During the 19th century a fresh light was thrown upon the subject by the discovery (1834) at the Peiraeus of some records of the Athenian dockyard superintendents, belonging to several years between 373-324 b.c. These were published and admirably elucidated by Boeckh. Further researches were carried out by his pupil Dr Graser. Since the publication of Graser’s notable work, *De re naυali υeterum,* the subject has been copiously treated by A. Cartauld, Breusing, C. Torr and others. The references to ancient writers, and the illustrations from vases, coins, &c., have been multiplied, and, though the vexed question of the seating of the rowers cannot be regarded as settled, yet, notwithstanding some objections raised, it seems probable that something like Graser’s solution, with modifications, will eventu­ally hold the field, especially as practical experiment has shown the possibility of a set of men, seated very nearly according to his system, using their oars with effect, and without any inter­ference of one bank with another.

On one point it is necessary to insist, because upon it depends the right understanding of the problem. The ancients *did not employ more than one man to an oar.* The method employed on medieval galleys was alien to the ancient system. A. Jab Admiral Fincati, Admiral Jurien de la Gravière and a host of other writers on the subject, some as recently as 1906, have been led to advocate erroneous, if ingenious, solutions of the problem, by neglect of, and in con- tradiction to, the testimony of ancient texts and representations, which overwhelmingly establish as an axiom of the ancient marine the principle of “ one oar, one man.”

The distinction between “ aphract ” and “ cataphract ” vessels must not be overlooked in a description of the ancient vessels. The words, meaning “ unfenced ” and “ fenced,” refer to the bulwarks which covered the upper tier of rowers from attack. In the aphract vessels these side plankings were absent and the upper tier of rowers was exposed to view from the side. Both classes of vessels had upper and lower decks, but the aphract class carried their decks on a lower level than the cataphract. The system of side planking with a view to the protection of the rowers dates from a very early period, as may be seen in some of the Egyptian representations, but among the Greeks it does not seem to have been adopted till long after the Homeric period. The Thasians are credited with the introduction of the improvement.

In our account of the trireme, both as regards the disposition of the rowers and the construction of the vessel, we have mainly, though not entirely, followed Grascr. Any such scheme must at the best be hypothetical, based upon inference from the ancient texts, or upon necessities of construction, and in every case plenty of room will be left for the critic, along with the Horatian invitation, “ si quid novisti rectius istis, Candidus imperti.”

In the ancient vessels the object of arranging the oars in banks was to economize horizontal space, and to obtain an increase in the number of oars without having to lengthen the vessel. It has been reasonably inferred from a passage in Vitruvius @@1 that the “ inter- scalmium,” or space horizontally measured from oar to oar, was 2 cubits. This is exactly borne out by the proportions of an Attic aphract trireme, as shown on a fragment of a bas-relief found in the Acropolis. The rowers in all classes of banked vessels sat in the same vertical plane, and seats ascending in a line obliquely towards the stern of the vessel. Thus in a trireme the thranite, or oarsman of the highest bank, was nearest the stern of the set of three to which he belonged. Next behind him and somewhat below him sat his zygite, or oarsman of the second bank; and next below and behind the zygite sat the thalamite, or oarsman of the lowest bank. The vertical distance between these seats was probably 2 ft., the horizontal distance about 1 ft. The horizontal distance, it is well to repeat, between each seat in the same bank was 3 ft. (the seat itself about 9 in. broad). Each man had a resting place for his feet, somewhat wide apart, fixed to the bench of the man on the row next below and in front of him. In rowing, the upper hand, as is shown in most of the representations which remain, was held with the palm turned inwards towards the body. This is accounted for by the angle at which the oar was worked. The lowest rank used the shortest oars, and the difference of the length of the oars on board was caused by the curvature of the ship’s side. Thus, looked at from within, the rowers amidship seemed to be using the longest oars, but outside the vessel, as we are expressly told, all the oar-blades of the same bank took the water in the same longitudinal line. The lowest or thalamite oar- ports were 3 ft., the zygite 4¼ ft., the thranite 5½ ft. above the water. Each oar-port was protected by an *ascοma* or leather bag, which fitted over the oar, closing the aperture against the wash of the sea without impeding the action of the oar. The oar was attached by a

@@@1 In Vitruvius 1, 2, 4 the MSS. give Dipheciaca (or Difeciaca), which is an unknown word. Many of the editions read ΔIIIHXAIKH, an emendation which commends itself as consonant with probability, though in itself conjectural. (We may suggest the reading ΔIIIIIXIAKA, by which the scribe’s error would be reduced to EC for X.)

thong (τpoπ6s, *τροπωτηρ)* to a thowl *(σκαλμός).* The port-hole was probably oval in shape (the Egyptian and Assyrian pictures show an oblong). We know that it was large enough for a man’s head to be thrust through it.

The benches on which the rowers sat ran from the vessel’s side to timbers, which, inclined at an angle of about 64° towards the ship’s stern, reached from the lower to the upper deck. These timbers were, according to Graser, called the diaphragmata. In the trireme each diaphragma supported three, in the quinquereme five, in the octireme eight, and in the famous tesseraconteres forty seats of rowers, who all belonged to the same “ complexus,” though each to a different bank. In effect, when once the principle of construction had been established in the trireme, the increase to larger rates was effected, so far as the motive power was concerned, by lengthening the diaphragmata upwards, while the increase in the length of the vessel gave a greater number of rowers to each bank. The upper tiers of oarsmen exceeded in number those below, as the contraction of the sides of the vessel left less available space towards the bows.

Of the length of the oars in the trireme we have an indication in the fact that the length of supernumerary oars (τrepiycψ) rowed from the gangway above the thranites, and, therefore, probably slightly exceeding the thranitic oars in length, is given in the Attic tables as 14 ft. 3 in. The thranites were probably about 14 ft. The zygite, in proportion to the measurement, must have been 10½, the thalamite 7½ ft. long. Comparing modern oars with these, we find that the longest oars used in the British navy are 18 ft. The university boat race has been rowed with oars 12 ft. 6 in. The proportion of the loom inboard was about one third, but the oars of the rowers amidship must have been somewhat longer inboard. The size of the loom inboard preserved the necessary equilibrium. The long oars of the larger rates were weighted inboard with lead. Thus the topmost oars of the tesseraconteres, of which the length is given as 53 ft., were exactly balanced at the rowlock. (See Oar.)

Let us now consider the construction of the vessel itself. In the cataphract class the lower deck was 1 ft. above the water-line. Below this deck was the hold, which contained a certain amount of ballast, and through an aperture in this deck the buckets for baling were worked, entailing a labour which was constant and severe on board an ancient ship at sea. The keel *(τρόπις)* appears to have had considerable camber. Under it was a strong false keel *(χΐλνσμα),* very necessary for vessels that were constantly drawn up on the shore. Above the keel was the kelson, under which the ribs were fastened. These were so arranged as to give the necessary intervals for the oar-ports above. Above the kelson lay the upper false keel, into which the mast was stepped. The stem **(σταpα)** rose from the keel at an angle of about 70° to the water. Within was an apron *(φaλκης),* which was a strong piece of timber curved and fitting to the end of the keel and beginning of the stern-post and firmly bolted into both, thus giving solidity to the bows, which had to bear the beak and sustain the shock of ramming. The stem was carried upwards and curved generally backwards towards the forecastle anti rising above it, and then curving forwards again terminated in an ornament which was called the acrostolion. The stern-post was carried up at a similar angle to the bow, and, rising high over the poop, was curved round into an ornament which was called “ aplustre ” *(aφλaστιv).* But, inasmuch as the steering was effected by means of two rudders *(πηδάλια),* one on either side, there was no need to carry out the stern into a rudder post as with modern ships, and the stern was left, therefore, much more free, an advantage in respect of the manoeuvring of the ancient Greek man-of-war, the weapon being the beak or rostrum, and the power of turning quickly being of the highest importance.

Behind the “ aplustre,” and curving backwards, was the “ chenis- cus ” *(χηvlσκος),* or goose-head, symbolizing the floating powers of the vessel. After the ribs had been set up and covered in on both sides with planking, the sides of the vessel were further strengthened by waling-pieces carried from stern to stem and meeting in front of the stern-post. These were further strengthened with additional balks of timber, the lower waling-pieces meeting about the water-level and prolonged into a sharp three-toothed spur, of which the middle tooth was the longest. This was covered with hard metal (generally bronze) and formed the beak. The whole structure of the beak pro- jected about 10 ft. beyond the stern-post. Above it, but projecting much less beyond the stern-post, was the “ proembolion ” *(πpοeμβολιοv),* or second beak, in which the prolongation of the upper set of waling- pieces met. This was generally fashioned into the figure of a ram’s head, also covered with metal; and sometimes again between this and the beak the second line of waling-pieces met in another metal boss called the *wpοeμβολις.* These bosses, when a vessel was rammed, completed the work of destruction begun by the sharp beak at the water-level, giving a racking blow which caused it to heel over and so eased it off the beak, and releasing the latter before the weight of the sinking vessel could come upon it. At the point where the pro­longation of the second and third waling-pieces began to converge inwards towards the stem on either side of the vessel stout catheads (⅛ωτtδ<s) projected, which were of use, not only as supports for the anchors, but also as a means of inflicting damage on the upper part of an enemy’s vessel, while protecting the side gangways of its own and the banks of oars that worked under them. The catheads were strengthened by strong balks of timber, which were firmly