ ἐτμήθησαν, καὶ τὰ τμήματα ἐπὶ ζευγῶν διεκομίσθη ἔστε ἐπὶ τὴν ὄχθην τοῦ Ὑδάσπου· κακεῖ ξυμπηχθὲν τὸ ναυτικὸν αὖθις*).[1]

The technique of transporting ships in sections was long known in the East. Ramses III in the 12th B.C. had ships so moved from Coptos to the Red Sea.[2] The legendary Semiramis, according to Diodorus (2.16.6, 17.2), summoned shipwrights from Syria and Cyprus and other maritime areas, had them build collapsible river craft, and furnished camels to transport 2,000 of these. And, just this past century, Muhammed Ali had a small fleet built at Alexandria and conveyed in sections down the Nile to Cairo and from there on camels to Suez.[3]

[1] It is hard to see how triaconters could be divided into just three sections, even though Alexander's, being two-banked (*dikrotoi*, Arrian, *Anab.* 6.5.2; for the demonstration that this term can apply only to the triaconters, see Tarn, "Warship" 144-45), were short, compact vessels (perhaps 45′ long; see 56 above). Arrian, however, is a trustworthy historian, and in this case he is following the account of Aristobulus, an eye witness. Larger craft, of course, must have been divided up into a great many sections.

[2] R. Faulkner in *CAH* II² (1966), Chapter XXIII, section xiii.

[3] See P. Newberry, "Notes on Seagoing Ships," *JEA* 28 (1942) 64-66.



# APPENDIX 2

## THE NAVAL ARMS RACE, 315–CA. 250 B.C.

W. W. TARN devoted a number of studies[1] to the history of naval construction in this period, exercising much ingenuity in an attempt to extract a coherent story from the details reported chiefly by Diodorus and Plutarch.

It had taken perhaps half a century to go from a "four" to a "six," and well over a quarter of a century from a "six" to a "seven." With the introduction of the "seven," the pace of development quickened dramatically. In but 25 years or so, the gamut was run from a "seven" to a "sixteen," thanks to the drive, inventiveness, and daring of Demetrius the Besieger of Cities. The first mention of "sevens" occurs in connection with the ambitious naval program that he and his father Antigonus inaugurated in 315. When Demetrius fought the Battle of Salamis (the Salamis on Cyprus) in 306 with the fleet so created, he had 10 "sixes" and 7 "sevens,"[2] while his opponent, Ptolemy I, had nothing larger than "fives";[3] Demetrius' flagship was a "seven," since this type was the biggest under his command.[4] There is one problem, however. Diodorus, who reports the above, in listing the ships Antigonus had put on the stocks in 315 includes 3 "nines" and 10 "tens."[5] Where were these in 306 if the largest Demetrius used then were "sevens"? Tarn suggests that Diodorus' mention of "nines" and "tens" at this early date is a mistake.[6] If not, we must assume that Demetrius for some reason did not take them into action; possibly, since the enemy had nothing larger than "fives," he felt the "sixes" and "sevens"

[1] "The Greek Warship," *JHS* 25 (1905) 137-56, 204-18; "The Dedicated Ship of Antigonus Gonatas," *JHS* 30 (1910) 209-22; "Alexander's Plans," *JHS* 59 (1939) 124-35; *Hellenistic Military and Naval Developments* (Cambridge 1930) 129-41.

[2] Diodorus 20.50.3: *ἑπτήρεις ἑπτὰ Φοινίκων . . . ἑξήρεις δέκα* "7 Phoenician 'sevens' . . . 10 'sixes.'"

[3] Diodorus 20.49.2: of Ptolemy's ships, "the biggest was a 'five,' the smallest a 'four'" (*ἦν ἡ μεγίστη πεντήρης, ἡ δ' ἐλαχίστη τετρήρης*).

[4] Diodorus 20.50.2: *τούτων δ' ἦσαν αἱ μέγισται μὲν ἑπτήρεις* "Of these [ships in his fleet], the biggest were 'sevens'"; 20.52.1: *Δημήτριος ἠγωνίσατο τῆς ἑπτήρους ἐπιβεβηκὼς ἐπὶ τῇ πρύμνῃ* "Demetrius fought, taking his stand on the poop of his 'seven.'"

[5] Diodorus 19.62.8: the total agglomeration included "90 'fours,' 10 'fives,' 3 'nines,' 10 'tens,' 30 aphracts" (*τετρήρεις μὲν ἐννενήκοντα, πεντήρεις δὲ δέκα, ἐννήρεις δὲ τρεῖς, δεκήρεις δὲ δέκα, ἄφρακτοι δὲ τριάκοντα*).

[6] "Alexander's Plans" 127.

were all he needed and preferred to mass his manpower on them rather than spread it thin on the bigger units.

The "nines" and "tens" that Diodorus mentions certainly came into being before 301 B.C., because, by that time, Demetrius' fleet included an "eleven"[7] and a "thirteen."[8] In 288 he raised the ante even further and launched the greatest ships he was to design, a "fifteen" and a "sixteen," both being vessels that were remarkable, considering their size, for their beauty and efficiency.[9] His bitter enemy, Lysimachus, had earlier requested and obtained permission to attend a naval review of Demetrius' growing aggregation,[10] and, about the time that Demetrius had added his two mightiest, Lysimachus was ready with an answer—the *Leontophoros*, a ship, equally remarkable for beauty and size; it is called an "eight,"[11] but it obviously must have been an "eight" of a type that was a match for

[7] Theophrastus, *Hist. Plant.* 5.8.1: *μῆκος μὲν ἦν τῶν εἰς τὴν ἐνδεκήρη τὴν Δημητρίου τμηθέντων τρισκαιδεκαόργυιον* "The timber cut for Demetrius' 'eleven' [*hendekeres*] was in 13-*orguia* [= about 75'] lengths." The building of an "eleven" would naturally have preceded a "thirteen."

[8] Plutarch, *Dem.* 31.1: after the defeat at Ipsus (301 B.C.), Demetrius demanded from Athens, and got back, the ships he had left there "which included the 'thirteen'" (*ἐν αἷς ἦν καὶ ἡ τρισκαιδεκήρης*). It was his flagship at the time; e.g., he once "entertained Seleucus on the 'thirteen'" (*ἐκεῖνον* [Seleucus] *ἐν τῇ τρισκαιδεκήρει δεξάμενος* Plutarch, *Dem.* 32.2).

[9] Plutarch, *Dem.* 43.4-5: *οὐδεὶς γὰρ εἶδεν ἀνθρώπων οὔτε πεντεκαιδεκήρη ναῦν πρότερον οὔτε ἑκκαιδεκήρη* "No mortal had ever before seen either a 'fifteen' or a 'sixteen,'" . . . *τῶν . . . νεῶν οὐκ ἦν τὸ καλὸν ἀναγώνιστον, οὐδὲ τῷ περιττῷ τῆς κατασκευῆς ἀπεστεροῦντο τὴν χρείαν, ἀλλὰ τὸ τάχος καὶ τὸ ἔργον ἀξιοθεατότερον τοῦ μεγέθους παρεῖχον* "The beauty of the ships was by no means neglected, nor did they lose in effectiveness because of the vast scale of their construction. As a matter of fact, they had a speed and maneuverability more remarkable than their size." Cf. *Dem.* 20, cited in the following note.

[10] Plutarch, *Dem.* 20.4: *Λυσίμαχος μὲν . . . ἔπεμψε παρακαλῶν ἐπιδεῖξαι . . . τὰς ναῦς πλεούσας· ἐπιδείξαντος δὲ θαυμάσας ἀπῆλθε* "Lysimachus . . . wrote to him, requesting that he show him . . . his ships under way. Demetrius did, and Lysimachus went off in amazement." Tarn ("Ded. Ship" 211, note 15) suggests this took place ca. 300 B.C., when Demetrius' biggest was a "thirteen."

[11] See Six, note 52. There is no certainty about the origin of this ship. All we know for sure is that the city of Heracleia (on the Black Sea) supplied it for Ptolemy Keraunos' fleet in 280 B.C. (cf. note 13 below). Tarn attributed its building to Lysimachus ("Warship" 208, note 93) on the basis of its name, the lion being Lysimachus' special symbol (cf. Tarn, *Antigonos Gonatas*, Oxford 1913, p. 131). The suggestion has much to be said for it, since a ship of such size has no place in a city-state fleet, nor could it be paid for out of a city-state treasury. Lysimachus might very well have had it built in one of Heracleia's shipyards; the city was within easy reach of good shipbuilding timber (E. Semple, *The Geography of the Mediterranean Region*, New York 1931, pp. 273-74).





a "sixteen."[12] This superdreadnought led the Ptolemaic navy to victory over Antigonus Gonatas in 280 B.C.[13] Gonatas took almost two dozen years to prepare for revenge and achieved it at the Battle of Cos, probably ca. 258 B.C., in which he utterly routed Ptolemy II, largely through the help of a superdreadnought of his design which he then dedicated to Apollo,[14] almost certainly at the sanctuary on Delos.[15] This ship must have been at least as powerful as, and very likely more powerful than, the *Leontophoros*. Ptolemy, with Egypt's vast wealth behind him, put an end to the

[12] I take this vessel to be a double-hulled "eight" and, in that way, the equal of a "sixteen"; see 112-14 above. Tarn's first idea was that it was "a new or abnormal development of some sort" ("Ded. Ship" 211), but afterward he changed his mind (*Hell. Dev.* 133, 135) and argued that it was really a "sixteen"—and indeed the very same one as that built by Demetrius, the fortunes of war having put it in Lysimachus' hands. This is impossible: Demetrius' ship was built either at Athens, Corinth, Chalcis, or near Pella (Plutarch, *Dem.* 43.3: [of the fleet that included the "sixteen"] *τὰς μὲν ἐν Πειραιεῖ τρόπεις ἔθετο, τὰς δὲ ἐν Κορίνθῳ, τὰς δὲ ἐν Χαλκίδι, τὰς δὲ περὶ Πέλλαν* "Some keels he had laid at Athens, some at Corinth, some at Chalcis, and some near Pella"), whereas one of the known facts about Lysimachus' ship is that it came from, or was built at, Heracleia (see previous note), which Lysimachus then ruled. For ordinary "eights," see, e.g., Polybius 16.3.2.

We can trace some of the subsequent history of Demetrius' last two great ships. After Demetrius' downfall in 285 B.C., Ptolemy I presumably got the "fifteen" and "sixteen" (cf. Tarn in *CAH* VII 92) and may have dedicated the "fifteen" to Apollo of Delos (Tarn, *BCH* 46, 1922, pp. 473-75). The "sixteen" probably was recaptured by Antigonus Gonatas at his victory over Ptolemy off Cos in 258 (Tarn's suggestions in *Hell. Dev.* 133, note 5, are pure guesswork), since it was still in Macedon's navy in 197 B.C.; by then it was so old and antiquated that Rome, after the victory over Philip V, had no hesitation in letting him keep it (see Six, note 10). Eventually, after 167 B.C., Aemilius Paulus took the old battlewagon to Rome and sailed up the Tiber in triumph on it (Livy 45.35.3: *Paulus . . . regia nave ingentis magnitudinis, quam sedecim versus remorum agebant . . . adverso Tiberi ad urbem est subvectus* "Paulus . . . was carried to Rome right up the Tiber . . . on the king's personal ship, an enormous vessel powered by 16 files of oarsmen").

[13] Memnon, frg. 13 = Jacoby, *FGH* no. 434, 8.6: *αὐτῶν δὲ τῶν Ἡρακλεωτίδων τὸ ἐξαίρετον ἔφερεν ἡ Λεοντοφόρος ὀκτήρης* "And of these ships from Heracleia, it was the 'eight,' the *Leontophoros*, that distinguished itself."

[14] Athenaeus 5.209e: *Ἀντιγόνου ἱερὰν τριήρη, ᾗ ἐνίκησε τοὺς Πτολεμαίου στρατηγοὺς περὶ Λεύκολλαν τῆς Κῴας ἐπειδὴ καὶ τῷ Ἀπόλλωνι αὐτὴν ἀνέθηκεν* "the sacred trireme of Antigonus with which he defeated Ptolemy's admirals off Leucolla in Cos, when he vowed the ship to Apollo." Tarn is certainly right in arguing ("Ded. Ship" 212-15) that the sanctuary which received the offering was the one on Delos, the island in the very center of the waters where the great naval struggles were taking place.

[15] Tarn is probably right in identifying ("Ded. Ship" 216-18) this "sacred trireme" of Antigonus with the one at Delos reported by Pausanias 1.29.1: *τὸ δὲ ἐν Δήλῳ πλοῖον οὐδένα πω νικήσαντα οἶδα, καθῆκον ἐς ἐννέα ἐρέτας ἀπὸ τῶν καταστρωμάτων* "I know that nobody ever conquered the ship in Delos, having as many as nine rowers from the decks." On the meaning of the last phrase and the size of this ship, see 115 above.

race by outclassing all rivals once and for all with the launching of a "twenty" and two "thirties." His fleet at its most powerful, the mightiest the ancient world was to know, included

| | | | | | |
|---|---|---|---|---|---|
| 17 | "fives" | 30 | "nines" | 4 | "thirteens" |
| 5 | "sixes" | 14 | "elevens" | 1 | "twenty" |
| 37 | "sevens" | 2 | "twelves" | 2 | "thirties" |

Although the list is given in a secondary source,[16] there is no reason to question its trustworthiness, particularly since the existence of the "twenty" and "thirty" and other units have been confirmed by contemporary documents.[17] It must represent the navy toward the end of Ptolemy II's reign (he died in 246). Earlier the fleet included at least one "ten,"[18] Demetrius' "fifteen," which may have been taken out of service to be dedicated to Apollo of Delos, and Demetrius' "sixteen," which was probably lost to Antigonus Gonatas at the Battle of Cos.[19] Why "tens" were abandoned as a class we cannot say. The "fifteen" and the "sixteen" needed no replacing now that the fleet boasted a "twenty" and two "thirties."

When Ptolemy IV built a "forty," the race had already run its course; the ship was intended only as a showpiece.[20]

[16] Athenaeus 5.203d.

[17] *OGIS* 39: a base of a statue found in the sanctuary of Aphrodite at Paphos inscribed [Β]ασιλεὺς Πτολεμαῖος [Πυργ]οτέλην Ζώητος, ἀρχιτεκτονήσ[αντα] τὴν τριακοντήρη καὶ εἰκ[οσήρη] "King Ptolemy for Pyrgoteles [or Ergoteles], son of Zoës, builder of the 'thirty' and 'twenty.'" Two of Ptolemy's supergalleys are mentioned in papyri. The first occurrence, of a "nine" in the abbreviated form τὴν θ′ (*P. Cairo Zen.* 59036 = *Select Papyri* II 410.21, 257 B.C., cited in THIRTEEN, note 29), was for so long the only one that the editor was not fully convinced he had read the abbreviation correctly, and it is still sometimes queried (e.g., W. Peremans and E. Van't Dack, *Prosopographia Ptolemaica* V, Louvain 1963, no. 13800). But now we can add two more: *Sammelb.* 9780, mid-3rd B.C., is a letter from someone angling for the job of *skeuophylax*, guard of gear and stores, aboard a "nine" (this time spelled out in full), and *P. Col. Zen.* 63, 257 B.C., an account of miscellaneous expenditures, lists (recto, col. II, lines 2-3) a loan to the captain of a "ten" (also spelled out in full).

[18] See the previous note.

[19] See note 12 above.

[20] Plutarch, *Dem.* 43.5: θέαν μόνην ἐκείνη παρέσχε. καὶ μικρὸν ὅσον διαφέρουσα τῶν μονίμων οἰκοδομημάτων, φανῆναι πρὸς ἐπίδειξιν, οὐ χρείαν, ἐπισφαλῶς καὶ δυσέργως ἐκινήθη "This ship [the "forty"] was only for show. Hardly differing from buildings that are fixed on the ground, it moved unsteadily and with difficulty, to make appearance for display, not use."





# *The Roman Imperial and Byzantine Navies*

## I THE ROMAN IMPERIAL NAVY

ACTIUM wrote finis to the formal sea battle for over 300 years. Octavian, who had matched "sixes" against Antony's "tens" and won, not only had firsthand experience of the effectiveness of light units, but also the historical vision to discern that, with no rival naval power on the horizon, Rome's chief task on the water was anti-piracy control, communications, transport. So, when he founded the navy that was to serve the empire for the next three centuries, he gave priority to speed and maneuverability over weight and, in the interests of efficiency, limited and standardized the units. There was a single "six," the flagship of the main squadron based at Misenum. There were perhaps two "fives" and a fair number of "fours." But the standard units were the trireme for the major Italian fleets[1] and the destroyerlike liburnian for the provincial fleets.[2]

The liburnian[3] was a fast, two-banked galley[4] adapted from a craft developed among the Liburnians, piratical-minded dwellers of the

[1] We know the names of 1 "six," 1 "five," 9 "fours," 52 triremes, and 13 liburnians belonging to the fleet at Misenum, and 2 "fives," 7 "fours," 22 triremes, and 2 liburnians belonging to the fleet at Ravenna; cf. Kienast 120, note 153a. These figures, it must be remembered, refer to names that happen to occur on tombstones and are in no sense an indication of the strength of the fleets at any given moment. Thus I suspect that the Ravenna fleet had only one "five" at a time to serve as flagship, even though two differently named ships of that size are recorded.

[2] E.g., only liburnians have been attested in the Alexandrian flotilla; see FIFTEEN, note 57.

[3] On the liburnian, see the exhaustive article by S. Panciera, "Liburna," *Epigraphica* 18 (1956) 130-56, and his entry *Liburna* in *Dizionario epigrafico di antichità romane*, s.v. (1958).

[4] Lucan 3.534: *ordine contentae gemino . . . liburnae* "the liburnians, content with twin banks"; Appian, *Ill.* 3: Ῥωμαῖοι τὰ κοῦφα καὶ ὀξέα δίκροτα Λιβυρνίδας προσαγορεύουσιν "The Romans call their fast open double-banked ships [*dikrota*] 'liburnians.'"

Dalmatian coast and its offshore islands. We know that in the third and second centuries B.C. these people were using *lemboi*, that some of these were pressed into Rome's service, and that at least one model of *lembos* had two levels of oarsmen (126 above). All this makes a strong case for there being a connection between the *lembos* and *liburnian*. There were, as noted above, many kinds of *lemboi*; no doubt the liburnian was the one that the Romans found particularly useful for their purposes. The earliest certain mention of liburnians is at the Battle of Naulochus in 36 B.C.,[5] but there is no reason why they could not have been in use long before.

As just mentioned, the Imperial navy included only liburnians, triremes, quadriremes, and quinqueremes and one "six." The light units that Roman writers refer to as biremes must therefore be liburnians.[6] On Trajan's column are pictured numerous galleys with two banks (upper ship in Fig. 127, lower in 128). These cannot be two-level "fours," "fives," or "sixes" because, for one, the artist specifically shows but one man to each oar, and, for another, in several scenes the vessels are portrayed on the Danube,[7] a locale where such heavy units have no place. They therefore can only be liburnians. As shown in these reliefs, the liburnian is a small, aphract galley with no outrigger; the upper oars are worked through a latticed bulwark and the lower through ports just below the gunwale.[8]

[5] Augustus put his flag aboard a liburnian (Appian, *Bell. Civ.* 5.111).

[6] Roman writers consistently use layman's language when referring to warships instead of naval jargon, *biremis* for *liburna* being but one example. They almost always speak of triremes, quadriremes, and quinqueremes, whereas the official terms were *trieres* (*CIL* VI 1063.17, 3095, 32771; IX 41, 43), *quadrieres* (*CIL* VI 1063.15, *AE* 1927.3), and *penteres* (*CPL* 193). Cf. the use of *tetreris* in the caption in Fig. 126.

[7] E.g., K. Lehmann-Hartleben, *Die Trajanssäule* (Berlin 1926) pl. 19, no. 34, and pl. 24, nos. 46/47.

[8] A glass vessel, found in Afghanistan, is adorned with a picture of the lighthouse of Alexandria and a two-banked galley; see J. Hackin, *Recherches archéologiques à Begram* (*Mémoires de la délégation archéologique française en Afghanistan* IX, Paris 1939) 43 and fig. 39. The lower level of oars are a second bank, not the oars of the other side of the ship as the author suggests; the artist is following normal procedures of representation, as the canoe in the picture (fig. 38), with an oar on only one side, reveals. Quite possibly the vessel was a "souvenir of





The Roman navy used both models of trireme, the cataphract (Fig. 125)[9] and the lighter aphract (lower ship in Fig. 127, upper in 128). The quadriremes and quinqueremes, as we can see from representations on Roman coins (Figs. 120-123),[10] were either single-banked (i.e., driven by four-man and five-man sweeps respectively) or two-banked (i.e., in the case of quadriremes, two levels of two-man oars, and, in the case of quinqueremes, presumably an upper level of three-man oars and a lower of two-man oars; cf. Fig. 126). All these types were inherited by the Romans from the previous age. There is, however, one novel feature: very very few now have a rowing frame, an oar-box.

The outrigger had been an essential element in the Greek triremes of the fifth and fourth centuries B.C. In the form of the straight-sided rowing frame, it continued on in Hellenistic galleys (117-19 above), was still in use in the mid-first century A.D.,[11] and may have supplied the inspiration for the *telaro* that was a standard feature in the larger galleys of a later age.[12] However, alongside the Greek trireme with its outrigger, there was always in existence the Phoenician type without one (94-95 above). From the late first century B.C. on,[13] Rome's naval architects, in designing not only triremes but bigger units as well, like the Phoenicians, dispensed with the rowing frame and placed the oars in ports pierced in the hull. Ships in many cases were still fitted with projections that run along either side from the bow to the steering oar and look very much like a rowing frame, but these house no oars—the oars are consistently shown emerging from

Alexandria" brought back by someone who had traveled to the great port. Liburnians were common in the fleet Rome maintained at Alexandria; see note 2 above.

[9] On the arrangement of the oars in Fig. 125, see Anderson 33-34 and fig. 9.

[10] See App.

[11] One of the Nemi barges was fitted with a straight-sided rowing frame; see Ucelli 169-74, 256-57, fig. 184 and pl. 7.

[12] For examples, see Six, note 72. Cf. Ucelli 257.

[13] Hellenistic coins (e.g., Fig. 107 and those cited in App., note 1) consistently show the rowing frame, as do the earliest Roman issues (App., note 2). Thereafter it appears but rarely (e.g., Fig. 129). Oars emerging from the hull, with the frame-like projection above, can be seen on coins of 38-36 B.C. (*BM Republic* II, p. 518, no. 155 = *Numismatische Zeitschrift*, 1905, pl. 2.16a; Moll E IV f 7).

the side of the hull *below* the projections. A comparison of Fig. 116 with Fig. 124 or Fig. 133, and Fig. 129 with Fig. 131 points up the difference graphically. In Fig. 116 and Fig. 129 the ships are rowed in the older fashion, with oars working through the rowing frame; in the other representations the oars come through the hull just below the projection. If the two arrangements were for a time in use simultaneously, the latter soon became standard. We see it in pictures and models of triremes, both aphract (lower ship in Fig. 127) and cataphract (Fig. 125), of two-banked polyremes either with the projection (Figs. 122, 130) or without it.[14] These vessels, accommodating all the oars within the span of the hull, would be of necessity beamier than the type with a rowing frame.

The projection just described seems to appear for the most part in the bigger units, quadriremes or larger, which were all, of course, cataphract. A series of paintings from Pompeii (e.g., Fig. 133) shows single-banked ships which, to judge from their size and the impressive number of marines on the fighting decks, are quadriremes or quinqueremes.[15] All have the projection. It can be seen on certain coin pictures (Figs. 122-123) that portray galleys of at least the same size.[16] It is present, though less prominent, in the well-known relief

[14] See also Anderson pl. 7a = Moll B IV 42a (a galley with two lines of ports in the hull, each port of the upper immediately above one of the lower, as in Fig. 125); L. Basch, "Un modèle de navire romain au Musée de Sparte," *AC* 37 (1968) 136-71, esp. fig. 1 and pls. 1, 2 (clay model of a cataphract of indeterminate size with a projection. Basch argues [147-48] that the projection is a rowing frame, but a wall-painting from Pompeii that he himself cites as a parallel [fig. 5 on p. 143] shows the truth of the matter—the oars emerge from *below* the projection); Basch, fig. 8 (clay model without rowing frame. As Basch points out, this piece, dated much earlier hitherto, is probably Roman).

[15] Fig. 133 has been selected from no fewer than eleven similar scenes, four in the House of the Vettii and seven originally in the Temple of Isis and now in the Naples National Museum. Cf. *IH* ill. 50, Moll B XI a 5. All consistently show the projection with oars below. And so does a very similar vessel—a heavy single-banked cataphract with marines on the fighting deck—from a tomb of Augustan date near Rome; see C. Pietrangeli, "Frammento di trabeazione romana del cemeterio dei Giordani," *Bullettino della Commissione Archeologica del Governatorato di Roma* 67 (1939) 31-36.

[16] See App. Gems picturing Roman warships have the same feature; see Moll E III 6693, 6694.





from Praeneste (Figs. 130, 132)[17] of what is at least a quadrireme[18] and very possibly still bigger. We can only guess at its purpose. Perhaps it served as a massive bumper to shield the oarsmen. Possibly, too, it helped protect the oars. One standard method of attack was to go after an opponent's oars, to try to shear them off and thereby render him a standing target for a mortal stroke of the ram;[19] on these Roman cataphracts, at the critical moment the rowers could swing the oars as close alongside the hull as possible, where, under the shelf of the projection, they could not easily be reached. Lastly, as the Praeneste relief (Figs. 130, 132) shows, it was a convenient jump-off point for marines preparing to board.

From the relatively large number of representations of warships available, we can gain a fair idea of what cataphract galleys of this age looked like. The walls of the hull rise to the level of the projection just described (Figs. 130, 132-133) or, where there is none, to the gunwale (Fig. 125), completely enclosing the rowers and eliminating the need for the removable screens of an earlier age (88 above). The oars work through ports in the hull, and—at least on some ships—a series of louvers furnish ventilation (Figs. 130, 132). The projection itself rests on a series of brackets that spring out from the hull just above the oarports (Fig. 124). Exactly when this mode of construction was introduced, whether in Roman times or earlier, during the Hellenistic age, is anybody's guess. Over the rowers is the deck (*katastroma*) on which the fighting personnel are stationed. It is guarded by a low bulwark (Figs. 125, 130, 133) to

[17] The Praeneste relief (Figs. 130, 132), on the basis of the crocodile shown on the prow as well as on stylistic grounds, is usually dated around the time of the Battle of Actium and often connected with it; for discussion of the piece and bibliography, see E. Simon in Helbig-Speier, *Führer durch die öffentlichen Sammlungen klassischer Altertümer in Rom.* I, *Die päpstlichen Sammlungen im Vatikan und Lateran* (Rome 1963⁴) no. 489. (Simon's comments on the ship must be treated with caution: she describes the prow as "Hellenistic," though prows of identical shape are common on galleys of the Roman Imperial Navy, and the oblique fittings in the projection, which I have called louvers, she identifies as the blades of lances; whatever they are, they cannot be that.)

[18] This is Anderson's (33, fig. 8) estimate of its size.

[19] Cf. Polybius 16.4.8-12, cited in Six, note 109.

which shields may be attached as added protection. Just forward of the bow oars the bulwark breaks to leave a narrow entry for coming aboard (Figs. 127, 130, 133).[20] At about the same point may be affixed a rectangular frame with a carving of the ship's patron deity or of a figure connected with its name (Figs. 125, 127, 129-131).

At both prow and stern the architects of the Imperial navy introduced significant changes. When the Roman Republic first launched a fleet in the middle of the third century B.C., it adopted from the Hellenistic galleys the stempost that ended in a volute and the three-pronged ram,[21] and both features lasted until at least the end of the Republic (Figs. 120-121, 124-126, 129-133).[22] Shortly after the middle of the first century A.D. a single-pointed ram makes its appearance,[23] and thereafter the older form is no longer seen (Figs. 122-123, 127).[24] The stempost ending in a volute was retained (Fig. 122),[25] although, from the beginning of the second century A.D. on, some galleys were given a massive forecastle that took up the whole area in the bows

[20] See Lehmann-Hartleben, *op. cit.* (note 7 above) pl. 38 for another example of the entry.

[21] See the coins cited in Six, note 68.

[22] See also the coins cited in App., notes 3-5 and *BM Empire* I, Augustus 670 and pl. 16.13 (29-27 B.C.). Cf. Vergil, *Aen.* 5.143: *rostrisque tridentibus* "three-pronged rams," Valerius Flaccus 1.688: *aere tridenti* "three-pronged bronze."

[23] *BM Empire* I, p. 285, nos. 1, 2 and pl. 49.1, 2 (A.D. 68). Mattingly says (p. clxxxviii) that "the galley is borrowed from the famous legionary coin of Mark Antony" (cf. App., note 4), but the vessel portrayed on those consistently is given a three-pronged ram. The single-pointed ram also appears on coins of Galba (A. Robertson, *Roman Imperial Coins in the Hunter Coin Cabinet* I, London 1962, no. 46 and pl. 27), Vespasian (*BM Empire* II, p. 74 and pl. 12.8), Titus (Robertson, no. 64 and pl. 46).

The ships in the Pompeian wall-paintings cited in note 15 above, dated shortly after A.D. 63, all have the three-pronged ram. Possibly it was still in use, but, equally possibly, the painter chose to represent old-fashioned types. In a house at Herculaneum which was painted shortly before the eruption (Casa dell'Atrio Corinzio), there are two spirited pictures (unpublished) of sea battles, the galleys in which all have the new single-pointed ram; see A. Maiuri, *Ercolano: I nuovi scavi (1927-1958)* I (Rome 1958) 261-65 (the pictures are in the room numbered 3 in his plan on p. 261).

[24] See the coins cited in App., notes 6-9.

[25] See the coins cited in note 23 above. Also *BM Empire* III, Hadrian 247, 509, 1028, 1394, 1403 and pls. 51.10, 56.20, 68.19, 85.1, 85.5; V, Severus 847 and pl. 51.4, Caracalla 267-68, 859 and pls. 33.14, 33.15, 52.6.





and incorporated the stempost into its structure, leaving just a residual volute or none at all (Fig. 127).[26]

Aft, the traditional fan-shaped *aphlaston* continues in favor (Figs. 120-123, 128-129, 131, 133), but the *stylis* (346 below) is gone; ships of the Republic carry nothing (Figs. 120-121),[27] those of the Imperial navy replace it with legionary standards (Figs. 122-123, 128). A cabin for the commander, perhaps a Roman invention,[28] is now a regular feature, taking the form of an arched doghouse under the curve of the *aphlaston* (Figs. 128, 133). Representations show the massive and complicated construction of the prow about the ram (Figs. 130, 132),[29] the fighting towers in position (Figs. 130, 132), and what seems to be a *hypozoma* (Figs. 119, 125).

A number of galleys are shown carrying sail (Fig. 120), a particularly welcome detail since it comes after a hiatus of nearly half a millennium. The main driver is still a square sail stepped amidships, but it is now abetted by an *artemon* in the bows (Fig. 127), an addition that made its debut at the earliest during Hellenistic times (238 below).

[26] See also *BM Empire* III, Hadrian 543, 1391, 1398 and pls. 57.20, 84.13, 85.3; the relief cited in note 29 below.

[27] See the coins cited in App., notes 2-5.

[28] See Six, note 66. Galleys pictured on Roman coins right down to the end of the 1st B.C. continue to show no cabin; see Fig. 120 and *BM Republic* II, pp. 526-30, 564-65 and pls. 116, 120.16. The cabin may have made its appearance in the time of Augustus. There is a wall-painting in Pompeii depicting Polyphemus attempting to smash Odysseus' ship as it pulls out of range; see P. von Blanckenhagen and C. Alexander, *The Paintings from Boscotrecase, Röm. Mitt.*, sechstes Ergänzungsheft (Heidelberg 1962) pls. 40, 43. The painting is an original work, not an adaptation of some earlier picture, and dates to the last decade of the first century B.C. (von Blanckenhagen-Alexander 10-11, 48-51). The ship is shown with a cabin, and it is quite possible that the painter had noted such a feature on contemporary galleys. The shape he gave it, with a peaked instead of arched roof, may reflect his imaginative idea of what suited a mythological vessel, cf. Six, note 74.

Cabins in the form of arched doghouses appear frequently in later wall-paintings (e.g., Fig. 133) and consistently in the coin-pictures (e.g., those cited in App., notes 6-9).

[29] See also *Huitième congrès international d'archéologie classique, Paris 1963* (Paris 1965) pl. 17.2 (relief of a galley prow on the gravestone of a Roman sailor).

guardian deity of the ship.[68] The average shipowner contented himself with an altar on the poop (Fig. 146) or the afterdeck (Fig. 151); here thanks were formally offered when a vessel arrived safely home.[69] On some craft the arrangements were more elaborate, with the altar set in a niche.[70]

[68] Athenaeus 5.207e, cited in App., pt. 4.

[69] Fig. 146 shows the thanksgiving ceremony being carried out on a ship entering its home port. The altar has a fire ablaze on it. Three people stand about it: a woman holding the *acerra*, or incense box; on her right a man who is sprinkling grains of incense on the fire; on her left another who holds a *patera* and bowl for a libation. One of the men must be the *naukleros*, the owner or charterer (see 315 below), and the woman his wife; the other may be the captain. On this scene, see D. Wachsmuth, ΠΟΜΠΙΜΟΣ Ο ΔΑΙΜΩΝ: *Untersuchung zu den antiken Sakralhandlungen bei Seereisen* (Berlin dissertation, 1967) 145-47. Wachsmuth calls the altar portable; perhaps, but see the following note.

[70] A stone altar 60 cm. (23 5/8″) high was found in the Spargi wreck along with a colonnette and other bits of worked stone that seem to have formed elements of a niche or shrine; see *CIAS* II 156 and *RSL* 30 (1964) 261-62. A graffito of a big sailing ship (Maiuri, *loc. cit.* [note 34 above]) shows something on the after deck which may be a niche with an altar in it.



# APPENDIX

# TONNAGE AND DIMENSIONS OF ANCIENT FREIGHTERS

## Part I: Tonnage of Freighters of Average Size

The port regulations from Thasos (note 23 above), which testify that at least by the third century B.C. vessels under 3,000 talents (=80 tons burden) were of negligible size, at the same time indicate that those of 5,000 talents (=130 tons burden) were at least of average size. The same conclusion can be deduced from certain roughly contemporary inscriptions which honor merchants, or on occasion rulers, either for having made outright gifts of grain to a given city or for having sold it at less than the current price. In a number of these the exact amount of grain involved is stated:

| *Reference and Date* | *Amount (Medimni)* | *(Tons)* | *Given To* | *Given By* |
|---|---|---|---|---|
| *IG* XI.4.627 (1st half of 3rd B.C.) | 500 | 20 | Delos | Dealer of Byzantium |
| *Syll.*[3] 354 (ca. 300 B.C.) | 2,333 | 95 | Ephesus | Rhodian dealer |
| *Insc. de Délos* 442A 100-105 (179) | 2,800 | 115 | Delos | Massinissa |
| *SEG* I 361 (end of 4th) | 3,000 | 120 | Samos | Dealer of Torone |
| *IG* II[2] 360 (ca. 325/4) | 3,000 | 120 | Athens | Cypriote dealer |
| *IG* II[2] 363 (324/3) | 3,000 | 120 | Athens | Dionysius, ruler of Heracleia |
| *IG* II[2] 398 (320/19) | 3,000 | 120 | Athens | Dealer from the Hellespont[1] |
| *IG* II 408 (ca. 330) | 4,000 (also certain amount of barley) | 165 | Athens | Two dealers of Heracleia |

[1] The text (stoichedon) now reads (lines 12-14): [ἀπέστει]λεν πυρῶν μ[εδίμνους . . . 'Αθήναζε] κτλ. In view of the other inscriptions, the restoration μ[εδίμνους XXX seems almost certain. Cf. the similar restoration in *SEG* XXI 298.14 (323/2 B.C.).

| | | | | |
|---|---|---|---|---|
| *IG* II² 400 (320/19) | 4,000 | 165 | Athens | lost |
| *IG* II² 845 (208/7; cf. *SEG* xvi 71) | 8,000 | 330 | Athens | an Aetolian; cf. *REG* 51 (1938) 428 |

The figures present a consistent picture: each of the persons honored had donated, as seems *a priori* likely, a shipload of grain, while a few, doubly generous, had donated two. And the commonest size was 3,000 *medimni* = 120 tons.

The evidence concerning cargoes of liquids, though less precise, points in the same direction. The inscription *IG* II² 903 (176/5) honors a man who loaded 1,500 *metretae* of olive oil intending to sell it abroad and bring back a cargo of grain to the Peiraeus, but returned with his original load when he learned of a scarcity of oil at Athens. The weight of the oil is about 52.6 tons (the *metretes* held 39 liters, and a liter of oil weighs .9 kg.), to which we must add the weight of the jars. At this period these commonly varied between 20 and 40 liters.[2] Assuming that all were of 20 liters, 3,000 would be needed , and since a 20-liter jar weighs some 17-18 kg.,[3] this would add another 51 to 54 tons, bringing the total weight of the cargo to a little over 100 tons. If, as is most likely, there was a miscellany of various sizes, this would not change the figure significantly. Again, one of Demosthenes' speeches on a bottomry case mentions (35.10) a ship that was carrying a load of 3,000 jars from Mende to Scione. The capacity is not stated, but since in Demosthenes' time also the smallest shipping jars in common use held 20 liters, the cargo must have been at least as large as the one just described. Lastly, the wreck of the Grand Congloué, dating about the middle of the second century B.C., had aboard an estimated 3,000 jars for a total weight of a little over 100 tons.[4]

### Part 2: Oversize Freighters

As POINTED out above (172), freighters of 350-500 tons, though considered large, were not out of the ordinary. There were some, however, much larger than this that were very much out of the ordinary, the *Queen Marys* of their day, as it were. We know of at least three such. All operated out of Alexandria which, requiring a sail of weeks or months over open water to reach western Mediterranean ports (TWELVE, notes 82, 86), had a special use for oversize freighters, even as the north Atlantic has had for oversize liners in our own century.

[2] Grace, *op. cit.* (NINE, note 18) 180.
[3] Benoit 163; Lane, "Tonnages" 218.
[4] Benoit 163-64.





One, the *Syracusia* (or *Alexandris*, as she was later called), was the largest merchantman built in antiquity, a distinction that induced a certain Moschion to draw up a detailed description of her, which Athenaeus centuries later included in an account of sundry remarkable ships.[5] The vessel was ordered by Hiero II of Syracuse, probably about 240 B.C.,[6] to use for transporting grain, Sicily's chief export at the time. He employed Archimedes himself as supervising architect.

Moschion, unfortunately, gives no dimensions. He does, however, itemize the cargo the vessel carried on her maiden voyage: 60,000 measures of grain, 10,000 jars of pickled fish, 20,000 talents of wool, 20,000 talents of miscellaneous items. Estimates of the weight of all this have ranged from 3,650 tons to as high as 4,200.[7] Yet even the lower figure is inconceivable: in the subsequent history of shipping, vessels capable of carrying this amount were not designed until the end of the nineteenth century, and then only after the use of iron elements or steel hulls had been introduced.[8] What brings the total so high is the grain. We are told that 60,000 measures were aboard, but what unit of measurement is intended, as so often happens, is not stated.[9] Since the ship was loaded at Syracuse, it has always been taken for granted that Greek *medimni* were meant, and since a *medimnus* of grain weighs about 40 kg., this part of the cargo was computed at 2,400 tons.[10] However, if we assume that during the interval of more than four centuries between Hiero's launching of the ship and Athenaeus' transcription of Moschion's account, the original figure in *medimni* was somehow converted to *modii*, the measure used

[5] Athenaeus 5.206d-209; see pt. 4 of this Appendix. Older writers such as Torr (28-29) were inclined to dismiss much of the account as fanciful, but, save perhaps for some occasional exaggeration (e.g., the numbers of the crew), it seems perfectly sound. Indeed, recent evidence has confirmed many of Moschion's details: we know now, for example, that the use of lead sheathing over pitch-impregnated fabric was a well-established practice (210 below). Even the 10-lb. and 15-lb. spikes are not apocryphal; a wreck of quite average size yielded one that weighed 4.05 kg. or 9 lb. (*Klio* 39, 1961, p. 306).

[6] Cf. note to *OGIS* 56.17; the Ptolemy involved is more likely Euergetes (246-221 B.C.) than Philadelphus (283-246).

[7] Torr 27, 3,650 tons; *ESAR* I 105, 4,000 tons; B. Graser, *De veterum re navali* (Berlin 1864) 48-49, 4,200 tons (followed by Beloch, *Griechische Geschichte*² IV.1.299 and W. Tarn, *Hellenistic Civilization*³, London 1952, p. 250).

[8] E.g., Donald McKay's monster *Great Republic*, rated 4,556 tons, was the largest wooden ship ever built (334′ 6″ long, 53′ 6″ broad, 38′ deep); the size was made possible by the use of iron braces.

[9] Cf., e.g., Polybius 5.89.7-9; Livy 43.6.3, 11.

[10] E.g., Torr 27. Köster (163-64) takes the 60,000 units to represent jars, which is impossible since grain was not shipped that way (see App., pt. 5). Consequently the figure he arrives at for the total cargo (3,310 tons) is worthless (yet repeated uncritically by Miltner 922).

by the Roman administration after it completed its reorganization of the island in 210 B.C., we arrive at a total that makes far better sense:

| | *(tons)* |
|---|---|
| 60,000 *modii* of grain | 400 |
| 10,000 jars of pickled fish at, e.g., 50 kg. per jar | 500 |
| 20,000 talents of wool | 520 |
| 20,000 of misc. cargo | 520 |
| | 1,940 |

This still makes the ship—as well it should be—extraordinarily large for that age, but not impossibly large. Moreover, the weight assigned above to the fish is a pure guess, deliberately set on the heavy side. It could easily be half that, which would bring the weight aboard to under 1,700 tons.[11]

The second superfreighter known is the *Isis*, one of the large grain ships used on the Alexandria-Rome run in the second century A.D. Blown off her course during one voyage, she put in at Athens, where Lucian, seizing the chance to get a look at such an unusual sight, paid the vessel a visit and reported some details about it. He unfortunately omits the capacity but does give the dimensions: "She was 120 cubits [180′ or 55 m.] in length, the ship's carpenter said, beam more than a quarter of that [45′ plus or 13.72 m. plus], and from the deck to the bottom, to the deepest point in the bilge, 29 cubits [43½′ or 13.25 m.]."[12] Both classical scholars and nautical experts have tried to work out the vessel's capacity from these figures; the variation in their conclusions is so great it is hard to believe they are all dealing with the same ship. Here are, in rough chronological order, the estimates that have been put forth so far: Jal[13] ca. 1,500

[11] Some comparative figures may help: the *Constitution*, 175′ long on the gun deck x 43′ 6″ wide x 14′ 3″ deep in the hold, was rated at 1,576 tons burden; Nelson's *Victory*, 186′ long on the gun deck x 51′ 6″ wide x 21′ 6″ deep in the hold, was rated at 2,162 tons burden.

[12] εἴκοσι καὶ ἑκατὸν πήχεων ἔλεγε τὸ μῆκος ὁ ναυπηγός, εὖρος δὲ ὑπὲρ τὸ τέταρτον μάλιστα τούτου, καὶ ἀπὸ τοῦ καταστρώματος ἐς τὸν πυθμένα, ᾗ βαθύτατον κατὰ τὸν ἄντλον, ἐννέα πρὸς τοῖς εἴκοσι *Navig.* 5. The episode may be fanciful (cf. J. Bompaire, *Lucien écrivain* [*Bibl. des écoles françaises d'Athènes et de Rome* 190, Paris 1958] 534-36), but this does not affect the verisimilitude of the details provided.

[13] A. Jal, *Arch. nav.* II 154 (cf. 150-51). Jal based his figures on the rather close resemblance of the *Isis*' dimensions to those of a French third-rate (for plans of a standard French third-rate, see F. Paris, *Souvenirs de Marine*, pt. 5, Paris 1892, no. 249).





tons, Graser[14] 1,575 (repeated in some of the handbooks),[15] Smith[16] 1,100-1,200, Breusing[17] 2,672, Assmann[18] 2,000, Köster (165) 3,000-3,500, Miltner (922) 3,250.

Clearly Lucian's three dimensions are in themselves not enough for determining the *Isis*' capacity. An additional figure is necessary, namely the length of her keel. If she were a stubby bluff-bowed craft like a British East Indiaman, her keel would be very long and she would have roomy holds fore and aft as well as amidships. But if her keel were much shorter than her overall length, she would have overhangs fore and aft, like the ships of the sixteenth century, and the sole area for accommodating sizable amounts of cargo would be amidships. The only way to determine the length of her keel is to find a comparable craft from a later age whose complete dimensions are known. It need not be a ship with exactly the same dimensions; one in which the relation between the dimensions is the same will do. We can assume that the *Isis* looked in general like any big Roman merchantman (Figs. 144, 149, 156). An eminently comparable ship is a Venetian man-of-war of the sixteenth century.[19] Its shape is very like that of Roman merchantmen and, though a much smaller ship than the *Isis*, it has proportions astonishingly similar:

| | *Isis (feet)* | | *Venetian Man-of-War (feet)* |
|---|---|---|---|
| Overall Length | 180 | | ca. 119 |
| Beam | 45 | = 25 per cent of length | 29½ = 25 per cent of length |
| Bottom of hold to (presumably) highest deck | 43½ | = slightly less than beam | 28½ = slightly less than beam |

[14] *Op. cit.* (note 7 above) 47.

[15] E.g., J. Marquardt, *Das Privatleben der Römer*[2] 406 and note 9; L. Friedländer, *Darstellungen aus der Sittengeschichte Roms*[10] I, 425 and note 10.

[16] 147-50. Smith arrived at his conclusion by comparing the *Isis* with two British ships of known dimensions and tonnage. However, he chose his ships rather arbitrarily: he took one of one shape and a second of another, compared the *Isis* with both, derived two possible figures, and chose the mean between the two.

[17] Breusing 157. A. C. Johnson in *ESAR* II, 402, note 42, gives 2,700, a figure arrived at by a colleague in the engineering department to whom he had submitted the problem and who apparently used the same approach as Breusing.

[18] Assmann 1622.

[19] Casson, "Isis," 54, fig. 3, after Paris (*op. cit.*, note 13 above) pt. 3, no. 172.

The keel of the Venetian ship is 75½′ long or ca. 63½ per cent of the overall length. The length of the *Isis*' keel works out conformably to ca. 114 feet.

The next step is to employ a formula involving length of keel which has been traditionally used for computing the burden of sailing ships. A standard one is the following:[20]

$$\frac{\text{length of keel x beam x one-half of beam}}{94}$$

Applying this to the *Isis* (114′ x 45′ x 22½ / 94), her tonnage works out to 1,228, a figure far more in line with the technology of the age than the astronomical estimates mentioned above. It makes her, properly, smaller than the *Syracusia*, but still an impressively large ship. After the fall of Rome, merchantmen of this size did not appear in any considerable numbers until the end of the eighteenth and beginning of the nineteenth centuries, when the British East Indiamen grew from 800 to 1,200 tons. Rome imported 150,000 tons of grain yearly from Egypt; had the fleet of carriers all been as large as the *Isis*, there need only have been 80 units to do the job.[21]

The third superfreighter was the vessel in which Caligula had the obelisk now standing in front of St. Peter's transported from Alexandria to Rome.[22] The obelisk weighs 322 tons, and it was brought over along with the four pieces forming its pedestal, which account for another 174

[20] See David Steel, *The Elements and Practice of Naval Architecture* (London 1822[8]) 210, and cf. 212-13; cf. Smith 148. From 1677 on, the British navy estimated the burden of the vessels it hired by the following formula: length on deck—3/5 of beam x beam x ½ beam / 94 (Lane, "Tonnages" 228-29); this is the formula Graser used [*loc. cit.* note 7 above]. This, while useful for the boxlike craft of the 17th and 18th centuries, would exaggerate the capacity of the crescent-shaped Roman merchantman.

[21] Twenty million *modii* yearly; see Aurelius Victor, *Caes.* 1.6: *ex Aegypto urbi annua ducenties centena milia frumenti inferebantur* "Each year 20,000,000 measures of grain were brought into the city from Egypt." Each vessel could make only one and a half round trips during the sailing season; cf. TWELVE, App.

[22] Pliny, *NH* 16.201: *nave, quae ex Aegypto Gai principis iussu obeliscum in Vaticano Circo statutum quattuorque truncos lapidis eiusdem ad sustinendum eum adduxit, qua nave nihil admirabilius visum in mari certum est. CXXX modium lentis pro saburra ei fuere* ". . . the ship, which, at the orders of the Emperor Gaius, brought over from Egypt the obelisk that stands in the circus on the Vatican Hill along with the four blocks of the same stone that serve as its base. Certainly nothing more wonderful has ever been seen on the water than this ship. There were 130,000 *modii* of lentils aboard as ballast."





tons.[23] These probably were able to be fitted into the hold, but the obelisk necessarily was carried on deck; the ship, therefore, needed considerable ballasting, and this was provided for by a load of about 800 to 900 tons of lentils.[24] Thus the total weight aboard was 1,300 or so tons—a figure that agrees nicely with that arrived at for the *Isis*. Indeed, the natural assumption is that the vessel was modeled on the great Alexandria-Rome grain carriers. It must have been bigger than the *Isis* because it apparently turned out to be commercially impractical: after discharging its unique load, it was kept on display until Claudius had it filled with concrete and sunk to form part of a mole of the new harbor he was building for Rome.[25]

### PART 3: DIMENSIONS OF FREIGHTERS OF AVERAGE SIZE

THE dimensions of the *Isis* were, until very recently, the only known of any freighter. Thanks to underwater archaeology, which has accounted for the discovery and examination of scores of wrecks, a good many dimensions are now known, at least approximately. They are all of vessels that were hauling building stone or shipping jars, for only such cargoes have been able to survive and mark the spot of an ancient wreck.

The wrecks and their dimensions are as follows (since wooden freighters in all ages have had a general length to beam ratio of 3 or 4:1, approximations of missing dimensions are given in brackets):

| *Wreck and Reference* | *Date* | *Length (meters)* | *Beam (meters)* | *Remarks* |
|---|---|---|---|---|
| Kyrenia Katzev | End of 4th B.C. | 15 | [4-5] | |

[23] D. Fontana, *Del modo tenuto nel trasportare l'obelisco Vaticano* (Rome 1590) 9, 23: the obelisk weighs 963,537 lb. and the four pieces 165,464, 67,510, 179,826, 110,778 respectively; a ton = ca. 2,996 of the pounds Fontana reckons in.

[24] Torr (26) reckons that Egyptian lentils, packed in a hold, would average ca. 15 lb. per *modius*.

[25] See the passages from Pliny cited in SIXTEEN, note 23. Similarly, the vessel in which Augustus had the so-called Flaminian obelisk (now in Piazza del Popolo) brought over was not used commercially but was put on display at Puteoli (Pliny, *NH* 36.70). The three pieces of this obelisk, according to Fontana (70), weigh 1,322,938 lb. = ca. 440 tons, or about 50 less than the Vatican obelisk with its pedestal.

Testaguzza has identified a part of the mole that almost certainly reveals traces of the forward part of this vessel (107, 112-13). However, his identification of the stern and starboard side, which leads him to assign a size of 104 m. x 20.30 = 343′ x 66½′ (109, 116-19) is by no means as sure.

| | | | | |
|---|---|---|---|---|
| Grand Congloué<br>Benoit 164 | Mid-2nd B.C. | 23 | 6.80 | cargo of ca. 3,000 jars = 108 tons |
| Mahdia<br>Taylor 48, 51 | 1st B.C. | 30-[40] | 10 | cargo of at least 230 tons<br>keel 26 m. long |
| Albenga<br>Lamboglia 219 | 1st half of 1st B.C. | 40 | 8-10 | cargo of ca. 10,000 jars = 450 tons |
| Spargi<br>*CIAS* ii 156, 161 | End of 2nd B.C. | 25-30 | 8-10 | |
| Chrétienne A<br>Dumas 163-64 | 1st half of 1st B.C. | [24-32] | 8 | mast-step to deck 3.56 m. |
| Titan<br>Taylor 88 | Mid-1st B.C. | 25 | [6-8] | keel 17 m. long |
| Dramont A<br>Taylor 97 | End of 1st B.C. | 20 | 7-8 | |
| Marzamemi I<br>*Klio* (1961) 292, 298 | 3rd A.D. | [21-32] | 7-8 | cargo of at least 200 tons |
| Marseilles<br>Benoit 145-46 | 3rd-5th A.D. | 17 | [4.25-5.5] | |
| Yassi Ada Byzantine<br>*AA* (1962) 552, van Doorninck 84 | 7th A.D. | 19-21 | 5.2 | 1,000 jars |
| Isola delle Correnti<br>*Klio* (1961) 284, 286 | undatable | [30-40] | 10 | cargo of at least 350 tons |

The last three were carrying building stone, the others chiefly amphorae.





## Part 4: Hiero's Superfreighter (Athenaeus 5.206d-209b)

*Since many of the technical points in this account have become clear only in the light of recent evidence, the older translations are unsatisfactory. Even the latest, Gulick's in the Loeb Classical Library (1928), has a number of serious mistakes and, in general, is not precise enough for the student of nautical antiquities. I have used Kaibel's text (Teubner 1887). The Hiero involved is Hiero II, 306-215 B.C.*

περὶ δὲ τῆς ὑπὸ Ἱέρωνος τοῦ Συρακοσίου κατασκευασθείσης νεώς, ἧς καὶ Ἀρχιμήδης ἦν ὁ γεωμέτρης ἐπόπτης, οὐκ ἄξιον εἶναι κρίνω σιωπῆσαι, σύγγραμμα ἐκδόντος Μοσχίωνός τινος, ᾧ οὐ παρέργως ἐνέτυχον ὑπογυίως. γράφει οὖν ὁ Μοσχίων οὕτως· Ἱέρων . . . ἦν . . . περὶ ναυπηγίας φιλότιμος, πλοῖα σιτηγὰ κατα-
206f σκευαζόμενος, ὧν ἑνὸς τῆς κατασκευῆς μνησθήσομαι. εἰς ὕλην μὲν ξύλωσιν ἐκ τῆς Αἴτνης παρεσκεύαστο ἑξήκοντα τετρηρικῶν σκαφῶν [τὸ] πλῆθος ἐξεργάσασθαι δυναμένην. ὡς δὲ ταῦτα ἡτοιμάσατο γόμφους τε καὶ ἐγκοίλια καὶ σταμῖνας καὶ τὴν εἰς τὴν ἄλλην χρείαν ὕλην τὴν μὲν ἐξ Ἰταλίας, τὴν δ' ἐκ Σικελίας, εἰς δὲ σχοινία λευκέαν μὲν ἐξ Ἰβηρίας, κάνναβιν δὲ καὶ πίτταν ἐκ τοῦ Ῥοδάνου ποταμοῦ καὶ τἆλλα πάντα τὰ χρειώδη πολλαχόθεν. συνήγαγε δὲ καὶ ναυπηγοὺς καὶ τοὺς ἄλλους τεχνίτας καὶ καταστήσας ἐπὶ πάντων Ἀρχίαν τὸν Κορίνθιον ἀρχιτέκτονα
207 παρεκάλεσε προθύμως ἐπιλαβέσθαι τῆς κατασκευῆς, προσκαρτερῶν καὶ αὐτὸς τὰς ἡμέρας. τὸ μὲν οὖν ἥμισυ τοῦ παντὸς τῆς νεὼς ἐν μησὶν ἓξ ἐξειργάσατο . . . καὶ ταῖς ἐκ μολίβου ποιηθείσαις κεραμίσιν ἀεὶ καθ' ὃ ναυπηγηθείη μέρος περιελαμβάνετο, ὡς ἂν τριακοσίων ὄντων τῶν τὴν ὕλην ἐργαζομένων τεχνιτῶν χωρὶς τῶν ὑπηρετούντων. τοῦτο μὲν οὖν τὸ μέρος εἰς τὴν θάλασσαν καθέλκειν προσετέτακτο, τὴν λοιπὴν κατασκευὴν ἵν' ἐκεῖ λαμβάνῃ. ὡς δὲ περὶ τὸν καθελκυσμὸν αὐτοῦ τὸν εἰς τὴν θάλασσαν πολλὴ ζήτησις ἦν, Ἀρχιμήδης ὁ μηχανικὸς
207b μόνος αὐτὸ κατήγαγε δι' ὀλίγων σωμάτων. κατασκευάσας γὰρ ἕλικα τὸ τηλικοῦτον σκάφος εἰς τὴν θάλασσαν κατήγαγε. πρῶτος δ' Ἀρχιμήδης εὗρε τὴν τῆς ἕλικος κατασκευήν. ὡς δὲ καὶ τὰ λοιπὰ μέρη τῆς νεὼς ἐν ἄλλοις ἓξ μησὶ κατεσκευάσθη καὶ τοῖς χαλκοῖς ἥλοις πᾶσα περιελήφθη, ὧν οἱ πολλοὶ δεκάμνοοι ἦσαν, οἱ δ' ἄλλοι τούτων ἡμιόλιοι — διὰ τρυπάνων δ' ἦσαν οὗτοι ἡρμοσμένοι τοὺς σταμῖνας συνέχοντες· μολυβδίναις δὲ κεραμίσιν ἐπεστεγνοῦντο πρὸς τὸ ξύλον, ὑποτιθεμένων

CHAPTER TWELVE

# *Seasons and Winds, Sailing, Rowing, Speed*

## I SEASONS AND WINDS

HESIOD URGED all sailors to stay away from the sea except for the fifty days after the summer solstice, in July and August.[1] Hesiod, to be sure, was a lubberly farmer living in the stony hills of Boeotia, but even Vegetius, who speaks professionally, points out that the sailing season par excellence is from 27 May to 14 September, and that the outside limits are 10 March to 10 November.[2] And, in point of fact, this is the way things were for the whole of the ancient period: during late fall and winter, sailing was reduced to the absolute minimum—the carrying of vital dispatches, the ferrying of urgently needed supplies, seaborne military movement that was impossible to delay.[3] All normal activity was packed into the summer

[1] Hesiod, *Works and Days* 663-65: ἥματα πεντήκοντα μετὰ τροπὰς ἠελίοιο . . . ὡραῖος πέλεται θνητοῖς πλόος "The 50 days after the summer solstice . . . is the right time for men to sail the seas."

[2] Vegetius, *re mil.* 4.39: *a die VI. kal. Iunias usque in Arcturi ortum, id est in diem VIII. decimum kal. Octobres, secura navigatio creditur . . . post hoc tempus usque in tertium idus Novembres incerta navigatio est. . . . ex die . . . tertio idus Novembres usque in diem sextum idus Martias maria clauduntur* "From the 6th day before the kalends of June until the rising of Arcturus, that is until the 18th before the kalends of October, is believed to be the safe period for navigation. . . . From then up to the 3rd before the ides of November, navigation is uncertain. . . . From the 3rd before the ides of November to the 6th before the ides of March, the seas are closed." Practically the same sailing season was still being observed in the 11th century, see Goitein 316.

[3] Thucydides mentions several instances of naval movement on the sea during the winter, all the result of exceptional circumstances: in the winter of 430/29 B.C., a squadron of 20 was sent around the Peloponnese to be on station at Naupactus when the sailing season reopened, and six were sent off to collect tribute in Lycia and Caria (2.69); in the winter of 427/6, a naval force of 30 attacked the Lipari Islands, since lack of water prevented a summer expedition (3.88); in the winter of 425/4, a Persian captured with important dispatches was sent back in a trireme from Athens to Ephesus (4.50). E. de Saint-Denis, "Mare clausum," *REL* 25 (1947) 196-214, supplies numerous references from Latin authors to the sailing season and





and a few weeks before and after it; at other times the sea lanes were nearly deserted, and ports went into hibernation to await the coming of spring.[4] It was not merely the severity of winter storms, although these played their part. It was even more a matter of visibility: during the winter a much greater incidence of cloudiness obscures the sun by day and the sky by night, making navigation difficult in an age that did not have the mariner's compass, and more often do scud and mist veil the cliffs, headlands and mountains,

a review of out-of-season voyages both military (201-203) and commercial (203-207). J. Rougé, "La navigation hivernale sous l'Empire romain," *REA* 54 (1952) 316-25, adds references from the Church Fathers. *Cod. Theod.* 13.9.3 (A.D. 380), addressed to the shippers of Africa, puts the situation clearly: acceptance and loading of government cargoes shall take place from 1 April to 1 October; transport of such cargoes shall take place from 13 April to 15 October; from November to April, navigation is suspended (*Novembri mense navigatione subtracta, Aprilis, qui aestati est proximus, susceptionibus adplicetur. Cuius susceptionis necessitas ex kal. Aprilib. in diem kal. Octob. mansura servabitur; in diem vero iduuum earundem navigatio porrigetur* "From the month of November, navigation shall be discontinued; the month of April, since it is just before the summer, shall be employed for the acceptance of cargo. The necessity of such acceptance from the kalends of April to the kalends of October shall be preserved permanently; but navigation shall be extended to the day of the ides of the aforesaid months").

The limitation affected every phase of maritime activity: a shipper had to pay increased interest rates on maritime loans if he sailed out of season (Demosthenes 35.10), or had to guarantee to complete contracted voyages within the season (*Dig.* 45.1.122.1); the Emperor Titus would not trust his troops to an overseas crossing in winter (Josephus, *Bell. Jud.* 7.1.3); a prince, presumably able to commandeer the best available transport, refused to go even from Caesarea to Ionia in winter (Josephus, *Ant. Jud.* 16.2.1); imperial enactments made in Europe in the autumn "practically never reached Africa till the following spring or early summer" (Jones *op. cit.* [ELEVEN, App. 3], 1 403, cf. III 92). Caligula's threat of death sent to Petronius in Antioch in midwinter took all of three months to get there (Josephus, *Bell. Jud.* 2.10.5); the messengers who followed with word of the assassination [24 January A.D. 41] "had a good voyage" (εὐπλόουν) and so arrived 27 days earlier. The trip in summer could have been made in two weeks (cf. Table 1).

One exception was the run between Rhodes and Alexandria. According to Demosthenes (56.30), "There sailing goes on continuously, so [certain specialists in bottomry loans] were able to put the same money to work two or three times, whereas when residing here [i.e., at Athens] they had to stay put through the whole winter awaiting the suitable season [sc. for sailing]" (ἐκεῖσε μέν γε ἀκέραιος ὁ πλοῦς, καὶ δὶς ἢ τρὶς ὑπῆρχεν αὐτοῖς ἐργάσασθαι τῷ αὐτῷ ἀργυρίῳ. ἐνταῦθα δ' ἐπιδημήσαντας παραχειμάζειν ἔδει καὶ περιμένειν τὴν ὡραίαν).

[4] An important subject that has never been treated is the extent of the economic dislocation that all port towns had to suffer because of the limited sailing season.

which, sighted from far off, gave skippers fair warning to stay clear.[5]

During the heart of this curtailed sailing period, Mediterranean winds are prevailingly northerly. This is particularly true of the eastern basin: "From June to September . . . the windroses between the 30th and 35th parallels, 20th to 35th meridians [i.e., from Egypt to Crete and from Cephallenia to Syria] show almost as steady a northwesterly direction as would be found from the northeast in many parts of the northern trade wind belts of the open ocean."[6] To the north, in the Aegean, the situation is practically the same: in the southeastern portion the northerly winds "reach the exceptional frequency of 80 percent or more in July and August."[7] In the western basin, northerlies still hold sway, the prevailing winds in the Tyrrhenian and Ionian Seas being northwest.[8] The situation changes finally at the Gulf of Lion, where summer winds are often from the southwest (although there is still the hard-blowing northerly Mistral to reckon with).[9] And, between the Balearics and the Strait of Gibraltar, easterlies are most common.[10]

Sailing season and wind direction combined to give a definite pattern to ancient seaborne activity. Ships traveling in most southerly directions—e.g., from Italy or Greece to Africa, Asia Minor, Syria, Egypt—could generally count on a quick and easy downhill voyage. But they paid for this on the return, which had to be made in the teeth of the prevailing wind. And, in both directions, they had to be prepared for fairly stiff breezes. The Mistral in the west has al-

[5] Cf. Vegetius' list (4.39) of the dangers of winter sailing: *lux minima noxque prolixa, nubium densitas, aëris obscuritas, ventorum imbri vel nivibus geminata saevitia* "scant daylight, long nights, dense cloud cover, poor visibility, and the violence of the winds doubled by the addition of rain or snow." Storms, it will be noted, are listed last. There is no question, of course, that they were troublesome. Herod's near shipwreck off Pamphylia took place in midwinter (Josephus, *Bell. Jud.* 1.14.2-3); a storm-plagued voyage described in a pair of papyri (*P. Cairo Zen.* 59029 and *P. Mich. Zen.* 10) took place in December or in January; and St. Paul's celebrated disaster happened because his skipper risked sailing from Crete after the season proper had closed (Acts 27.9).

[6] *HO* 154A.32-33. [7] *HO* 154B.25. [8] *HO* 152.32-33.
[9] *HO* 152.33, 578. [10] *HO* 151.41.





ready been mentioned; the Etesians, which ruled the Aegean, are notorious: "In August they attain such violence that sailing vessels for weeks at a time cannot beat against them but have to tie up behind islands."[11] Compared with the winds, other factors were minor: the Mediterranean's currents are in general too feeble, and its tides too faint, to be of significance; the one affected only certain straits (Hellespont, Bosporus) and the other only the ends of deep inlets (the head of the Adriatic, the Syrtes) or certain channels (Euripus, the Strait of Messina).[12]

## II SAILING

ANCIENT square-riggers, with their broad mainsail as principal driver, were designed first and foremost for traveling with the wind astern[13] or on the quarters.[14] But, when pressed, the ancient mariner could also sail a close-hauled course with the wind abeam or forward

[11] E. Semple, *The Geography of the Mediterranean Region* (New York 1931) 580.
[12] Semple 582-83.
[13] Nonnos, *Dionys.* 4.231: *ἰσάζων ἑκάτερθε νεὼς πόδας* "equalizing the sheets on both sides of the vessel"; Cicero, *ad Att.* 16.6.1 and Ovid, *Fasti* 3.565, both cited in ELEVEN, App. 1, note 1; Catullus 4.20-21: *utrumque Iuppiter/ simul secundus incidisset in pedem* "A favorable wind falls on both sheets simultaneously," i.e., they were slacked off the same amount; Lucan 8.193: *cornibus aequis* (cf. the following note) "with equal yards," i.e., with the yard squared, set at right angles to the keel. (In *Aen.* 4.587, however, by *aequatis velis* Vergil means "with sails set the same way," i.e., the ships in the fleet, sailing close-hauled, had all braced the yards about and sheeted the canvas home at exactly the same slant; cf. Mohler 61).
[14] Achilles Tatius 2.32.2: *ἡ κεραία περιήγετο* "The yard was braced round."
Lucan (8.193-99) gives a nice description of turning from a run to a reach. Pompey, fleeing from his defeat at Pharsalus in August, 48 B.C., left Lesbos and headed southwest for Chios with a following wind (the Etesians are often northeasterly). Off Chios the skipper swung the vessel to the south to negotiate the strait between Chios and the mainland, taking the wind on the port quarter: "The sails, hanging evenly from the squared yards, he twisted round, and headed the ship to port, and, to cut through the waters that Chios and the rocks of Asina make so turbulent, he slacked off the lines toward the prow [i.e., the weather sheets and braces] and took in those toward the stern [i.e., the lee sheets and braces]. The sea sensed the movement and changed its sound as the prow cut a different way through the water and the vessel headed on a new course" (*iusto vela modo pendentia cornibus aequis / torsit et in laevum puppim dedit, utque secaret / quas Asinae cautes et quas Chios asperat undas / hos dedit in proram, tenet hos in puppe rudentes. / aequora senserunt motus aliterque secante / iam pelagus rostro nec idem spectante carina / mutavere sonum*).

of the beam—"tack" as we put it, "make a sheet"[15] as he put it—although, with his relatively inefficient rig he could probably point no closer to the wind than seven points.[16] The yard was braced round till it ran from bow to quarter and slanted toward the wind,[17] thus bringing the windward sheet forward of the mast.[18] When his destination lay well to windward he resorted, as ships willy-nilly did until the age of steam, to tacking, i.e., he pursued a zigzag course with the ship taking the wind first on one bow and then being swung about to take it on the other.[19]

[15] ποδιαῖον ποιεῖσθαι in Greek, *facere pedem* in Latin; see notes 19 and 24 below.

[16] Cf. Smith 177-78. Square-riggers as late as the 19th century could get no closer than six—i.e., if headed north, they could aim no better than WNW on one leg, ENE on the other.

[17] Lucian, *Navig.* 9: πρὸς ἀντίους τοὺς ἐτησίας πλαγιάζοντας "They slanted against the foul northerly tradewinds." Vergil, *Aen.* 5.16: *obliquatque sinus in ventum* "And [Palinurus] slants the sails toward the wind" (the fleet had left Carthage under the favorable land breeze [*Zephyros secundos* 4.562] and, heading westward, probably for Corsica, must have gone on a starboard tack when the prevailing northerly set in [*Aquilone,* 5.2]; then, when the wind suddenly backed to the west [*mutati transversa fremunt et vespere ab atro / consurgunt venti* "The winds have changed and rage against us, rushing from the black west," 5.19-20], Palinurus had to harden sheets and braces [*colligere arma* 5.15] and sail as close to the wind as he could to hold his course—without success, as we learn from 5.27). Lucan 5.427-28: *flexo navita cornu / obliquat laevo pede carbasa* "The crew swivels the yard and slants the canvas on the port tack" (the words translated "port tack" literally mean "left sheet." Lucan is describing Caesar's crossing from Brindisi to Dyrrachium, a course roughly NE. Since the winds were northerly [cf. 5.417], his ships were on a port tack, i.e., with the wind coming over the port bow and the sails on the starboard side of the mast, held slanted toward the wind by the port sheet).

[18] Seneca, *Medea* 322: *prolato pede transversos captare Notos* "carry the sheet forward to catch the south winds blowing against [the ship]"; Pliny, *NH* 2.128: *isdem autem ventis in contrarium navigatur prolatis pedibus* "By carrying the sheet forward, ships sail in opposite directions on the same wind."

[19] Cf. Vergil, *Aen.* 5.830-32: *una omnes fecere pedem; pariterque sinistros, / nunc dextros, solvere sinus; una ardua torquent / cornua, detorquentque* "Together they all tacked; in unison they unfurled the sails, now to port and now to starboard; together they braced the lofty yards about, then braced them round again [on the new course]." Cf. Achilles Tatius 3.1.3-6: κλίνεται δὴ κοῖλον τοιχίσαν τὸ σκάφος καὶ ἐπὶ θάτερα μετεωρίζεται καὶ πάντῃ πρηνὲς ἦν. . . . μετεσκευαζόμεθα οὖν ἅπαντες εἰς τὰ μετέωρα τῆς νηός. . . . αἰφνίδιον δὲ μεταλλάττεται τὸ πνεῦμα ἐπὶ θάτερα τῆς νηὸς. . . . καὶ τρίτον καὶ τέταρτον καὶ πολλάκις τὸ αὐτὸ πάσχοντες κοινὴν ταύτην εἴχομεν τῷ σκάφει τὴν πλάνην "The ship heels over, laying one side in the water amidships and going high in the air on the other side; it is all aslant. . . . So we all change our position to the high side of the vessel. . . . Suddenly the wind leaps to the other side of the ship. . . . And a third time, a fourth time, many times, we go through the same procedure, keeping up with the gyrations of the ship." It was rather the ship





When the wind was somewhat too strong for normal sailing, the yard was carried lower on the mast to bring down the center of pressure;[20] this maneuver, by keeping the bow from digging in, enabled the vessel to plane better. When that did not suffice, sail was shortened by taking up on the brails.[21] The vertical brailing ropes (70 above) were a unique device for reefing, one that was made possible by the absence on ancient ships of superimposed sails. It had many advantages to offer over the reef points of later ages.[22] For one, it furnished immediate and complete control of the sail from the

that was leaping to the other side of the wind as she changed from one tack to another.

Nicander, describing the motion of the horned viper Cerastes, likens it to a "merchantman's ship's boat which, forcing its way to windward in a violent blow, when hit by the blast of the southwesterly dips its whole side in the sea" (τράμπιος ὁλκαίης ἀκάτῳ ἴσος ἥ τε δι' ἅλμης / πλευρὸν ὅλον βάπτουσα κακοσταθέοντος ἀήτεω / εἰς ἄνεμον βεβλῆται ἀπόκρουστος λιβὸς οὔρῳ *Theriaca* 268-70). The Cerastes has a "side-winding movement," it "advances by throwing its body forward in a series of loops, and leaves as its track in dust or sand a series of parallel lines, disconnected and oblique to the direction in which the snake is moving," A. Gow and A. F. Scholfield, *Nicander: The Poems and Poetical Fragments* (Cambridge 1953) 175. Anyone who has sailed a small boat will recognize the aptness of the simile, for this is precisely the way a small boat advances against a strong wind: as each gust hits it, it heels over sharply; then, as the tiller is eased, it makes a looping turn oblique to its course into the wind and straightens up.

[20] Seneca, *Epist.* 77.2: *quotiens ventus increbruit maiorque est quam expedit, antemna submittitur: minus habet virium flatus ex humili* "Whenever the wind makes up and becomes too strong for comfort, the yard is lowered; for the wind exerts less force from low down." The yard could be lowered a third of the way down the mast (Sallust, *Hist.* 4.3 [Maurenbrecher]: *demissis partem quasi tertiam antemnis* "lowering the yard about a third") or halfway (Caesar, *Bell. Alex.* 45.2: *antemnis ad medium malum demissis* "with yards lowered half-way; Seneca, *Medea* 323-24: *nunc antemnas medio tutas / ponere malo* "place the yards safely at midmast"). Cf. Aristotle, *Mech.* 851a: ὅσῳ ἂν ἡ κεραία ἀνωτέρα ᾖ, θᾶττον πλεῖ τὰ πλοῖα "The higher the yard is carried, the faster ships sail." Plutarch records another reason for carrying sail this way: to escape detection. Lucullus got safely to Rhodes "by sailing with the sails lowered far down during the day and only raising them at night" (μεθ' ἡμέραν μὲν ὑφειμένοις πλέων τοῖς ἱστίοις καὶ ταπεινοῖς, νύκτωρ δ' ἐπαιρομένοις, *Luc.* 3.3).

[21] ἱστία στέλλειν, *aut sim.* (e.g., *Il.* 1.433; *Od.* 3.10-11, cited in note 28 below; Aristophanes cited in note 23 below; Aristotle cited in note 24 below); *contrahere vela* (e.g., Cicero, *ad Att.* 1.16.2; Livy 36.44.2, cited in ELEVEN, note 53; Seneca, *Epist.* 19.9). The Latin expression means literally "contract the sails."

[22] In its method of operation and efficiency it compares with the highly praised Chinese lugsail; cf. *IH* 176-77. Both systems, of course, are limited to rigs without superimposed sails.

deck; there was no need to send men aloft. For another, it permitted the shortening of selected areas of the sail. When the wind blew hard over the quarters or astern, the center of the sail was brailed up (Figs. 81, 147).[23] When the wind blew hard while a ship was sailing close-hauled, with its yard braced about to run from bow to quarter, the brails abaft the mast were tightened to reduce the amount of canvas aft; this lessened the tendency of the ship to head into the wind with consequent easing of the pressure on the helm.[24] In this particular maneuver the sail must have been

[23] Cf. Aristophanes, *Frogs* 999-1000: "drawing in sail and using only the tips" (*συστείλας ἄκροισι / χρώμενος τοῖς ἱστίοις*).

[24] Aristotle, *Mech.* 851b: *διὰ τί, ὅταν ἐξ οὐρίας βούλωνται διαδραμεῖν μὴ οὐρίου τοῦ πνεύματος ὄντος, τὸ μὲν πρὸς τὸν κυβερνήτην τοῦ ἱστίου μέρος στέλλονται, τὸ δὲ πρὸς τὴν πρῷραν ποδιαῖον ποιησάμενοι ἐφιᾶσιν; ἢ διότι ἀντισπᾶν τὸ πηδάλιον πολλῷ μὲν ὄντι τῷ πνεύματι οὐ δύναται, ὀλίγῳ δὲ, ὃ ὑποστέλλονται. προάγει μὲν οὖν τὸ πνεῦμα, εἰς οὖριον δὲ καθίστησι τὸ πηδάλιον, ἀντισπῶν καὶ μοχλεῦον τὴν θάλατταν. ἅμα δὲ καὶ οἱ ναῦται μάχονται τῷ πνεύματι· ἀνακλίνουσι γὰρ ἐπὶ τὸ ἐναντίον ἑαυτούς.* "Why is it that sailors, after sailing with a favorable wind, when they wish to continue on their course even though the wind is not favorable, brail up the part of the sail toward the helmsman, yet, as they go close-hauled, leave the part toward the prow unfurled? It is because the rudder cannot produce an effect against the wind when it is strong, but can when it is not, and this is why they shorten [sc., the sail area aft]. The wind moves the ship forward, and the action of the rudder converts it into a favorable breeze, producing an effect against it and using the sea as a fulcrum. At the same time, the sailors join in the fight against the wind, for they lean their bodies in the direction opposite to it." Cf. on this passage, *GOS* 312-13, where it is rightly pointed out that Aristotle's reasoning is perfectly sound. When sailing close-hauled, too much canvas aft will increase the tendency of a vessel to come into the wind, which must be counteracted with the rudder; a stiff enough wind can make this arduous. Reducing the sail area aft corrects the situation.

The same maneuver is described by Achilles Tatius (3.1.1-2): *ἐγείρεται δὲ κάτωθεν ἄνεμος ἐκ τῆς θαλάσσης κατὰ πρόσωπον τῆς νηός, καὶ ὁ κυβερνήτης περιάγειν ἐκέλευε τὴν κεραίαν. καὶ σπουδῇ περιῆγον οἱ ναῦται, πῇ μὲν τὴν ὀθόνην ἐπὶ θάτερα συνάγοντες ἄνω τοῦ κέρως βίᾳ (τὸ γὰρ πνεῦμα σφοδρότερον ἐμπεσὸν ἀνθέλκειν οὐκ ἐπέτρεπε), πῇ δὲ πρὸς θάτερον μέρος φυλάττοντες τοῦ πρόσθεν μέτρου καθ' ὃ συνέβαινεν οὖριον εἶναι τῇ περιαγωγῇ τὸ πνεῦμα* "A wind arose from low over the water and struck the ship head on. The captain ordered the yard braced around [i.e., in order to go off on a tack]. The sailors quickly braced the yard around, and, on one side they furled the canvas aloft toward one yardarm by main force since the wind had hit too strongly to permit them to haul [sc. on the brails] against it, while, on the other side, toward the other yardarm, they kept just as much of the original spread of sail as would take the wind at the proper angle for bringing the yard around." In this instance, not only was the canvas brailed up to form a triangle, but, be-





brailed up into a triangle, with the yard and luff forming the arms and the hypotenuse running from the foredeck up to the after yardarm (Figs. 188a-b). The weather sheet would be made as tight as possible in order to draw the luff taut, and this would have a tendency to bring the forward yardarm down, to tilt the whole sail (Fig. 188c). A square sail brailed up in this triangular fashion and set aslant is in shape not unlike a lateen, and may possibly have sparked the invention of that all-important sail (244-45 above).

But the brails had uses over and above that of shortening sail. In light breezes they could be so slacked off[25] that the great mainsail would belly out to meet the forestay (Fig. 90).[26] Sail could be completely doused in a twinkling by taking up on all the brails at once.[27] Sail was furled in the same way when a ship snugged down

cause of the violence of the wind, sail was at the same time further shortened by making the triangle as small as possible.

[25] *κάλως ἐξιέναι, ἐφιέναι aut sim.* in Greek (e.g., Plato, *Prot.* 338a [cited in ELEVEN, App. 1, note 3] and *Sisyphus* 389c; Euripides, *Medea* 278 and *Trojan Women* 94; Aristophanes, *Knights* 756), *immittere* or *laxare rudentes* in Latin (e.g., Ovid, *Pont.* 4.9.73; Vergil, *Aen.* 10.229; Pliny, *Epist.* 8.4.5, cited in ELEVEN, App. 1, note 3).

Vergil (*Aen.* 3.267-68; cf. 682-83) gives a full description of the handling of the brails when getting under way: *excussosque iubet laxare rudentis. / tendunt vela Noti* "And he gives orders to shake loose the brails and slack them off. The south wind fills the sails." In other words, the men whip the lines to get them to run through the blocks and fairleads and let the stiff canvas unfurl, and then they let them run out the proper amount. Thus Lucan (2.697-98), in describing a departure that was carried out with maximum secrecy, relates that "the men, hanging [from the yards], lower the furled canvas and do not shake the stout brails so as not to make the wind whistle [sc. by whipping the lines briskly to get them to run]" (*strictaque pendentes deducunt carbasa nautae / nec quatiunt validos, ne sibilet aura, rudentes*).

[26] Euripides, *Hec.* 111-12: *σχεδίας / λαίφη προτόνοις ἐπερειδομένας* "the ship resting its sail on the forestays"; *Frag.* 773.42: *σινδὼν δὲ πρότονον ἐπὶ μέσον πελάσσει* "The sail travels to the middle of the forestay"; *Anth. Pal.* 10.2.7: *λαίφεα δ' εὐυφέα προτονίζετε* "Forestay your well-cut sail" (i.e., let it out to the forestay). Synesius, describing one of the storms his ship ran into (ELEVEN, App. 3) says (*Epist.* 4.164c) *ᾠόμεθα προτονίζειν τὴν ναῦν* "We had in mind to forestay the ship." Torr suggests (94) that he means "tightening the forestay to secure the mast," but Synesius unmistakably says "ship" and not "mast." It is not unlikely that he was trying to use a nautical term he did not understand; cf. ELEVEN, App. 3, note 1.

[27] Ovid, *Met.* 11.483: *antemnis totum subnectite velum* "bind the whole sail to

or docked (Fig. 150);[28] men had to go aloft only to secure the canvas with gaskets (Figs. 144, 151).

## III ROWING

As MENTIONED earlier (80, 104 above), one of the trireme's advantages was that it enabled the oarsmen to row from a seated position. In recompense, it required an extraordinarily high degree of skill to ensure that 170 individual rowers would carry out orders with split-second speed and in perfect unison.

A good crew was said to be "beaten together,"[29] i.e., it rowed with a unified beat. Veteran crews had to be kept up to the mark by frequent exercises and racing competitions.[30] New crews had to be broken in by arduous repetitive practice.[31] When galleys were not available for this, the men could be given the elementary lessons seated in temporary platforms erected on land.[32] Here they would

the yard"; Lucan 9.328: *antemnae suffixit lintea summae* "had tied the canvas to the yard on high."

[28] Cf. *Od.* 3.10-11: *οἱ δ' ἰθὺς κατάγοντο, λὸ' ἱστία νηὸς ἐίσης / στεῖλαν ἀείραντες, τὴν δ' ὥρμισαν* "They straightway made for the shore, quickly raised [i.e., brailed up] and furled the sail of their graceful craft and moored her." Conformably, to unfurl sail is to "lower" it; cf. Achilles Tatius 2.32.2, where he says of a ship getting underway *τὸ ἱστίον καθίετο* "The sail was lowered."

[29] *συγκεκροτημένος*; see Polyaenus 3.11.7, cited in note 32 below (same expression in Polybius 1.61.3) and cf. Thucydides 8.95.2: *Ἀθηναῖοι . . . ἀξυγκροτήτοις πληρώμασιν ἀναγκασθέντες χρήσασθαι* "the Athenians . . . forced to use untrained (*axynkrotetos*) crews."

[30] See *GOS* 308-309. The boat race in Book Five of the Aeneid may very well be based on races held by the Roman navy that Vergil had seen; cf. Mohler 62.

[31] Cf. Herodotus' story (6.12) of the Ionian citizens who volunteered to serve as rowers and, able to take but a week of the rigorous training an experienced naval officer put them through, quit en masse.

[32] Chabrias trained raw Egyptian recruits in the 4th century B.C. this way; see Polyaenus 3.11.7: "He removed the oars from the triremes, laid out long planks along the shore so that the men could sit in single file, issued them the oars, and, putting them in charge of bilingual *keleustai* (302 below), in a few days he taught them to row and filled his ships with trained [*synkekrotemenos* 'beaten together'] oarsmen" (*ἐξελὼν τὰς κώπας τῶν τριήρων, ξύλα μακρὰ παραβαλὼν ἐπὶ τὸν αἰγιαλὸν ὥστε ἐφ' ἕνα καθῆσθαι, δοὺς αὐτοῖς τὰς κώπας καὶ κελευστὰς τῶν διγλώσσων ἐπιστήσας ὀλίγαις ἡμέραις ἐλαύνειν αὐτοὺς ἐδίδαξεν [καὶ τὰς ναῦς] ἐρετῶν συγκεκροτημένων ἐπλήρωσεν*). The Romans trained men for their newly built fleet in 260 B.C. in this way (Polybius 1.21.1-2) and Agrippa for Augustus' newly reconstituted fleet in 37 B.C.





learn all the basics of rowing: to stroke to the "trireme tune" or the beat of a mallet,[33] back water,[34] dip and hold the oars,[35] ship oars,[36] spurt.[37] The next stage in the oarsmen's education was necessarily carried out on the water and in concert with other ships,

(Dio Cassius 48.51.5: *τοὺς δὲ ἐπ' ἰκρίων ἐρέττειν ἤσκει* "the [oarsmen] he taught to row on frames"). Thiel, *History* 172-73, note 345, argues that this was standard practice, which goes a little too far; it was standard emergency practice.

[33] Cf. Athenaeus 12.535d: [Alcibiades, making a grand entrance into Athens' harbor, had a concert flute-player] "pipe the trireme beat" (*ηὔλει τὸ τριηρικόν*). For time-keeping aboard Roman galleys by pounding with a mallet, see THIRTEEN, note 52.

The general term for what gave the time to the rowers, whether the sound of an instrument or a coxswain's cry, was *keleuma* or *keleusma* in Greek (cf., e.g., Euripides, *IT* 1405: *κώπῃ προσαρμόσαντες ἐκ κελεύσματος* "fitting [their movements] with the oar to the beat [*keleusma*])," which was borrowed by Latin (cf., e.g., Martial 3.67.4: *lentos tinguitis ad celeuma remos* "You dip the oars lazily to the beat [*celeuma*]" and 4.64.21).

[34] *πρύμναν (ἀνα)κρούεσθαι* in Greek; see, e.g., Thucydides 1.50.5, 7.40.1; Aristophanes, *Wasps* 399; Diodorus 11.18.6. *inhibere remis puppim* (*aut sim.*) in Latin; see, e.g., Cicero, *ad Att.* 13.21.3 (*inhibitio . . . remigum motum habet et vehementiorem quidem remigationis navem convertentis ad puppim* "*Inhibitio* [literally 'holding back'] of the oars involves motion, rather violent motion at that, of the oarage driving the ship toward the stern"); Livy 26.39.12, 30.10.17, 37.30.10.

[35] *τὰς κώπας καθεῖναι* in Greek; see Thucydides 2.91.4, Dio Cassius 50.31.5. *remos demittere* in Latin; see Livy 36.44.8. The maneuver was used to check way or to steady the ship.

[36] Cf. *GOS* 310.

[37] Latin authors employ a variety of expressions. Caesar (*Bell. Gall.* 3.14.6, 4.25.1; *Bell. Civ.* 2.6.5) prefers (*navem*) *incitare* "hurry [a ship] along," others *concitare* (Cicero, *de orat.* 1.33.153; Livy 30.25.8; Curtius 4.3.2; Frontinus, *Strat.* 1.5.6). Tacitus (*Ann.* 3.1) uses *alacre remigium* "quick rowing"; cf. *citis remigiis* in Ammianus 24.6.5, *concitatis remigiis* in Seneca, *Dial.* 6.18.7.

In Greek, the technical expression is *ῥοθίῳ τῇ εἰρεσίᾳ πλεῖν* "to travel with rush-roaring rowing" (Polyaenus 4.7.6). Greek poets of the 5th B.C. use the expression *rhothios* "rush-roaring" of the sound of a galley's oars as they pass through the water (cf. *GOS* 203, 311) and *pitylos* of the "plash" as the oars are dipped. Both terms seem to have entered the technical vocabulary; for the latter see THIRTEEN, note 53. Aristophanes, *Frag.* 84 (Edmonds 1, p. 596), speaks of a "ship, when it makes a rush-roar with its plashes" (*ναῦς ὅταν ἐκ πιτύλων ῥοθιάζῃ*).

We have no information on how fast an ancient galley could spurt. The galleys of Louis XIV, driven by four or five men to the oar, could do perhaps 6 nautical miles per hour (Masson 206). Conformably, Guglielmotti (s.v. *palata*) reckons that Italian galleys of the 16th century did ca. 5½ to 6½, with a maximum of ca. 8¾ (30 strokes a minute, each producing 9.1 m. of forward movement, and a nautical mile is 1854.96 m.), or even better for very brief dashes. Thus Admiral Rodgers' estimate of better than 7 for ancient galleys may not be far from the mark (W. Rodgers, *Greek and Roman Naval Warfare*, Annapolis 1937, p. 516).

namely the fundamental fleet evolutions: to form line ahead,[38] to form line abreast,[39] to go from one to the other.[40] Lastly there would be intensive training in battle maneuvers, notably the *diekplous* "break-through" and the *periplous* "envelopment."[41]

It was only during battle or in emergencies that all oars were manned.[42] Sails were used as much as possible.[43] When rowing was unavoidable, and particularly when it had to be carried on for long periods, the men were divided into squads that rowed in turn, or, if all were kept at the oars, were given regular short spells of rest.[44]

[38] *κατὰ μίαν* (*ναῦν*) Thucydides 2.84.1, 2.90.4; *ἐπὶ μιᾶς* Xenophon, *Hell.* 1.6.29-31. For the Latin terminology, see W. Lacey, "Some Uses of *Primus* in Naval Contexts," *CQ* 51 (1957) 118-22, esp. 118. Livy's word for a file of ships (i.e., in line ahead) is *agmen* (36.43.13, 37.23.8). The head of the file is *prima navis*, the ship in the center is *media navis*, the tail end is *extremum agmen*, and "to bring up the rear" is *agmen cogere* (36.44.4, 37.23.8).

[39] In Greek *μετωπηδόν* (*πλεῖν aut sim.*) Herodotus 7.100, Thucydides 2.90.4. Livy's word for a line of ships abreast is *acies* or *frons* (30.10.4, 37.30.6; cf. Lacey, *ibid.*).

[40] Cf. Thucydides 2.90.4: *ἐπιστρέψαντες τὰς ναῦς μετωπηδὸν ἔπλεον* "Turning the ships [sc. from line ahead], they sailed line abreast"; Livy 37.29.8: *regia classis, binis in ordinem navibus longo agmine veniens . . . aciem . . . explicuit* "The king's fleet, traveling line ahead in a long double column, . . . went into . . . line abreast."

[41] On these terms, see *GOS* 137-39, 314-19.

[42] Cf. *GOS* 309. As Thucydides tersely puts it (7.14.1): "Peak performance of a crew is short" (*βραχεῖα ἀκμὴ πληρώματος*).

[43] Cf. *GOS* 310-11, Mohler 48-52. Cicero's description (*ad Att.* 16.6.1) of a trip he took in a 20-oared *actuariola* (cf. 16.3.6 and EIGHT, note 11) from Pompeii to Vibo is instructive: *magis commode quam strenue navigavi; remis enim magnam partem, prodromi nulli. illud satis opportune, duo sinus fuerunt quos tramitti oporteret, Paestanus et Vibonensis, utrumque pedibus aequis tramisimus* "I had a comfortable rather than strenuous voyage, for most was under oars and there were no boisterous northerlies (*prodromi*). A bit of luck this, since we had two bays to cross, the Bay of Paestum and the Bay of Vibo, and we crossed both with the yard squared" (*pedibus aequis*; see note 13 above). In other words, in a light galley the rowers went to work not only when there was no wind but on occasion when there was too much—and winds like the *prodromi* "forerunners," i.e., the harbingers of the summer northerlies (Pliny, *NH* 2.123), though fine for heavy sailing craft could often prove too much for a galley with its scant draft. At such times it had to stay out of open water and creep along the coast, perforce under oars. Cicero voyaged comfortably because he was spared both the buffeting a light boat takes in a stiff breeze and the long hours needed to row around the circuit of a bay. Heading straight for his destination, he went along mostly under oars but catching just the right wind for crossing the mouth of the Gulf of Salerno and Gulf of S. Eufemia.

[44] When Athens sent a second trireme rushing to Mytilene in 427 B.C. to countermand the orders for the town's destruction, "the men slept and rowed in turns" (*οἱ μὲν ὕπνον ἠροῦντο κατὰ μέρος, οἱ δ' ἤλαυνον* Thucydides 3.49.3). When Conon was caught at Aegospotami in 405 B.C. with the crews wandering ashore, he ordered the ships launched, but "some were double-leveled (*dikrotoi*, i.e., had only two banks





## IV SPEED

How fast could ancient ships travel?[45]

The question so put is meaningless: the speed of a sailing ship depends first and foremost on the direction of the wind and varies drastically with it. Against the wind, 100 miles can take as long as 200

manned), some single-leveled (*monokrotoi*, i.e., had only one bank manned), and some completely empty" (*αἱ μὲν τῶν νεῶν δίκροτοι ἦσαν, αἱ δὲ μονόκροτοι, αἱ δὲ παντελῶς κεναί* Xenophon, *Hell.* 2.1.28). Traveling under only one bank of oars was apparently common practice. Polyaenus (5.22.4) reports that Diotimus (4th B.C.), after sending off contingents from his crews to set up an ambush against an enemy city, "held off with his ships [sc., to give the ambush party enough time], ordering the marines on the decks to prepare for battle and the oarsmen to ply the thalamite, the zygite, and the thranite oars in turn" (*ταῖς ναυσὶν ἀνεκώχευε παραγγείλας τοῖς μὲν ἐπὶ τῶν καταστρωμάτων διασκευάζεσθαι πρὸς μάχην, τοῖς δὲ ἐρέταις ἀνὰ μέρος ὁτὲ μὲν τὰς θαλαμιάς, ὁτὲ δὲ τὰς ζυγίας, ὁτὲ δὲ τὰς θρανίτιδας κώπας ἀναφέρειν*). Vergil (*Aen.* 5.268-81) describes Sergestus' ship as returning ingloriously from the boat race "feeble under one bank" (5.271: *ordine debilis uno*; it had lost a good many oars taking a cliff too closely); the poet only means that the ship's progress was feeble in comparison with the others which had dashed home under full power.

On spells of rest, cf. Statius, *Theb.* 6.799-801: *sic ubi longa vagos lassarunt aequora nautas / et signum de puppe datum, posuere parumper / bracchia: vix requies, iam vox citat altera remos* "Just so, when long wandering over the sea has wearied the rowers and the signal is given from the poop, they rest their arms for a while; a scarce moment of repose, and then a second cry recalls them to the oars"; cf. H. Levy in *Classical Journal* 41 (1945-46) 327.

[45] The topic has been dealt with any number of times. The various treatments, over and above taking no cognizance of wind direction, have been marred by inaccuracy and incompleteness. Here are a few samples. W. Götz, *Die Verkehrswege im Dienste des Welthandels* (Stuttgart 1888) 259 cites *Od.* 15.474ff. as evidence that the trip from the Cyclades around Malea to Ithaca took 7 days. The passage does not say this: 7 days out at sea a killing took place, and some unspecified time later the vessel arrived at Ithaca. Similarly, W. Riepl, *Das Nachrichtenwesen des Altertums* (Leipzig 1913) 164 cites Livy 36.29 to prove that Nicander traveled from Asia Minor to Greece in 12 days. Again, the passage does not say this: Nicander went to King Antiochus, spent an undisclosed amount of time there, then returned to Phalara, a port on the Malian Gulf; the round trip, including whatever time he spent with the king, took 12 days (Livy's words *duodecimo is die quam conscenderat navem* mean "on the 12th day from the day he had boarded ship" at the port from which he left Greece). E. de Saint-Denis, "La vitesse de navires anciens," *Rev. arch.* sér. 6, 18 (1941) 121-38, omits Marcus Diaconus, *Vita Porph.* 6, though citing other passages from the same work. R. van Compernolle, "La vitesse des voiliers grecs à l'époque classique (V^e^ et IV^e^ siècles)," *Bulletin de l'institut historique belge de Rome* 30 (1957) 5-30, dismisses as exceptional (16) a significant passage from Thucydides (2.97.1; see Table 2), makes (16) an unproven and probably wrong assumption about another (6.1; see note 93 below), and bases his chief argument on a series of totally hypothetical calculations. See also notes 60 and 111 below.

with the wind. Columbus flew to America with the Atlantic trades at his heels; when he met headwinds while working north along the coast of South America he was lucky to log 1 mile forward an hour. A very first step must be to classify voyages according to the winds encountered en route, to sift those done with a wind from some point abaft the beam, enabling the ship to move at its fastest directly toward its destination, from those with a wind from ahead, when a vessel must go through the uncomfortable and wearisome procedure known as tacking.[46] Fortunately, in many cases we are specifically told what the wind conditions were; where we are not, we can often make some sort of guess by using modern hydrographic information.[47] No doubt, in any crossing, the nature of the vessel, whether fast or slow, and the force of the wind had a certain effect. But never as much as wind direction; this sets the basic speed, and other factors cause only variations.

### Voyages Made with Favorable Winds

Pliny, in a much-quoted passage,[48] mentions a pair of record voyages and a number of others that he obviously considers examples

[46] This has been overlooked by the many who provide a list of miscellaneous voyages and from it deduce—or let the reader deduce—what the "average speed" of ancient ships was. E.g., Götz (*op. cit.* previous note, 260) concludes that the average speed in Greek times was 4 to 6 knots. Riepl (*op. cit.*, previous note, 160-61) agrees with this but adds (168) an overall average of 5-7½ knots for the whole ancient period. Cedric Yeo (*TAPA* 77, 1946, p. 232) holds for an average speed of about 3 to 4 knots. W. Kroll (*RE*, s.v. *Schiffahrt* 411 [1921]) offers 5.6 knots for the Greek period and up to 7.5 for the Roman.

[47] The same winds prevail today as in the days of the ancients. Cf. e.g., Casson, "Isis" note 4, which points out that Nelson in 1798 met the identical winds encountered in a voyage described by Lucian. Mohler has applied hydrographic information and a knowledge of the effect of the wind on sailing vessels to certain passages in the Aeneid with illuminating results.

[48] *NH* 19.3-4: "[Is there a greater miracle than the flax plant which (sc. made into sails) enabled] Galerius to reach Alexandria on the seventh day from the Strait of Messina, and Balbillus on the sixth . . . and Valerius Marianus . . . from Puteoli on the ninth day with the lightest possible breeze . . . , which puts Gades, near the Pillars of Hercules, within seven days of Ostia, Hither Spain within four, the Province of Gallia Narbonensis within three, Africa within two?" (*ut Galerius a freto Siciliae Alexandriam septimo die pervenerit, Balbillus sexto . . . , Valerius Marianus . . . a Puteolis nono die lenissimo flatu . . . , quae Gades ab Herculis columnis septimo die Ostiam adferat et citeriorem Hispaniam quarto, provinciam Narbonensem tertio, Africam altero*).





of exceptionally fast runs. All, of course, must have been made under favorable wind conditions. The voyages are as follows:[49]

Table 1

| *Voyage* | *Distance (nautical miles)* | *Length of Voyage (days)* | *Overall Speed (knots)* |
|---|---|---|---|
| Ostia-Africa | 270[50] | 2 | 6 |
| Messina-Alexandria | 830 | 6[51] | 5.8 |
| Ostia-Gibraltar | 935 | 7 | 5.6 |
| Ostia-Hispania Citerior | 510[52] | 4 | 5·3 |
| Ostia-Provincia Narbonensis | 380[53] | 3 | 5·3 |
| Messina-Alexandria | 830 | 7 | 5 |
| Puteoli-Alexandria | 1,000 | 9 | 4.6 |

This list gives a good point of departure. It provides an upper limit: with a wind from the right direction, a speed of between 4½ and 6 knots could be realized. The variation reflects the two factors mentioned above, that some winds are stronger and some ships faster than others, a point that can be best illustrated by the voyage between Ostia and Africa. The record crossing took, as Pliny shows, two days. A more usual but still fast trip took two and a half or three days,[54] while

[49] Distances are based on G. Philip, *Mercantile Marine Atlas*[16] (London 1959) maps 16-18; Reed's *Tables of Distances Between Ports and Places in all Parts of the World*[11] (Sunderland 1947) 62-69; *Table of Distances between Ports*, United States Navy Hydrographic Office, no. 117 (Washington, D.C. 1943) *passim*. In addition, I have used measurements based on the U.S. Navy Hydrographic Office charts of the Mediterranean.

[50] This is the distance between Ostia and a point off Cape Bon. Pliny, who cannot resist exaggeration, adds that this voyage (like the Puteoli-Alexandria run mentioned in note 48) was done "with the lightest possible breeze."

[51] The voyage from Italy to Alexandria was a downhill run with the northwest trades at a vessel's heels all the way. Goitein (326) reports one 11th century run from Palermo to Alexandria that took 13 days and another that took 17, while Ibn Jubayr went from Sardinia to Egypt in 12 (Goitein 325). I estimated that the Marseilles-Alexandria run would take 20-30 days ("Speed" 146); Goitein (325) has subsequently reported an 11th century voyage that took exactly 25.

[52] The distance from Ostia to Tarraco through the Strait of Bonifacio is 510 nautical miles.

[53] To Narbo.

[54] Cato the Elder showed the Senate at Rome a fig that "had been picked at Carthage three days before" (*tertium . . . ante diem . . . decerptam Carthagine*, Pliny, *NH* 15.75; cf. Plutarch, *Cato Maior* 27.1).

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long leg of the journey, from Syracuse to the mouth of the Alpheus, the same ship logged but 2.5 knots.[65] We are told nothing about the wind conditions en route but the prevailing winds in this area blow from the NW, which should have been perfect for such a voyage[66]—had he actually encountered them.

In one of the episodes in Xenophon of Ephesus' novel, he has a pirate ship make the 400 miles from Rhodes to Ephesus in four days,[67] or an average of 4 knots, somewhat slower than the speeds just given. The wind failed on the second day, and some time was lost in a boarding operation. Presumably the author conceived of the rest of the run as being made under a favorable wind—and the northwesterlies of the area would, in fact, be ideal.[68]

Sulpicius Severus in one of his dialogues mentions that the trip from Narbo to Utica took five days.[69] The distance is about 500 nautical miles, which works out to an average speed of 4.1 knots. For the 70-odd miles through the Gulf of Lion the ship may have had to tack[70] and, if so, made no more than 2 knots.[71] The rest of

[65] *Ibid.*: "Having arrived at Syracuse, they set sail for the Peloponnese . . . [and] arrived on the sixth day at the mouth of the Alpheus" (ἐπὶ Συρακουσῶν κομισθέντες ἀνήγοντο ἐς Πελοπόννησον . . . , ἀφίκοντο δι' ἡμέρας ἕκτης ἐπὶ τὰς τοῦ Ἀλφειοῦ ἐκβολάς). The distance is somewhat over 300 nautical miles.

[66] Cf. Plutarch, *Dion* 25.1-6 (cited in part in note 98 below) for a graphic picture of the effect of the northwest winds in this area. Dion's fleet was driven before them from Syracuse to the Greater Syrtes. All hands were amazed when a fresh south wind sprang up; they never expected a wind from that direction in those waters.

[67] Xenophon of Ephesus, *Eph.* 1.12.3, 13.4-5, 14.6: "At first they were carried along by a fair wind . . . and that day and the following night they were borne along. . . . On the second day the wind died down. . . . At first [a galley full of pirates] kept sailing alongside . . . but about midday . . . they leaped on to the ship . . . [and after looting it], completing the rest of the sail in three days, arrived at . . . Tyre" (1.12.3: καὶ τὰ μὲν πρῶτα ἐφέροντο οὐρίῳ πνεύματι . . . κἀκείνην τε τὴν ἡμέραν καὶ τὴν ἐπιοῦσαν νύκτα ἐφέροντο . . . τῇ δὲ δευτέρᾳ ἐπέπαυτο μὲν ὁ ἄνεμος . . . 1.13.4-5: τὰ μὲν πρῶτα παρέπλεον . . . περὶ μέσον ἡμέρας . . . ἀνεπήδησαν ἐπὶ τὴν ναῦν . . . 1.14.6: διανύσαντες ἡμέραις τρισὶ τὸν πλοῦν κατήχθησαν εἰς . . . Τύρον).

[68] 272 above.

[69] Sulpicius Severus, *Dial.* 1.3.1: "We set sail from Narbo and entered the port of Africa [most likely Utica] on the fifth day; so prosperous a voyage had we made with God's consent" (*Narbone navem solvimus, quinto die portum Africae intravimus: adeo prospera Dei nutu navigatio fuit*).

[70] The course was southeast and southwest winds are common in this area; see 272 above.

[71] See Table 5 below.





the journey probably saw favorable winds[72] and an average speed of somewhat better than 5 knots.

The following instances are not records of actual voyages but indications of the time it usually took to cross from one point to another. As it happens, all involve sailing with favorable winds.

TABLE 3

| *Voyage* | *Distance (nautical miles)* | *Length of Voyage (days)* | *Overall Speed (knots)* |
|---|---|---|---|
| Ibiza-Gibraltar[73] | 400 | 3 | 5.5 |
| Epidamnus-Rome[74] | 600 | 4½ | 5.5 |
| Cape Samonium in Crete-Egypt[75] | 310 | 3 or 4 | 4.3 or 3.2 |
| Rhodes-Alexandria[76] | 325 | 3½ | 3.9 |
| Sea of Azov-Rhodes[77] | 880 | 9½ | 3.9 |

In the light of this evidence, the lower limit of the rate of speed should be revised from the 4½ knots noted hitherto to 4 knots.

Consider the following voyages:

[72] *HO* 152.581 and 35, bottom.

[73] Diodorus Siculus 5.16.1: "The Pityuses . . . lie a voyage of three days and three nights distant from the Pillars of Hercules" (Πιτυοῦσσα . . . διέστηκεν ἀπὸ μὲν Ἡρακλέους στηλῶν πλοῦν ἡμερῶν τριῶν καὶ τῶν ἴσων νυκτῶν). The prevailing easterly winds of the area (272) would be favorable.

[74] Procopius, *Bell. Goth.* 3.18.4: "For those sailing [from Epidamnus] . . . with a favorable wind, it is possible to reach the harbor of Rome in five days" (πλέουσι μὲν ἀνέμου . . . ἐπιφόρου ἐπιπεσόντος πεμπταίοις ἐς τὸν Ῥωμαίων λιμένα καταίρειν δυνατὰ ἔσεσθαι).

[75] Strabo 10.475: "The voyage from Samonium to Egypt takes four days and nights; though some say three" (ἀπὸ δὲ τοῦ Σαμωνίου πρὸς Αἴγυπτον τεττάρων ἡμερῶν καὶ νυκτῶν πλοῦς, οἱ δὲ τριῶν φασί).

[76] Diodorus Siculus 3.34.7: "From the Lake of Maeotis [Sea of Azov], . . . many on merchant ships traveling with a fair wind make Rhodes on the 10th day . . . , and from there make Alexandria on the 4th" (ἀπὸ γὰρ τῆς Μαιώτιδος λίμνης . . . πολλοὶ τῶν πλοϊζομένων οὐριοδρομούσαις ναυσὶ φορτίσιν εἰς μὲν Ῥόδον δεκαταῖοι . . . ἐξ ἧς εἰς Ἀλεξάνδρειαν τεταρταῖοι καταντῶσιν).

[77] See previous note.

TABLE 4

| *Voyage* | *Distance (nautical miles)* | *Length of Voyage (days)* | *Overall Speed (knots)* |
|---|---|---|---|
| Byzantium-Rhodes[78] | 445 | 5 | 3.7 |
| Byzantium-Gaza[79] | 855 | 10 | 3.6 |
| Thessalonica-Ascalon[80] | 800 | 12 | 2.8 |

The three voyages took place in an area where the prevailing winds would be fair. The slower speed, if they actually did encounter fair winds, may have been because the run involved some island-hopping and coasting, which is more time-consuming than sailing over the open sea. Vessels could not reach their maximum speed until in the waters south of Rhodes.

Combining all the above evidence, it would seem that, under favorable wind conditions, ancient vessels averaged between 4 and 6 knots over open water, and slightly less while working through islands or along coasts.[81]

[78] Marcus Diaconus, *Vita Porph.* 55: "We arrived at Rhodes [from Byzantium] in five days" (*ἐφθάσαμεν δὲ τὴν Ῥόδον δι' ἡμερῶν πέντε*).

[79] Marcus Diaconus, *Vita Porph.* 27: "I left Byzantium and arrived in 10 days at Gaza" (*ἐξεπόρισα ἐκ τοῦ Βυζαντίου καὶ φθάνω δι' ἡμερῶν δέκα τὴν Γαζαίων πόλιν*).

[80] Marcus Diaconus, *Vita Porph.* 6: "And going immediately to Ascalon and finding a ship, I set sail and after a good voyage of 13 days, we arrived at Thessalonica. . . . I sailed back, arriving in 12 days at the port of Ascalon" (*εὐθέως δὲ κατελθὼν εἰς Ἀσκάλωνα καὶ εὑρὼν πλοῖον ἀνήχθην, καὶ δι' ἡμερῶν δέκα τριῶν εὐπλοήσαντες ἐγενόμεθα εἰς Θεσσαλονίκην . . . ἐπανέπλευσα φθάσας δι' ἡμερῶν δέκα δύο εἰς τὸ ἐμπορεῖον Ἀσκάλωνος*). The voyage out was indeed good: though in a direction that would normally encounter foul winds, it took but one day longer than the voyage back.

[81] Cf. Aristides' remark (*Orat.* 36.111 [II, p. 298 Keil]) to the effect that "a vessel, running for a day and a night with a wind from astern—one that whistles, I may add—. . . will make . . . perhaps better than 1,200 stades [120 nautical miles = 5 knots]. I have often made this speed myself during a good crossing" (*ναῦς πανημερία θέουσα ὑπ' ἀνέμου κατὰ πρύμναν πνέοντος, προσθήσω δὲ καὶ 'λιγέος', . . . σταδίους ἀνύσει . . . ἴσως μᾶλλον διακοσίους καὶ χιλίους. καὶ ἡμεῖς τοσούτους ἐν εὐπλοίᾳ πολλάκις ἠνύσαμεν*). Menippus, who wrote a coast pilot toward the end of the 1st B.C., mentions (Marcianus of Heracleia, *Epitome peripli Menippei* 5 [Müller, *GGM* 1, p. 568]) that an ordinary vessel makes 700 stades (70 nautical miles = ca. 3 knots) and a well-made one 900 (90 nautical miles = ca. 4 knots) "in one day" (*διὰ μιᾶς ἡμέρας*); whether he means 24 hours or just the daylight hours is not certain.





## VOYAGES MADE WITH UNFAVORABLE WINDS

The difference in speed when traveling before and against the wind can most graphically be illustrated by several of the voyages of Mark the Deacon. Sailing with a following wind he made from Byzantium to Rhodes in five days and from Byzantium to Gaza in ten (Table 4). The return trip in both cases took just twice as long (Table 5).[82]

Here are the records of voyages made under unfavorable wind conditions:

TABLE 5

| *Voyage* | *Distance (nautical miles)* | *Length of Voyage (days)* | *Overall Speed (knots)* |
|---|---|---|---|
| Cyrene-West Point of Crete[83] | 160 | 2 | 3.3 |
| Ascalon-Thessalonica[84] | 800 | 13 | 2.6 |
| Rhodes-Gaza[85] | 410 | 7 | 2.4 |
| Alexandria-Marseilles[86] | 1,500 | 30 | 2.1 |
| Puteoli-Ostia[87] | 120 | 2½ | 2.0 |
| Gaza-Byzantium[88] | 855 | 20 | 1.8 |
| Rhodes-Byzantium[89] | 445 | 10 | 1.8 |
| Caesarea-Rhodes[90] | 400 | 10 | 1.7 |
| Alexandria-Cyprus[91] | 250 | 6½ | 1.6 |
| Sidon-Chelidonian Isles[92] | 350 | 9½ | 1.5 |

[82] Equally graphic are voyages from Rome to the Near East and back. Puteoli to Alexandria could be done in as few as 9 days (Table 1), while the trip back could take over 50 and even 70 (Casson, "Isis" 43-51).

[83] Strabo 10.475: "The voyage from Cyrene to Criumetopon [the west point of Crete] takes two days and nights" (*ἔστι δ' ἀπὸ τῆς Κυρηναίας ἐπὶ τὸ Κριοῦ μέτωπον δυεῖν ἡμερῶν καὶ νυκτῶν πλοῦς*).

Thucydides mentions that the sail from Carthaginian Neapolis to Sicily, a distance of about 125 nautical miles, took two days and a night (7.50.2: *Νέαν πόλιν, Καρχηδονιακὸν ἐμπόριον ὀθνεπερ Σικελία ἐλάχιστον δύο ἡμερῶν καὶ νυκτὸς πλοῦν ἀπέχει* "Neapolis, a Carthaginian port that lies the closest to Sicily, a voyage of two days and a night"). If he means 36 hours, then the speed works out to ca. 3.5 knots; if

The speed in this list that appears most out of line is the first, but a moment's further study will reveal that it is not really so. From Cyrene to the west point of Crete is NNE. The prevailing wind in these waters is NW. A vessel making the voyage would theoretically travel on a port tack the whole distance. If the wind, however, backed merely a point or so, it would cease being unfavorable. The second,

he means 24 hours plus a long day of, say, 15, then it works out to slightly less. The first leg, along the coast of Cape Bon, could take advantage of the favorable land breeze, but the rest would generally be against the prevailing easterlies (*HO* 151.47). Thus, like the crossing from Cyrene to Criumetopon, it reveals somewhat better time than could be made in trips against the wind all the way.

[84] See note 80 above.

[85] Marcus Diaconus, *Vita Porph.* 56-57: "Sailing out of Rhodes, the weather being good, we had a good voyage for two days; then a storm suddenly arose. . . . Toward evening, the wind shifted, and we had good sailing conditions. Putting in four more days on the sea, at dawn on the fifth we sailed up to the beach at Gaza" (*πλεύσαντες δὲ ἐκ τῆς Ῥόδου καὶ εὐπλοήσαντες ἐπὶ ἡμέρας δύο εὐδίας οὔσης, ἄφνω κινεῖται χειμών . . . πρὸς ἑσπέραν ἐτράπη ὁ ἄνεμος, καὶ ἐπλέομεν ἐπιτηδείως, καὶ ποιήσαντες ἐν τῷ πελάγει ἄλλας ἡμέρας τέσσαρας, τῇ πέμπτῃ ὄρθρου κατεπλεύσαμεν εἰς τὸ παράλιον μέρος τῆς Γαζαίων*).

[86] Sulpicius Severus, *Dial.* 1.1.3: "There [i.e., at Alexandria] I found a merchant ship that was getting ready to shove off with a cargo for Narbo. . . . On the 30th day I arrived at Massilia, and from there I came here [to Narbo] on the 10th. So prosperous was the voyage that fell to my pious wish" (*navem ibi onerariam inveni, quae cum mercibus Narbonam petens solvere parabat . . . tricensimo die Massiliam adpulsus, inde huc decimo perveni: adeo prospera navigatio piae adfuit voluntati*). Indeed it was a prosperous voyage, considering the consistently unfavorable prevailing winds; cf. note 82. Goitein (326) reports an 11th century voyage from al-Kanais, just west of Alexandria, to Palermo that took 25 days, which accords fairly well with the 30 days reported by Sulpicius for the trip from Alexandria to Marseilles. Goitein also reports (325) a voyage from Alexandria to Almeria—the distance sailed would be about the same as from Alexandria to Marseilles—that took 65 days, which accords with Lucian's comment that it could take as much as 70 days to go from Alexandria to Rome (see Casson, "Isis" 43-51).

[87] Philostratus, *Vita Ap.* 7.16: "Sailing from Puteoli, they arrived at the mouth of the Tiber in three days" (*ἀποπλεύσαντες δὲ τῆς Δικαιαρχίας τριταῖοι κατῆραν ἐς τὰς ἐκβολὰς τοῦ Θύμβριδος*). Friedländer suggests (*Darstellungen aus der Sittengeschichte Roms*[10] I 337-38) that the ship put in for the night at Cajeta and Antium. More likely it was sailing night and day beating into the eye of the northwesterlies.

[88] Marcus Diaconus, *Vita Porph.* 26: "[At Gaza, Porphyrius] put me aboard, and in 20 days we arrived [at Byzantium]" (*ἐπλώισέν με καὶ δι' ἡμερῶν κ ἐφθάσαμεν*). Cf. the 11th century voyage reported by Goitein (326) that took 18 days from Alexandria to Constantinople. I had earlier estimated ("Speed" 145) that such a voyage would take 17-20 days. For the route, cf. Josephus, *Ant. Jud.* 16.17-20 (Herod sailed from Palestine to Byzantium via Rhodes, Cos, Chios and Mitylene. He was held up by contrary winds at Chios).

[89] Marcus Diaconus, *Vita Porph.* 37: "Leaving [Rhodes] on that very day, we set





the voyage from Ascalon to Thessalonica, is patently exceptionally fast since it took but one day longer than the trip the other way (Table 4), which was in the direction favored by the prevailing winds. The very low average of the last voyage was caused by a heavy storm encountered en route. It would seem therefore that ancient vessels averaged from less than 2 to 2½ knots against the wind.[93]

sail and in 10 more days arrived at Byzantium" (*ἀναχθέντες ἐκείνῃ τῇ ἡμέρᾳ ἐπλεύσαμεν καὶ δι' ἄλλων ἡμερῶν δέκα ἐφθάσαμεν τὸ Βυζάντιον*).

[90] Marcus Diaconus, *Vita Porph.* 34: "Arriving at Caesarea, we set sail . . . and . . . making a good voyage . . . arrived at Rhodes in 10 days" (*καταλαβὼν τὴν Καισάρειαν . . . ἐπλεύσαμεν . . . καὶ . . . εὐπλοήσαντες δι' ἡμερῶν δέκα κατήχθημεν εἰς Ῥόδον*).

[91] Lucian, *Navig.* 7: "Setting sail from Pharos with no very strong wind, on the 7th day we sighted Acamas [the eastern tip of Cyprus]. . . . [On leaving Sidon] we were struck by a great storm and on the 10th day, passing through the Strait of Aulon, we arrived at the Chelidonian Isles" (*ἀπὸ τῆς Φάρου ἀπάραντας οὐ πάνυ βιαίῳ πνεύματι ἑβδομαίους ἰδεῖν τὸν Ἀκάμαντα. . . . χειμῶνι μεγάλῳ περιπεσόντας δεκάτῃ ἐπὶ Χελιδονέας διὰ τοῦ Αὐλῶνος ἐλθεῖν*). Cf. the 11th century voyage reported by Goitein (321) from Alexandria to Tripoli on the Lebanese coast opposite Cyprus; a constant fight against storm and foul winds, it took 8 days.

[92] See the preceding note.

[93] Wind conditions were often bad enough to force vessels to stop at intermediate ports for days or weeks or even months. It took Cicero three weeks to cross from Patras to Brindisi in 50 B.C. (*ad Fam.* 16.9.1-2), and St. Paul, of course, was forced to spend the winter at Malta (Acts 28.11).

Several voyages have not been included in the tables because it is impossible to determine the winds encountered. There are, e.g., those reported by Herodotus (4.86) that took place in the Black Sea, an area of variable winds. The speed seems to have been 3 to 4 knots, but there is a complication in that the figures Herodotus gives for the distances covered are much greater than they should be. He based them on a ship's average speed, which in this case he overestimated; cf. How and Wells, note to 4.85.2. Strabo (11.498) reports that the voyage from Phasis to Amisus and Sinope took two or three days. Since the distance is 235 nautical miles, this would mean a speed of 3¼ or 5 knots. Then there is the circumnavigation of Sicily to which there are references in Thucydides, Strabo, and Plutarch. On such a course a vessel would theoretically meet both favorable and unfavorable winds. Strabo (6.266) quotes Ephorus as saying that it took five days and nights. Since the distance is roughly 500 nautical miles, the speed works out to 4.2 knots. Plutarch (*Mor.* 603a) says four days, which would mean 5.2 knots. Thucydides (6.1) gives eight days. He means traveling by day only (cf. 2.97.1, cited in note 57 above, where he specifies day and night). If we allow 15 hours a day for sailing, he agrees with Strabo; if less, with Plutarch. In either event, all the figures indicate that, in going around Sicily, vessels met with more fair winds than foul.

Other voyages must be left out of account since there is no certainty that they were nonstop. Vessels traveling along coastal routes frequently put in at a con-

## V SPEED OF FLEETS UNDER SAIL

A good deal of attention has been given to how fast ancient warfleets could travel. Aemilius Paulus' record 8-knot dash from Brindisi to Corcyra is quoted again and again.[94] Yet this was surely exceptional speed, unquestionably made with strong favorable winds and very likely helped out by periods of hard rowing.[95] It cannot be used as evidence for a fleet's speed under sail alone.[96] Voyages in which supply ships participated are good evidence, for a fleet's speed is determined by its slowest members, and the swift galleys would have no occasion to put the rowers to work while dawdling alongside

venient port for the night, while those threading their way through the Aegean often laid over at whatever island they reached by evening. For example, the 4-day trip from Rome to Stabiae mentioned by Galen (*Methodus Medendi* 5.91-92 [Kuhn, vol. 10, p. 363]) may be a case in point; with any sort of luck with the wind, the voyage would have taken, nonstop, less than two. St. Paul needed 15 days according to the Western text of Acts 27.5 to travel from Sidon to Myra. If the figure can be relied upon, it indicates that his ship probably laid over a good many nights, since the distance is under 400 nautical miles; cf. also Paul's voyages in Acts 20.14-15 and 21.1. A crossing Cicero made from Athens to Ephesus consumed no less than two weeks (*ad Att.* 5.12, 13); the *aphracti* he sailed in must have been very much like the open caiques that still ply between some of the islands today. When Paul went from Philippi to Alexandria Troas (Acts 20.6), he probably laid over at Samothrace (cf. Acts 16.11-12). The 4-day sail from Athens to Rhodes mentioned by Lycurgus (*in Leoc.* 70) probably included stopovers, for the distance is ca. 275 miles and the wind would normally be favorable.

Voyages that took less than a day have also been omitted; they are too short to be of value in computing averages.

[94] Livy 45.41.3: "Departing from Italy, I set sail with the fleet from Brundisium at daybreak; by the 9th hour of the day I reached Corcyra with all my ships" (*profectus ex Italia classem a Brundisio sole orto solvi; nona diei hora cum omnibus meis navibus Corcyram tenui*). Nine Roman hours would be 11½ of our hours, and the distance from Brindisi to the tip of Corcyra is about 90 nautical miles. Cf. Assmann, *Segel* 1054; Köster 180; How and Wells, note to 7.183.3; Mohler 54, note 26.

[95] Cf. Mohler, *ibid.* Grundy's assumption (*loc. cit.* note 57 above) that 8 knots was a reasonable speed was convincingly answered by Tarn ("Fleet-Speeds; A Reply to Dr. Grundy," *CR* 23, 1909, pp. 184-86) who held for 4½ knots or 5 for a fleet in a hurry and 2 when not.

[96] Tarn's estimate of 2 knots (see previous note) includes at least one voyage during which oars very probably were used: Alcibiades took all night up to breakfast to go from Parium to Proconnesus (Xenophon, *Hell.* 1.1.13), about 25 nautical miles—in other words, an average of not over 1½ knots. Very likely this was the speed made while rowing in shifts (cf. 280 above), since in this area the ships were presumably bucking contrary current as well as wind; cf. *The Black Sea Pilot*[3] (Hydrographic Department of the Admiralty, London 1942) 25 and 62.





slow-sailing transports. Almost as good are voyages that lasted several days or more; on such occasions there would be no reason to use the oars, which were intended for battle or emergencies.

TABLE 6

| *Voyage* | *Distance (nautical miles)* | *Length of Voyage (days)* | *Overall Speed (knots)* | *Wind* |
|---|---|---|---|---|
| Rhodes-Alexandria[97] | 325 | 3 | 4.5 | Unstated; probably favorable |
| Greater Syrtes-Heraclea Minoa[98] | 475 | 4½ | 4.4 | Favorable |
| Sason-Cephallenia[99] | 160 | 1¾ | 4 | Unstated; probably favorable |
| Troy-Alexandria[100] | 550 | 7 | 3.3 | Favorable |
| Carales-African Coast[101] | 200 | 2½ | 3.3 | Unstated; probably favorable |

[97] Appian, *Bell. Civ.* 2.89: "[Caesar] left [Rhodes] toward evening . . . and after three days on the sea was off Alexandria" (*περὶ ἑσπέραν ἀνήγετο . . . καὶ ὁ μὲν τρισὶν ἡμέραις πελάγιος ἀμφὶ τὴν Ἀλεξάνδρειαν ἦν*). For the winds in this region, see 272 above.

[98] Plutarch, *Dion* 25.4-5: "[Off the Greater Syrtes] a land breeze from the south arose; a south wind was hardly what they expected, and they had no faith in the shift. As it little by little freshened and grew strong, they spread all sail . . . and, running swiftly, anchored off Minoa on the fifth day" (*αὔραν τινὰ κατέσπειρεν ἡ χώρα νότιον, οὐ πάνυ προσδεχομένοις νότον οὐδὲ πιστεύουσι τῇ μεταβολῇ. κατὰ μικρὸν δὲ ῥωννυμένου τοῦ πνεύματος καὶ μέγεθος λαμβάνοντος ἐκτείναντες ὅσον ἦν ἱστίων . . . θέοντες ἐλαφρῶς πεμπταῖοι κατὰ Μίνῳαν ὡρμίσαντο*).

[99] Polybius 5.110.5: "[Philip, from Sason] making a helter-skelter departure and return, arrived at Cephallenia on the second day, having sailed continuously day and night" (*οὐδενὶ δὲ κόσμῳ ποιησάμενος τὴν ἀναζυγὴν καὶ τὸν ἀνάπλουν δευτεραῖος ἐς Κεφαλληνίαν κατῆρε συνεχῶς ἡμέραν καὶ νύκτα τὸν πλοῦν ποιούμενος*). For the winds, see *HO* 152.33. Sason is off the mouth of the Aous, not the Achelous as Tarn (*loc. cit.* note 95 above) has it.

[100] Lucan 9.1004-5: "[After Caesar left Troy] the west wind ever keeping the rigging taut, the seventh night brought in sight the shores of Egypt and the flames of [the lighthouse on] Pharos" (*septima nox Zephyro numquam laxante rudentes / ostendit Phariis Aegyptia litora flammis*).

[101] Procopius, *Bell. Vand.* 1.25.21: "Setting sail from there [Carales], with the whole fleet, on the third day they reached the Libyan shore at the point where Nu-

| | | | | |
|---|---|---|---|---|
| Lilybaeum-Cape Bon[102] | 65 | 1 | 2.7 | Generally favorable |
| Messina-Cephallenia[103] | 250 | 4½ | 2.3 | Unstated; probably favorable |
| Pisa-Marseilles, via Ligurian Coast[104] | 240 | 4½ | 2.2 | Favorable-unfavorable |
| Utica-Carales[105] | 160 | 3 | 2.2 | Probably unfavorable |
| Lilybaeum-Ruspina[106] | 140 | 3½ | 1.7 | Favorable |
| Lilybaeum (?)-Anquillaria[107] | 90 | 2½ | 1.5 | Unstated |
| Syracuse-Cape Bon[108] | 220 | 6 | 1.5 | Probably unfavorable |
| Euripus-Phalerum[109] | 96 | 3 | 1.3 | Variable |
| Zacynthus-Cape Pachynus[110] | 340 | 12½ | 1.1 | Very light |
| Lilybaeum-Africa[111] | 85 | 3½ | 1 | Unfavorable |
| Zacynthus-Mt. Etna[112] | 320 | 15½ | .9 | Very light |

midia borders on Mauretania" (ἄραντες δὲ ἐνθένδε παντὶ τῷ στόλῳ τριταῖοι κατέπλευσαν ἐς τὴν Λιβύης ἀκτὴν ἣ Νουμίδας τε καὶ Μαυριτανοὺς διορίζει). For the winds, see *HO* 151.47.

[102] Livy 29.27.6-8: "They set forth [from Lilybaeum] with a favorable and nicely strong wind. . . . At mid-day fog closed them in. . . . The wind was lighter on the open water. During the night that followed, fog again held them in its grip; at daybreak it dispersed, and the wind gained strength. Soon they sighted land. Not long afterward, the helmsman reported to Scipio that Africa was no more than 5 miles off, that he could see Cape Mercury" (*vento secundo vehementi satis profecti . . . a meridie nebula occepit . . . lenior ventus in alto factus. noctem insequentem eadem caligo obtinuit; sole orto est discussa, et addita vis vento. iam terram cernebant. haud ita multo post gubernator Scipioni ait non plus quinque milia passuum Africam abesse; Mercuri promunturium se cernere*).

[103] Livy 42.48.9: "The praeter Caius Lucretius set out from Naples; after passing through the strait [of Messina], he crossed to Cephallenia in five days" (*C. Lucretius praetor ab Neapoli profectus, superato freto, die quinto in Cephallaniam transmisit*). For the winds, see *HO* 152.33.

[104] Polybius, 3.41.4: "Publius, following the coast of Liguria, arrived off Massalia on the fifth day out of Pisa" (Πόπλιος δὲ κομισθεὶς παρὰ τὴν Λιγυστίνην ἦκε πεμπταῖος ἀπὸ Πισῶν εἰς τοὺς κατὰ Μασσαλίαν τόπους). The northerly and northwesterly winds in this area (cf. *HO* 152.33, 35) would have been unfavorable for the first leg of the voyage as well as part of the last.

[105] Caesar, *Bell. Afr.* 98: "[Caesar] embarked in the fleet at Utica and two days later arrived at Carales in Sardinia" (*Uticae classem conscendit et post diem tertium Caralis in Sardiniam pervenit*). For the winds, see *HO* 151.47.





The first three voyages listed in Table 6 are considerably faster than all the others. This can be easily accounted for. The first involved triremes alone, the third swift *lembi* alone, and the second was made under a wind that was remarkable for its steadiness and

[106] Caesar, *Bell. Afr.* 34: "[The ships, setting out from Lilybaeum], catching a favorable wind, arrived safely . . . on the fourth day at the port of Ruspina (*ventum secundum nactae quarto die in portum ad Ruspinam . . . incolumes pervenerunt*). Ruspina was near the modern Monastir on the east coast of Tunis.

[107] Caesar, *Bell. Civ.* 2.23: "Caius Curio left Sicily for Africa . . . spending two days and three nights sailing, he arrived at the place called Anquillaria" (*C. Curio in Africam profectus ex Sicilia . . . biduoque et noctibus tribus navigatione consumptis appellit ad eum locum qui appellatur Anquillaria*). For the winds, see note 105 above. Anquillaria was somewhere on the tip of Cape Bon.

[108] Diodorus Siculus 20.6.1-2: "[Agathocles and his fleet, leaving Syracuse], sailed for six days and as many nights . . . and, on sighting Libya, a cheer arose among the crews" (ἓξ δ' ἡμέρας καὶ τὰς ἴσας νύκτας αὐτῶν πλευσάντων . . . καθορωμένης δὲ τῆς Λιβύης παρακελευσμὸς ἐγίνετο τοῖς πληρώμασι). The landing was eventually made at the "Quarries" (20.6.3: Ἀγαθοκλῆς ἀποβιβάσας τὴν δύναμιν πρὸς τὰς καλουμένας Λατομίας) which would appear to be those on Cape Bon.

[109] Herodotus 8.66: "They sailed through the Euripus and in another three days came to Phalerum" (ἔπλεον δι' Εὐρίπου καὶ ἐν ἑτέρῃσι τρισὶ ἡμέρῃσι ἐγένοντο ἐν Φαλήρῳ).

[110] Plutarch, *Dion* 25.2: "[From Zacynthus] sailing with a light and gentle breeze for 12 days, on the 13th they were at Pachynus" (ἀραιῷ δὲ καὶ μαλακῷ πνεύματι πλεύσαντες ἡμέρας δώδεκα, τῇ τρισκαιδεκάτῃ κατὰ Πάχυνον ἦσαν).

[111] Caesar, *Bell. Afr.* 2: [About 10 miles out of Lilybaeum Caesar] "aboard a swift ship and carried by a steady wind, three days later arrived with a few warships in sight of Africa; for, except for a very few, all the other merchant ships, scattered by the wind and wandering about, made for shore at different points" (*ita vento certo celerique navigio vectus post diem quartum cum longis paucis navibus in conspectum Africae venit; namque onerariae reliquae praeter paucas vento dispersae atque errabundae diversa loca petierunt*). The passage is not inconsistent, as has been thought (cf., e.g., A. Way's note in the Loeb translation, 1955: "3-4 days' sail in a fast ship seems unduly long for the passage of less than 100 miles. . . . Other apparent inconsistencies are . . . the capriciousness of the wind, which favored the warships but scattered the transports"). When Caesar says "carried by a steady wind" he can only mean that the ships traveled quickly through the water; every schoolboy must have known that Scipio had taken a huge fleet over the same crossing in one quarter the time (see note 102 above). The wind blew steadily but so strongly it drove everyone off course, doing a thorough job of scattering the transports and forcing them ashore at all different points. Assmann (1622) states that this voyage "agrees [with Livy 29.27.6-8] in an average of 2¾ knots." It, of course, does nothing of the sort. The error is repeated by How and Wells, note to 7.183.3.

[112] Procopius, *Bell. Vand.* 1.13.22: "Sailing with a very gentle and languid breeze, on the 16th day they arrived at a deserted spot in Sicily near which Mt. Etna rises" (ἀνέμου δὲ σφίσι μαλακοῦ τε καὶ νωθροῦ κομιδῇ ἐπιπνεύσαντος ἑκκαιδεκαταῖοι κατέπλευσαν τῆς Σικελίας ἐς χῶρον ἔρημον, οὗ τὸ ὄρος ἐγγὺς ἡ Αἴτνη ἀνέχει).

freshness.[113] The rest of the table presents a consistent picture. Before a favorable wind, a fleet could log between 2 and 3 knots.[114] With unfavorable or very light winds, a fleet usually could do no better than 1 to 1½ knots.

[113] With a strong favorable wind Belisarius' fleet made from Malta to Caputvada on the east coast of Tunis, 165 nautical miles, in either a day or a day and a half (Procopius, *Bell. Vand.* 1.14.17: "There [off Malta] a good wind from the southeast sprang up and brought the fleet on the following day to the Libyan shore at the point that in Latin is called Caputvada" [ἔνθα δὴ αὐτοῖς Εὖρου πολύ τι πνεῦμα ἐπιπεσὸν τῇ ὑστεραίᾳ τὰς ναῦς ἐς τὴν Λιβύης ἀκτὴν ἤνεγκεν ἐς χωρίον, ὃ δὴ Κεφαλὴν Βράχους τῇ σφετέρᾳ γλώσσῃ καλοῦσι Ῥωμαῖοι]). His speed must have been anywhere from 4.5 to 7 knots depending upon the exact time of arrival. Similarly, Himilco in 397 B.C. left Carthage "with 100 [of the best] triremes [in the fleet], crossed to Selinus, then doubled the promontory at Lilybaeum, arriving at Motya at dawn of the following day" (ἐκπλεύσας οὖν μετὰ νεῶν ἑκατὸν κατήχθη ἐπὶ τὴν τῶν Σελινουντίων χώραν νυκτός, καὶ περιπλεύσας τὴν περὶ Λιλύβαιον ἄκραν ἅμ' ἡμέρᾳ παρῆν ἐπὶ τὴν Μοτύην Diodorus 14.50.2); since he most likely had left Carthage at dawn, he covered ca. 150 nautical miles in 24 hours for an average speed of slightly over 6 knots.

[114] The expedition sent by Caesar from Lilybaeum to Ruspina, consisting of heavily laden transports, made very slow time.



# APPENDIX

## THE ALEXANDRIA-ROME SAILING SCHEDULE

PROBABLY the most ambitious maritime enterprise of the ancient world was the transport of the tribute in grain that Rome levied on Egypt, 150,000 tons which traveled annually from Alexandria to Rome during the first three centuries A.D. and required the services of a fleet of the biggest and fastest freighters available.[1] These seem to have fitted their sailings into the curtailed season as follows.

1. Those of the fleet[2] which had wintered at Alexandria loaded up at the beginning of spring with grain that had been stored in the dockside silos, and departed at the earliest possible moment, probably in April. They followed either of two routes: the northerly by way of Cyprus, Myra, Rhodes or Cnidos, south of Crete, Malta, Messina;[3] or the southerly by way of the north African coast to Cyrene.[4] Either, involving beating against the prevailing northwesterlies, could take at least a month,

[1] See NINE, App., pt. 2, and Philo, *In Flaccum* 26 (Caligula advised Prince Agrippa, headed for Palestine, not to make the wearisome journey by short hops from Brindisi to Syria, but to go directly from Puteoli to Alexandria and then backtrack, since that way he could cross on one of the crack Puteoli-Alexandria freighters whose skippers "drive them like racehorses"). Arrian describes the special craft Trajan used on the Euphrates as having "the width and depth of a merchantman big as the biggest Nicomedian or Egyptian" (*Parth.* fr. 67 = Jacoby, *FGH* no. 156, fr. 154, vol. II B, p. 876: εὖρος δὲ καὶ βάθος καθ' ὁλκάδα, ὅσον μεγίστη Νικομηδὶς ἢ Αἰγυπτία). The "Egyptians" he refers to must certainly be the ships of the Alexandria-Rome run.

[2] That they traveled as a fleet is clear—see *P. Oxy.* 1763 (3rd A.D.): οὔπω μέχρι σήμερον τὰ πλοῖα τῆς ἀννώνας ἐξῆλθεν "The ships carrying the grain tribute have not yet sailed"; *W. Chrest.* 445 (cf. note 5 below); and Seneca, *Epist.* 77.1 (cited in ELEVEN, note 71). A. Pelletier, translator of the Éditions du Cerf publication of Philo's *In Flaccum* (1967), overlooks this when he explains (p. 161) that Philo, in reporting Agrippa's passage (cf. previous note), speaks of "captains" because Agrippa and his entourage crossed on numerous small units; the "captains" were the commanders of the several ships in the convoy.

[3] See Casson, "Isis" 43-51.

[4] Cf. *P. Mich.* 490 (2nd A.D.), where a recruit, en route from Alexandria to Rome, dispatches a letter to his family in Egypt through a traveler he met in Cyrene ("Finding someone going your way from Cyrene, I felt I had to let you know I was safe and sound" [ἀπὸ Κυρήνης εὑρὼν τὸν πρός σε ἐρχόμενον ἀνάνκην ἔσχον σοι δηλῶσαι περὶ τῆς σωτηρίας μου]). This southern route was the one used in the 11th century by ships plying between Alexandria and Palermo (Goitein 319-20).

sometimes two, so arrival was at the earliest in May.[5] They dropped their cargoes and immediately set off back to Alexandria, a downhill sail that could be made in two to three weeks or even less (above, Table 1); here they reloaded to squeeze in a second crossing before the season closed.[6] What was all-important was a quick turn-around, but this, unfortunately, could not always be counted on. A papyrus[7] reveals that on one occasion the fleet completed its spring run to Rome on 30 June, unloaded by 12 July—and was still hanging around waiting for clearance on 2 August.

2. Those vessels that had wintered in Rome would leave, probably in ballast,[8] in April,[9] be in Alexandria in May, take on a load of grain, and

[5] For the length of the voyage, see TWELVE, notes 82, 86.

*W. Chrest.* 445 (=*Select Papyri* 113, 2nd-3rd A.D.) mentions arrival at Ostia (see Wilcken in *Archiv* 9, 1930, p. 86) of the grain fleet on 30 June ("I arrived on Epeiph 6, and we unloaded on the 18th of the same month. . . . Day after day we have been waiting for notification of release. Right up to today not one of the grain carriers has been released" [ἐλήλυθα τῇ ς τοῦ Ἐπεὶφ μηνὸς καὶ ἐξεκενώσαμεν τῇ ιη τοῦ αὐτοῦ μηνός. . . . καὶ καθ' ἡμέραν προσδεχόμεθα διμισσωρίαν ὥστε ἕως σήμερον μηδέναν ἀπολελύσθαι τῶν μετὰ σίτου]). *P. Mich.* 490 (see previous note) mentions arrival at Ostia on 20 May ("We arrived at Portus Pachon 25" [ἰς Πόρτον παρεγενάμην Παχὼν κε]; cf. 491.5-6). *P. Oxy.* 2191 (2nd A.D.) mentions arrival at Puteoli on 29 May ("Having disembarked on Italian soil, I felt I had to write to tell you that I am well . . . we had a slow voyage but not an unpleasant one. . . . Written at Puteoli Pauni 4" [ἐπιβὰς τῆς Ἰταλικῆς χώρας ἀναγκαῖον ἡγησάμην δηλῶσαι ὑμῖν ὅτι ἔρρωμαι . . . τῷ βραδυπλοίᾳ μὲν χρησάμενος οὐ μὴν δυσπλοίας . . . ἐγράφη ἐν Πυτιόλοις Παῦνι δ]). In none of these is the type of carrier mentioned, but all are evidence for early spring sailings. An inscription from Puteoli (*OGIS* 594 = *Berytus* 9, 1948/49, p. 47, A.D. 79) which records a ship that "sailed into Puteoli from Tyre on Artemisios 11 [29 May]" (μηνὸς Ἀρτεμισίου ια κατέπλευσεν ἀπὸ Τύρου εἰς Ποτιόλοις) provides another example of a spring sailing since the journey is about the same length as that from Alexandria and has to be made against the same winds. Cicero, *ad Att.* 4.10.1, written 22 April, mentions a rumor rife at Puteoli that Ptolemy Auletes had regained his throne; since it most likely came by sea (overland news would have gone via Brindisi and the Appian Way), the ship that carried it clearly had been able to start very early in the year and made excellent time. Titus, for example, when he hastened back from Alexandria to Rome on a merchant ship in the spring of A.D. 71 (Suetonius, *Titus* 5), did not set sail until after 25 April (cf. *P. Oxy.* 2725, written 29 April, which mentions his entry into Alexandria on 25 April).

[6] This late summer trip back to Rome is attested by the experience of those ships that, for one reason or another, failed to make it all the way before the season closed. E.g., two notable cases in point are the ship that St. Paul boarded at Myra (Acts 27.6), which only reached Crete by the end of the season (27.9), and the one he completed his voyage on, which had gotten no farther than Malta (28.11).

[7] *W. Chrest.* 445, cited in note 5 above. The letter was written Mesore 9 = 2 August.

[8] Cf. Strabo 17.793: "The exports of Alexandria are much greater than the imports. Anyone who goes to Alexandria and Puteoli becomes aware of this, watching





be back in Rome by August.[10] This gave them enough time to return to Alexandria and spend the winter there, available for a quick departure the following spring.

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the ships at arrival and departure and observing how much heavier or lighter they are as they sail in and out" (τὰ ἐκκομιζόμενα ἐξ Ἀλεξανδρείας πλείω τῶν εἰσκομιζομένων ἐστι· γνοίη δ' ἄν τις ἔν τε τῇ Ἀλεξανδρείᾳ καὶ τῇ Δικαιαρχίᾳ γενόμενος, ὁρῶν τὰς ὁλκάδας ἔν τε τῷ κατάπλῳ καὶ ἐν ταῖς ἀναγωγαῖς ὅσον βαρύτεραί τε καὶ κουφότεραι δεῦρο κἀκεῖσε πλέοιεν).

[9] It was one of these sailings that Caligula advised Agrippa to take (cf. note 1). Agrippa was surely in Alexandria by June, since riots that followed in the wake of his appearance took place not long after the death of Drusilla (Philo, *In Flaccum* 56), who died on 10 June A.D. 38 (*Prosopographia Imperii Romani*, s.v. "Iulia Drusilla"; the news would have taken some two to three weeks to arrive).

The ship celebrated in Statius, *Silvae* 3.2, on which Maecius Celer was to sail to Egypt, was not one that had wintered in Rome but one that had arrived in the spring convoy. Statius reports (line 22) that it "heavy laden, was the first to carry the harvest of Pharos [i.e. Egypt] to the shores of Puteoli" (*prima Dicarcheis Pharium gravis intulit annum*). It is generally assumed, on the basis of a passage from Seneca (*Epist.* 77.1, cited in ELEVEN, note 71), that what is meant is one of the dispatch boats which heralded the arrival of the convoy (cf. F. Vollmer, *P. Papinii Statii Silvarum libri*, Leipzig 1898, p. 397; A. Pézard, "*Gravis artemo*," *REL* 25, 1947, pp. 215-35, esp. 216; H. Izaac, Stace, *Silves*, Paris 1944, 1 106, note 1). But Statius' words are far more naturally taken as describing one of the actual carriers; it was *prima* because it had come in with the first group to arrive that year. For other arguments against the traditional interpretation see NINE, note 47.

[10] E.g., the ship from Alexandria whose passengers according to Suetonius (*Aug.* 98.2) hailed Augustus off Puteoli shortly before his death (19 August), could have been one that made this sailing.

the original pantheon, had in this age become important figures. Occasionally the cult titles are used, such as *Pythios* and *Smintheus* for Apollo.[71] The Egyptian deities *Ammon* and *Serapis*,[72] worshipped at this time far beyond the boundaries of Egypt, are also represented, and Nile craft bear the names of lesser native figures, such as *Aigyptos*, the legendary founder of Egypt, and *Ibis*, the sacred bird.[73] From the Christian era we have several examples of ships called *Maria*.[74] There are very few names preserved of vessels belonging to Latin owners: possibly *Fortuna Redux* "good luck that brings one home";[75] *Jupiter* and *Juno*;[76] *Felix Itala*, perhaps the feminine form of *Italus*, legendary founder of Italy.[77] A few mythological names occur: *Aias* (?), *Europa, Pantomorphos* "all shapes" (= perhaps Proteus, the Old Man of the Sea).[78] And there are a handful that, appropriate as boat names, fit no particular category: *Eirene* "peace," *Chresmos* "oracle," *Halion Griphos* "sea-fishnet," *Lakaina* "Spartan," *Pontos* "sea," *Thalia* "abundance."[79]

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Aphrodite, *SEG* XIV 344 (= Sandberg no. 27), *P. Oxy.* 2415.49 (Aphrodite and Apollo); Demeter, *IG* XII 8.584 (= Sandberg no. 42), *SEG* XI 1012 (= Sandberg no. 23); Dionysus, *SEG* XIV 341 (= Sandberg no. 21), *P. Oxy.* 2415.30; Hermes, *P. Oxy.* 2415.28; Hestia, *SEG* XIV 342 (= Sandberg no. 22); Nike, see note 5 above; Poseidon, *IG* XII 8.582 (= Sandberg no. 40).

[70] Heracles, *IG* XII 5.1.712.26, XII 8.581a (= Sandberg nos. 31, 39); Tyche, *P. Teb.* 486 (2nd/3rd A.D.).

[71] Pythios, *P. Oxy.* 2415.37, 41 (two different boats in the same transport fleet); Smintheus, *IG* XII 8.586 (= Sandberg no. 44).

[72] Ammon, *P. Oxy.* 2415.24, 34, 84 (three different boats in the same transport fleet); Serapis, *IG* XII 8.584 (= Sandberg no. 42). An Egyptian craft named *Nikastachtes* occurs in *Sammelb.* 977 (= Sandberg no. 46), A.D. 14. This may be a mistake for *Nikastarte*, i.e., "Victory of Astarte," the Asia Minor goddess identified with Aphrodite.

[73] Aigyptos, *Sammelb.* 9223.4 (2 B.C.); Ibis, *W. Chrest.* 443 (A.D. 15).

[74] *IG* V 1.1554 (= Sandberg no. 17), XII 5.1.712.56, 65, 75, 78.

[75] *AM* pl. 9b. An inscription over a picture of a ship, it may be the caption for the scene rather than a name.

[76] See note 2 above.

[77] See note 5 above.

[78] A[ἴα]s, *Sammelb.* 9223.2 (2 B.C.); *Europa*, see NINE, note 34; *Pantomorphos*, *W. Chrest.* 248 (A.D. 220/21).

[79] *Eirene*, *IG* V 1.1552 (= Sandberg no. 15); *Chresmos*, *P. Oxy.* 2415.39; *Halion Griphos*, *P. Teb.* 486; *Lakaina*, see note 5 above; *Pontos*, *P. Oxy.* 2415.43, *Thalia*, *P. Teb.* 486.





# *Harbors*

THE HARBORS OF the ancient world are a subject that demands extended treatment. It took a sizable book to provide a satisfactory survey,[1] and whole volumes have been devoted to single harbors.[2] Moreover, in recent years, underwater archaeology has been steadily producing masses of new data.[3] This chapter can do little more than outline the general features of ancient harbors and indicate the bibliography where further information may be found.

## I EARLY GREEK HARBORS

EGYPTIANS, Minoans, and the many others who sailed the Mediterranean before the coming of the Greeks no doubt had harbor installations of some sort. Of these, however, only the scantiest of traces have been found, and few which can be identified with complete certainty.[4] Yet, even if we rarely are able to establish the existence of Bronze Age moles or quays, this in no way affects the picture archaeology furnishes of active and far-flung commerce at this time. Readers of Richard Henry Dana's classic, *Two Years Before the Mast*, will recall that, as late as the mid-nineteenth century, a ship large enough to round the Horn could be loaded to the gunwales while lying off an open California beach. Throughout Greco-Roman antiquity, the craft that tramped from coastal town to coastal town

[1] K. Lehmann-Hartleben, *Die antiken Hafenanlagen des Mittelmeeres* (Klio, Beiheft 14, Leipzig 1923).

[2] A. Poidebard, *Un grand port disparu, Tyr* (Paris 1939); A. Poidebard and J. Lauffray, *Sidon, Aménagements antiques du port de Saida* (Beirut 1951), including a short but useful history of the development of harbors by R. Mouterde; R. Bartoccini, *Il porto romano di Leptis Magna* (Bollettino del Centro Studi per la Storia dell' Architettura 13, supplemento al 1958).

[3] Cf. Taylor 160-78; *Archeologia, Tresors des Ages* 17 (July-August 1967) 12-17 (Anthedon), 20-22 (Sabratha), 23-24 (Thapsus), 25-29 (Athlit, just south of Haifa); G. Kapitän, "Sul Lakkios, porto piccolo di Siracusa del periodo greco," *Archivio storico Siracusano* 13-14 (1967-68) 167-80.

[4] Cf. Mouterde 16.

or between small islands often loaded and unloaded off beaches without benefit of harbor installations of any kind (Fig. 191); there is every reason to think that Bronze Age cargo carriers did the same. When Homer describes the harbor of the Phaeacians—who lived, as it were, in Shangri-la—he sings of a protective bay on which the only works of man are the shacks where each shipowner stored his sails and rigging, the stone bollards, probably sunk in the sand, to which ships could tie up, the area where sailmakers and riggers and shipwrights worked, and a shrine to Poseidon.[5]

In the eighth century B.C., man-made harbor arrangements stage a sudden and impressive debut. At Delos there dates from this time a mole 100 m. long made up of massive rough-hewn blocks of local granite.[6] In the next century, other sites join Delos in offering examples of these primitive but mighty moles.[7] And, by the end of the sixth B.C., Polycrates of Samos had built the sophisticated harbor works that Herodotus saw; it included two moles, one 370 m. long and the other 180, and the whole complex was kept safe from enemy attack by being included in the circuit of the city's defense wall.[8]

Thus, by the time Greece entered the Classical Age, her engineers had gone far in adding man's touches to whatever basic elements nature provided at a given port site. A harbor (*limen*) now boasted strong moles (*chomata*) to ensure a quiet and safe anchorage (*hormos*); it was equipped with the quays, open sheds, and warehouses needed for a commercial port (*emporion*) or the boathouses and gear

[5] *Od.* 6.263-69: "There was a fine harbor on either side of the city with a narrow entrance. The round-ended ships were drawn up as far as the road. Each and every one [of the owners] has his own gear shed. They have there a meeting place around a fine shrine to Poseidon . . . there they take care of the tackle of their black ships, the ropes and cables, and there they fashion the oars" (καλὸς δὲ λιμὴν ἑκάτερθε πόληος, / λεπτὴ δ' εἰσίθμη· νῆες δ' ὀδὸν ἀμφιέλισσαι / εἰρύαται· πᾶσιν γὰρ ἐπίστιόν ἐστιν ἑκάστῳ· / ἔνθα δέ τέ σφ' ἀγορή, καλὸν Ποσιδήϊον ἀμφὶς / . . . ἔνθα δὲ νηῶν ὅπλα μελαινάων ἀλέγουσι, / πείσματα καὶ σπείρα, καὶ ἀποξύνουσιν ἐρετμά). See also *Od.* 13.77: πεῖσμα δ' ἔλυσαν ἀπὸ τρητοῖο λίθοιο [on departure, the Phaeacian sailors] "cast off the mooring line from the pierced stone" [sc. a stone bollard with a hole bored in it for making lines fast].

[6] Mouterde 17-18.

[7] Lehmann-Hartleben 50-65.

[8] Herodotus 3.60; cf. Lehmann-Hartleben 54-56.





sheds for a naval base (*neorion*); and, for protection, massive defense towers rose at the seaward end of the moles and the whole complex could be brought within the embrace of the town wall (*limen kleistos* "closed harbor").[9]

## II GREEK AND ROMAN NAVAL BASES

To ensure an ancient warship's effectiveness, it had to be kept as dry as possible (89-90 above). And so, the principal features of an ancient naval base (*neorion* or *neoria* in Greek, *navalia* in Latin) were the boathouses (*neosoikoi*) where the galleys with their wooden gear were kept under cover, and the sheds (*skeuothekai* or *hoplothekai*) where their sails and rigging were stowed away.[10]

Enough remains of ancient boathouses are extant to give us a fair idea of what they were like.[11] The best preserved are those in the bay of Zea in the Piraeus, built to house the great fleet of triremes Athens maintained during the fifth and fourth centuries B.C. (Fig. 197). They were partly cut out of bedrock, partly built up with blocks of local stone. The essential ingredient was a stone slip, ca. 3 m. (9′ 10″) wide, on which the ship rested. From its landward end each slip sloped downward with a gentle gradient of 1 in 10 for a dry length—that is, the part clear of the water and roofed over—of 37 m. (121′ 5″), a crucial figure since it gives us the length of a trireme. The slip then entered the water to continue submerged for a certain distance. Flanking each slip was a series of stone columns to support a roof of wood and tiles. The clear width of each slip between columns was just under 6 m. (19′ 6″), another crucial figure giving us a trireme's beam. The lines of columns alternated in height, one line higher and the next lower, in order to permit a

[9] Polycrates' harbor at Samos is the earliest of this type that we know of (Mouterde 19). For a full discussion of the *limen kleistos*, see Lehmann-Hartleben 65-74.

[10] See *GOS* 186-89 for references for the Greek terms, and *DS* s.v. *navalia* for the Latin.

[11] For a good summary of what is known about ancient boathouses, see D. Blackman's section in *GOS* 181-86.

pitched roof: the ridge-pole topped a line of higher columns and the roof slanted down over the slips to right and left to the lines of lower columns (Fig. 197, bottom sketch). Building a roof on columns in this fashion instead of on solid walls ensured good ventilation. The landward end of the boathouses was closed off by a continuous stone wall pierced by occasional access doors. The boathouses accommodated not only the ships themselves but the wooden gear—mast, yard, poles, ladders, oars; this was stored either alongside or, more likely, in racks overhead.

Boathouses are known from a few other sites as well, and these show some variations from the type favored by Athens. At Apollonia, the harbor of Cyrene, some of the slips have runners cut down their middle, while at Oeniadae in Acarnania, the slips were beveled to fit the ships' bilges and, instead of being flat all their length, curved upward to cradle the stern.[12] At Apollonia, the gradient was gentler than at Athens, 1 in 14, whereas at Oeniadae it was steeper, roughly 1 in 6, and at Sunium much steeper, 1 in 3.5; here the craft were necessarily drawn up with the aid of winches or the like.

The slips at Zea, made for triremes, had, as mentioned above, a dry length of 37 m. At Apollonia the dry length is just under 40 m. (131′ 2″) and at Oeniadae 47 m. (154′ 2″). The width, however, is about the same as at Zea. It would seem, then, that Apollonia and Oeniadae were built to take larger units, quadriremes and quinqueremes, and that these had roughly the same beam as a trireme. The slips at Sunium, with a dry length of 21 m. (68′ 9″), were for smaller craft used as guard ships.

The second key feature in an ancient naval base were the gear sheds in which the galleys' lines and canvas were stored. In the fourth century B.C., Athens built one so elaborate and handsome that it gained a long-lasting reputation as an architectural achievement. It was some 130 m. long (ca. 425′), 18 m. wide (ca. 60′), and 10 m. (ca. 33′) high. Two rows of columns divided it into a nave and

[12] See the reconstruction in Singer II 517, fig. 470.





aisles; the aisles were two-storied for holding tackle, and the nave provided easy access to the racks.[13]

Of Roman *navalia* we know very little. At Misenum, headquarters of the Empire's major fleet, nothing is left aside from the moles which formed the harbor and the reservoir which ensured the base its drinking water.[14] Yet surely it and every other Roman naval base, just like their Greek predecessors, must have had long lines of boathouses producing all about a base, as one ancient writer put it,[15] "the look of a continuous colonnade."

## III GREEK AND ROMAN COMMERCIAL HARBORS

THE essential elements of a harbor had been worked out by the fifth century B.C. The successive centuries saw chiefly elaboration of facilities and increase in size.

Athens' harbor for merchant shipping (*emporion*) at Piraeus, for example, by the fourth century B.C. boasted stone quays backed by colonnades, which provided an extensive covered area where merchandise could be stocked and business conducted.[16] The Piraeus had only one basin, but certain other ports offered the flexibility of

[13] The so-called Arsenal of Philon, minutely described in an inscription (*IG* II² 1668 = *Syl.*³ 969). For a comprehensive study of the building, see V. Marstrand, *Arsenalet i Piraeus* (Copenhagen 1922), Chapters 2-8 (reconstruction on p. 119; see also Plan IV).

[14] Starr 15-16.

[15] Appian, *Pun.* 96: [The boat houses at Carthage] "have each two Ionic columns in front of them, producing all around the harbor . . . the look of a continuous colonnade" (*κίονες δ' ἑκάστου νεωσοίκου προῦχον Ἰωνικοὶ δύο, ἐς εἰκόνα στοᾶς τὴν ὄψιν τοῦ τε λιμένος . . . περιφέροντες*). A number of pictures showing galleys in boathouses that form what can aptly be described as a continuous arcade must surely be illustrations of *navalia*; see F. Coarelli, "Navalia, Tarentum e la topografia del Campo Marzio meridionale," *Studi di topografia romana* (Quaderni dell'Istituto di Topografia Antica della Università di Roma, V, Rome 1968) 27-37, esp. figs. 1, 3-5 (fig. 1 = coin of 47 B.C.; for similar coins see *BM Republic* I, p. 517 and pl. 50.18. Fig. 3 = mosaic of possibly first B.C. though also dated as late as Hadrian; see M. Blake in *Memoirs of the American Academy in Rome* 13, 1936, p. 121 and pl. 28.2. Fig. 5 has been published in a very poor line-drawing in *JDI* 4 [1889] 100 and in an excellent photograph in C. Ragghianti, *Pittori di Pompei* [Milan 1963] pl. 96). For still another example of the motif, see J. Guey and P.-M. Duval, "Les mosaïques de la Grange-du-Bief," *Gallia* 18 (1960) 83-102, esp. 88, 94-95 (mosaic of 2nd A.D.).

[16] Lehmann-Hartleben 120.

two, generally on either side of a promontory, oriented in different directions.[17]

The Hellenistic Age brought to harbor construction the vastness of size and the layout according to an integrated plan that characterized the architecture of the times. In addition, it contributed a feature of the highest practical importance, the lighthouse.[18] The new note was struck with the creation of the greatest harbor yet seen, the one at the mouth of the Nile to serve Ptolemaic Egypt's new capital. The lighthouse, Alexandria's famed *Pharos*, a multiple-level tower at the entrance with a blazing fire at its top able to be seen far at sea, was so striking an achievement that it became one of the Seven Wonders of the Ancient World.[19] (Another port monument of this age was also counted among the seven, the Colossus that beckoned ships into the harbor of Rhodes.[20]) There were two harbors, one facing east and the other west. The arms of the first, the Great Harbor, were formed by two moles, one of which was all of 900 m. long; their tips were 600 m. apart, but reefs and other obstacles in the middle reduced this to two entrances 100 and 200 m. wide respectively. The inner circuit of the Great Harbor was ringed with quays backed up by warehouses as well as with the installations of the naval base. Nearby, palaces and other grandiose buildings added to the general effect.[21]

Greek engineers had consistently turned to stone for their harbor

[17] The classic example is Alexandria, with the Great Harbor oriented toward the east and the Eunostos toward the west; see Lehmann-Hartleben, Plan 21. Other examples are Syracuse, Cyzicus, Tyre (but not Sidon; see Poidebard-Lauffrey 83).

[18] On the harbors of the Hellenistic Age, see Lehmann-Hartleben 122-61.

[19] For a suggested reconstruction of the tower, see Singer II 521, fig. 474. For the range of its light, cf. Josephus, *BJ* 4.613: πύργον . . . ἐκπυρσεύοντα . . . ἐπὶ τριακοσίους σταδίους "a tower . . . showing a light visible . . . 300 stades [ca. 33 miles] away."

[20] There is no evidence to support the popular conception of a gigantic figure whose legs straddled the harbor entrance. On the location of the Colossus, see H. Maryon, "The Colossus of Rhodes," *JHS* 76 (1956) 68-86.

[21] Most of our knowledge of Alexandria's harbor comes from Strabo's description (17.791-92, 794-95). See also Lehmann-Hartleben 132-38. For a reconstruction of a typical Hellenistic harbor (Cnidus), see Rostovtzeff, *SEHHW* pl. 112.1. On Carthage's harbor, see J. Baradez, "Le port marchand de Carthage," *CRAI* (1955) 299-300.





works, and taken advantage as much as possible of whatever help nature supplied. The Romans[22] introduced a significant innovation, the use of concrete that would set under water. This powerful and flexible material enabled them to strike out boldly and plant harbors where nature had nothing at all to offer. Claudius, for example, decreed the building of a great port to serve Rome on an open beach just north of the Tiber's mouth; to help make one arm he used the mighty freighter that had brought over the Vatican obelisk as a form and filled it with concrete.[23] Another Roman innovation, made possible by the use of concrete, was the building of moles pierced by arches and of quays resting on arches. These, however, were of

[22] On Roman harbors, see Lehmann-Hartleben 161-217. Portus, the harbor of Rome, and Leptis Magna and several others of Roman date have been investigated since Lehmann-Hartleben wrote. On Portus, see G. Lugli and G. Filibeck, *Il porto di Roma imperiale e l'agro portuense* (Rome 1935); the excellent summary in Meiggs (149-71); the preliminary report on the new excavations in the harbor of Claudius by O. Testaguzza, "The Port of Rome," *Archaeology* 17 (1964) 173-79; and the final report in his *Portus*. On Leptis, see Bartoccini's work cited in note 2 above. On Caesarea, see L. Haefeli, *Cäsarea am Meer: Topographie und Geschichte der Stadt nach Josephus und Apostelgeschichte* (Neutestamentliche Abhandlungen, x Bd, 5. Heft, Münster 1923) 12-16; A. Reifenberg, "Caesarea: A Study in the Decline of a Town," *Israel Exploration Journal* 1 (1950/51) 20-32. On Pompeiopolis see A. Boyce, "The Harbor of Pompeiopolis," *AJA* 62 (1958) 67-78. On Sarepta (between Tyre and Sidon), see *AJA* 74 (1970) 202. On Anthedon, see H. Schläger, D. Blackman, J. Schäfer, "Der Hafen von Anthedon," *AA* 83 (1968) 21-98. For other Italian sites, see the bibliography in L. Crema, *L'architettura romana* (*Enciclopedia Classica*, sezione III: Archeologia e storia dell'arte classica XII.1, 1959) 348. R. Paget, "The Ancient Ports of Cumae," *JRS* 58 (1968) 152-69, gives the history of the ports on this site from their inception through the Roman period. For the ports in Gaul, see A. Grenier, *Manuel d'archéologie gallo-romaine*, Deuxième partie (Paris 1934) 476-529.

[23] Pliny, *NH* 16.202: *longitudo spatium obtinuit magna ex parte Ostiensis portus latere laevo. ibi namque demersa est Claudio principe cum tribus molibus turrium altitudine in ea exaedificatis obiter Puteolano pulvere advectisque* "The length [of the ship] takes up much of the space on the left side of Ostia's port. For, during the reign of Claudius it was sunk there after three masses tall as towers had been built out of Puteoli sand in it and transported [sc. into place]." Cf. 36.70: *in ipsa turribus Puteolis e pulvere exaedificatis perductam Ostiam portus gratia mersit* "after towers had been built out of Puteoli sand in it, it was brought to Ostia and sunk to help make the harbor." "Puteoli sand" is *pozzolana*, the key ingredient in Rome's excellent hydraulic cement. Testaguzza (105-20), on the basis of the recent excavations, offers a reconstruction showing what part of the mole was created by using the ship as a form. See also 72-73 for the possible use of several smaller vessels as forms for other parts of the mole.

limited importance, for they seemed to have been used chiefly along the Campanian coast of Italy during the early Imperial period.[24]

The harbor at Leptis Magna, as improved by Septimius Severus at the end of the second century A.D., has been thoroughly explored and furnishes a good idea of what a medium-sized Roman harbor looked like.[25] At the mouth stood the lighthouse, 21.20 m. (69½′) at the base and at least three levels high,[26] flanking an entrance 80 m. wide.[27] The arms embraced a basin with an expanse of 102,000 sq. m. (25.2 acres); its sides were lined with 1,200 m. of stone quays.[28] Ships made fast nose to, tying up to mooring blocks built into the quays.[29] Back of the quays, approached by flights of steps, were porticoes providing covered space and buildings providing warehousing facilities.

The greatest man-made harbor of antiquity was Portus "the port," the complex mentioned above that served Rome (Fig. 196); it was started by Claudius and expanded by Trajan. Moles jutted into the sea to form a more or less circular expanse of nearly one-third of a square mile in extent, with an entrance 200 m. wide.[30] At one side rose the lighthouse, a massive building of three square levels topped by a cylindrical level which housed the fire (Fig. 144);[31] the inside

[24] Lehmann-Hartleben 165, 167-70. For an example, see the mole that is so prominent a feature in the well-known wall-painting from Herculaneum showing a harbor, probably Puteoli (Singer II 520, fig. 473).

[25] See the reconstructions in Bartoccini pl. A; Crema (*op. cit.*, note 22 above) figs. 398, 399.

[26] Bartoccini 59 and pl. 28.

[27] Bartoccini 11. For a reconstruction of the entrance with the lighthouse, see his pl. B.

[28] Bartoccini 12.

[29] Well indicated in the drawing in Singer II 519, fig. 472. Cf. Fig. 144.

[30] Testaguzza (*op. cit.*, note 22 above) 177, 179; Testaguzza 69, 75.

[31] Testaguzza (121-27), on the basis of a newly discovered painting (125), reconstructs the lighthouse with two square levels and two cylindrical.

The lighthouse became a celebrated building and often appears in paintings and reliefs; G. Stuhlfauth, "Der Leuchtturm von Ostia," *Röm. Mitt.* 53 (1938) 139-63, provides a large number of examples. It served as model for the bell tower of the church of St. Paul outside the Walls on the road from Ostia to Rome.

The National Museum of Antiquities at Turin has an interesting miniature replica, done in bronze, of a Roman lighthouse; see Bollini, *op. cit.* (THIRTEEN, note 60) 40, fig. 7. Only the lowermost stage is square; above this rise three round stages.





was ringed with quays where ships could make fast to mooring blocks (Fig. 144, ship to right). Trajan added an octagonal inner basin,[32] approached from the outer by a channel so narrow most ships surely had to be warped through it. This inner basin, one-eighth of a square mile in size,[33] was surrounded by lines of stone quays and backed up by warehouses and other dockyard facilities.[34] From it a channel enabled barges to go directly to the Tiber for the haul up to Rome.[35]

Big Roman harbors had the equipment and specialized personnel to deal with a high volume of cargo that was often of great bulk. At Portus, for example, by the time of Nero perhaps half a million tons of grain was unloaded each year on the quays.[36] The standard vessels employed by the government as carriers had a capacity of 340 tons;[37] since grain was handled in sacks of a size to make a load for one man,[38] the arrival of each such ship meant 7,500 sacks to be unloaded and sent up the Tiber—and grain ships arrived in fleets not singly (cf. TWELVE, App.). Oil and wine was transported in massive clay jars holding roughly from 20 to 30 liters; each jar with its contents would weigh from 70 to 110 or so pounds, and vessels of just ordinary size carried 2,000 to 3,000 such jars in their holds.[39] The bulkiest cargoes of all were timber and building stone, the timber often in tree-length poles and the stone in chunks weighing dozens of

[32] The arrangement with two basins, an outer and an inner, is also found at Sidon (Poidebard-Lauffray 84; cf. 89 for the Roman date). Achilles Tatius (1.1.1) furnishes a clue to its purpose. He describes the harbor at Sidon as "a wide double harbor in a bight that, with an easy curve, encloses part of the sea. Within the curve of the bight, on the righthand side, a second opening has been dug, and the sea flows in here as well. The harbor also has a subsidiary basin so that merchantmen can lay over here for the winter undisturbed, whereas during the summer they go into the harbor's forward basin" (δίδυμος λιμὴν ἐν κόλπῳ πλατύς, ἠρέμα κλείων τὸ πέλαγος. ἡ γὰρ ὁ κόλπος κατὰ πλευρὰν ἐπὶ δεξιὰ κοιλαίνεται, στόμα δεύτερον ὀρώρυκται, καὶ τὸ ὕδωρ αὖθις εἰσρεῖ. καὶ γίνεται τοῦ λιμένος ἄλλος λιμήν, ὡς χειμάζειν μὲν ταύτῃ τὰς ὁλκάδας ἐν γαλήνῃ, θερίζειν δὲ τοῦ λιμένος εἰς τὸ προκόλπιον). The description tallies with the extant remains; see Poidebard-Lauffray Plan 2.

[33] Testaguzza (*op. cit.* note 22 above) 179.

[34] Meiggs 162-66.

[35] Meiggs 159-60.

[36] See *ESAR* V 139-40.

[37] *Dig.* 50.5.3, cited in NINE, note 23.

[38] See, e.g., *IH* ill. 64.

[39] See NINE, note 25 and App., pt. 1.

tons.[40] To transfer it out of the holds to carts or barges, powerful revolving cranes[41] were used, operated by skilled professionals.[42] And, for hauling sacks, amphorae, and other such cargo,[43] there was a veritable army of stevedores[44] backed up by squads of clerks (Fig. 174). Divers were no doubt available for going after any merchandise that went overboard.[45] And there was a special squad of men to handle the sand used as ballast.[46]

[40] Trajan's Column, for example, required 18 cubes of Carrara marble, each weighing 50 tons (*ESAR* v 222). Of two cargoes of building stone that sank off the east coast of Sicily in antiquity and have been investigated by divers, one consisted of 15 blocks totaling 172 tons, of which the biggest single piece weighed 40, and the other of 39 blocks totaling 350 tons, of which the single biggest piece weighed 28½. See G. Kapitän, "Schiffsfrachten antiker Baugesteine und Architekturteile vor den Küsten Ostsiziliens," *Klio* 39 (1961) 276-318, esp. 284, 290.

[41] Vitruvius 10.2.10: *ad onerandas et exonerandas naves sunt paratae, aliae erectae, aliae planae in carchesiis versatilibus conlocatae* "There are [derricks] rigged for loading and unloading ships, some fixed vertically, others set horizontally on revolving platforms"; cf. Rougé 162-64.

[42] The *professionarii de ciconiis* "technicians of the 'storks' "; cf. Rougé, "Ad ciconias nixas," *REA* 59 (1957) 320-28. We prefer to call a derrick a "crane" rather than a "stork."

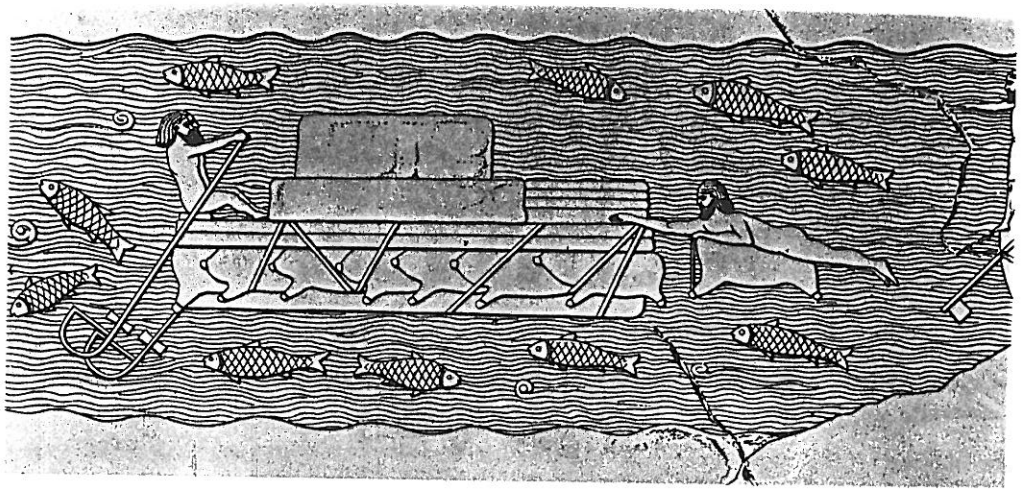
[43] *IH* ill. 64 shows stevedores handling sacks, while Fig. 144, lower right corner, Fig. 174, and *IH* ill. 69 show them handling amphorae.

[44] Our sources mention *saccarii* "sack-men"; see *CIL* VI 4417 (*ust(rina) sacca(riorum)* "crematorium of the *saccarii*") and *Cod. Theod.* 14.22, 364 A.D. (*omnia, quaecumque advexerint privati ad Portum . . . , per ipsos saccarios . . . comportari* "[The Prefect is to issue orders that] whatever private shippers convey to The Port be transported by the *saccarii* themselves" [i.e., even nongovernment cargoes are to be handled only by stevedores belonging to the officially recognized guild]). Since a term such as "*amphorarii*" or the like is yet to be attested, possibly the word *saccarius* meant "stevedore," one who handles all forms of cargo.

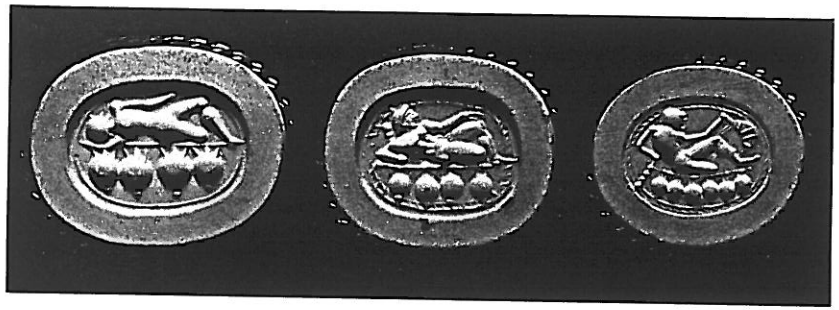
[45] For the use of divers in salvage operations, see *Dig.* 14.2.4.1: *si navis . . . summersa est et aliquorum mercatorum merces per urinatores extractae sunt* "if a ship sinks . . . and the goods of some merchants have been retrieved by divers [*urinatores*]." There was a guild of *urinatores* at either Ostia or Portus; see *CIL* XIV, suppl. 4620 and note to line 9. For a convenient summary of what is known about ancient divers, see F. Frost, "Scyllias: Diving in Antiquity," *Greece and Rome*, Second Series, 15 (1968) 180-85.

[46] The *saburrarii*, literally "sandmen." Cf. the inscription found at Portus, the harbor of Rome (text in Testaguzza 76): *Sicut coram praecepit v(ir) p(erfectissimus) Messius Extricatus, praefectus annonae, titulus ponetur qui demonstret ex quo loci in quem locum saborrariis saborram tollere liceat* "In accordance with the orders of His Excellency Messius Extricatus, Commissioner of the Grain Supply, a notice shall be posted to show from what point to what point the *saburrarii* may dig sand." The inscription dates 210 A.D. See *CIL* XIV 102 = *ILS* 6177 (156 A.D.) for mention of a guild of "sandmen" (*corpus saburrariorum*).

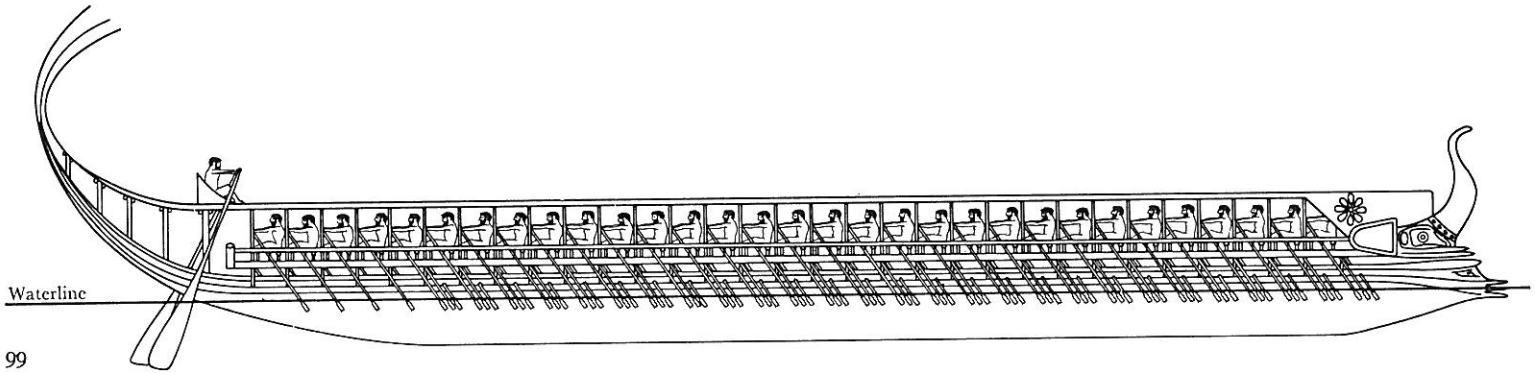




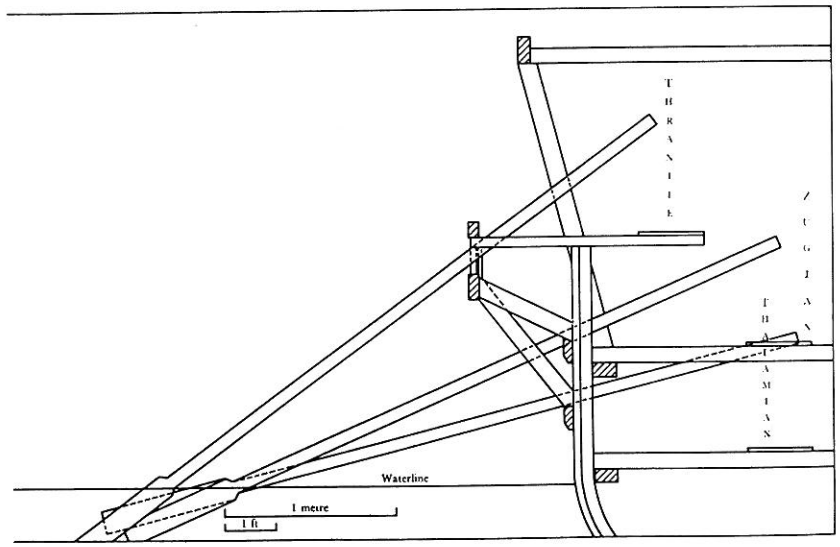
1. Raft of inflated skins, ca. 700 B.C.



2. Hercules on a pot raft, 6th B.C.



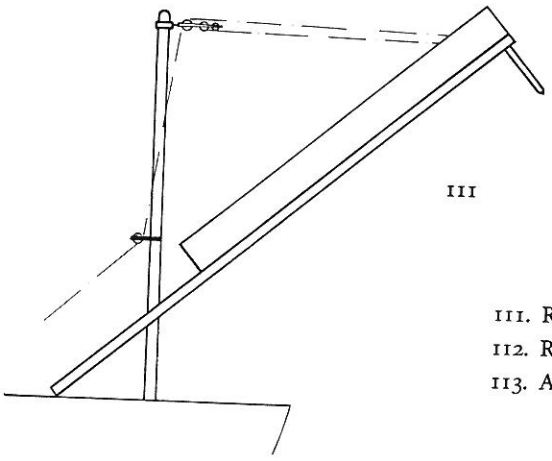

99




100

99. Sketch of a trireme of the 5th-4th B.C. in profile view

100. Sketch of the oar arrangements in a trireme of the 5th-4th B.C.



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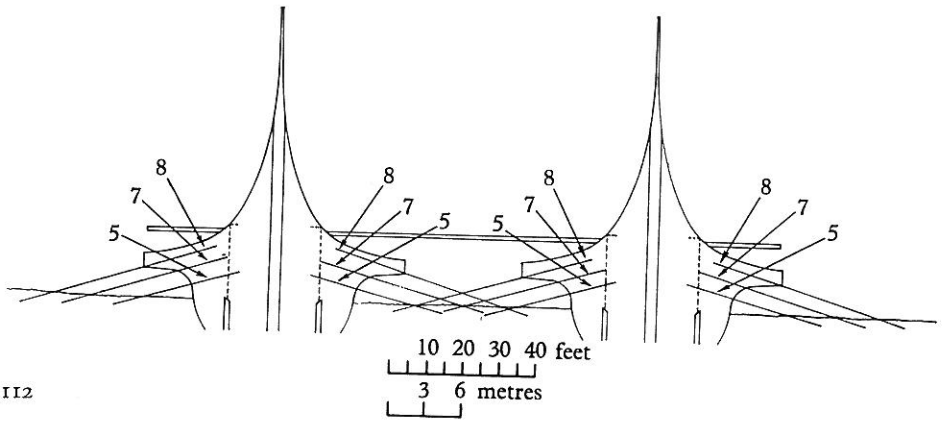
111. Reconstruction of the *corvus*
112. Reconstruction of the "forty" of Ptolemy IV
113. Another view

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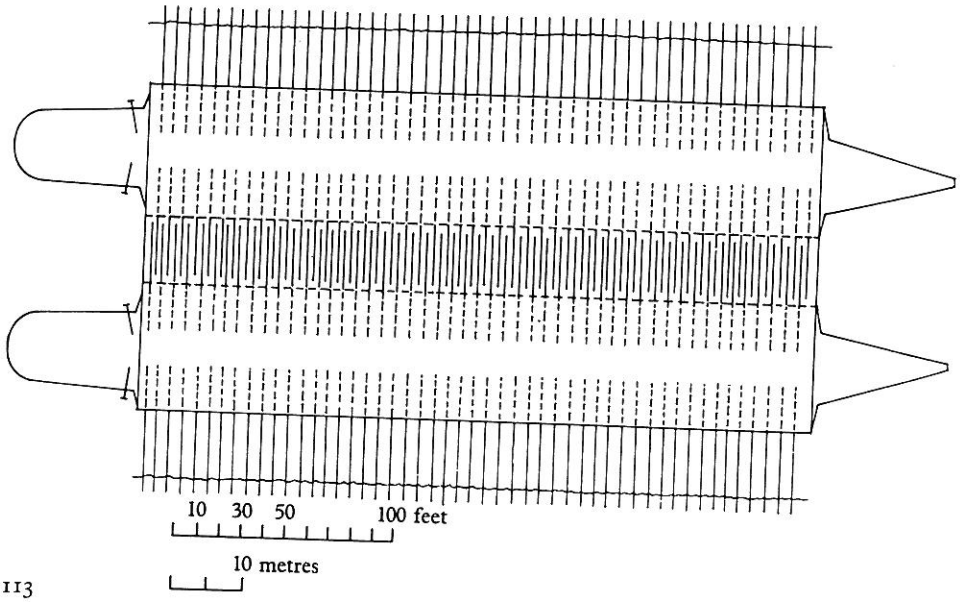
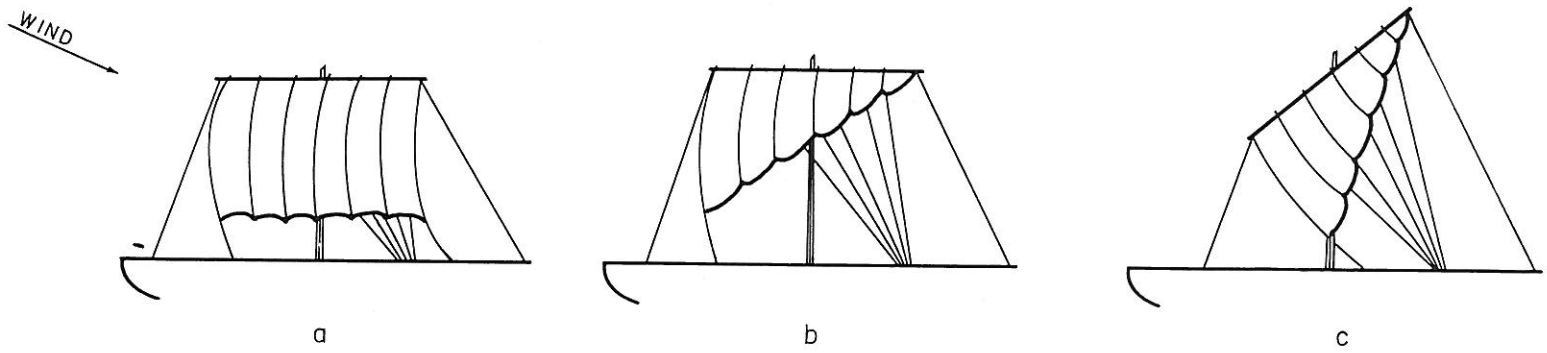
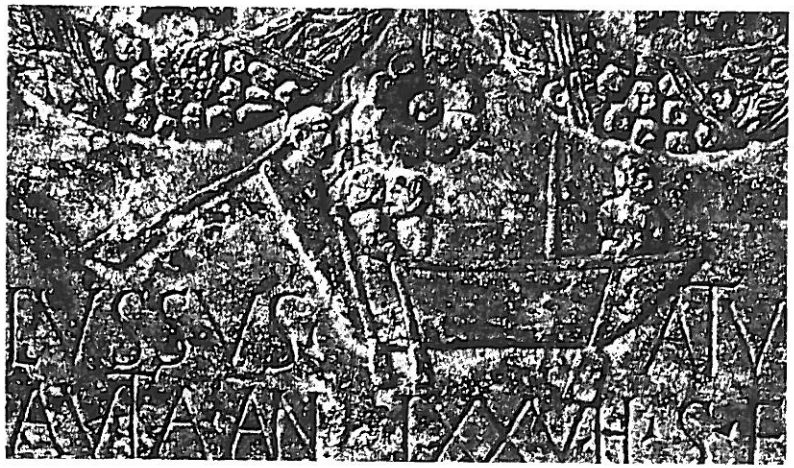


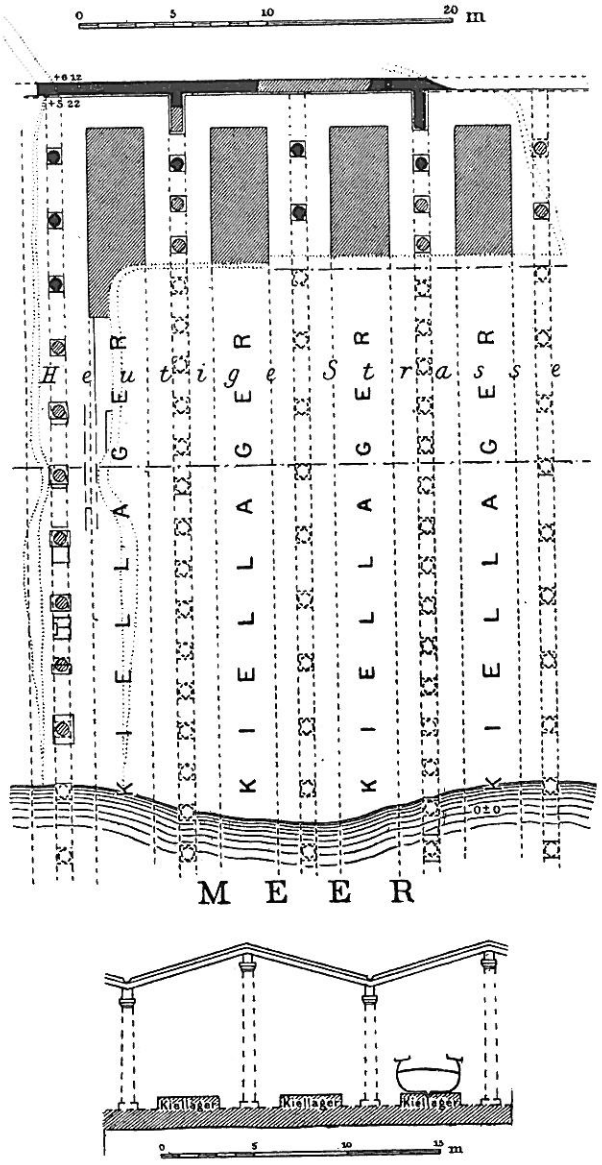

113



188. Sketch showing method of sailing against the wind with sail brailed up

189. A rivercraft of the Rhine or Moselle, mid-1st A.D.




197. Plan and reconstruction of the boat houses at Zea, 4th B.C.