CLASSICAL MEDITERRANEAN SHIPBUILDING OUTSIDE THE MEDITERRANEAN

Although it is well known that Greek and Roman trading ships sailed as far as Britain before the Roman invasions of northern Europe (McGrail 1990), it is not clear what the various local types of ships there looked like, though it is thought that the shapes of some of the native vessels are depicted on pre-Roman Celtic coins minted in north-west Europe (Allen 1971; Muckleroy et al 1978). However, it has long been assumed, in Britain at least, that once Roman rule had begun in the 1st centuries BC and AD most Roman trading ships were like those of the Mediterranean. Is this valid? Recent research on ships, cargoes and ports in northern Europe is enabling us to examine evidence for water transport and its use and conclude that the assumption is not valid.

Many of the vessels, strange by Mediterranean standards, that are depicted on Roman stone sculptures from the Rhineland are believed to be of Celtic type (Ellmers 1978), and it is significant that of the thirty-two plank-built vessels of the Roman period, excluding planked logboats, that have been recorded in the central and northern provinces only five are of a Mediterranean type of construction: Oberstimm, 2, on the Danube (Hockmann 1989); Vechten (de Weerd 1988, 184-194) and Zwammerdam, on the Rhine (de Weerd 1988); and London-County Hall, on the Thames (Marsden 1974); Moreover, three-ring analysis and a study of the vessel sizes shows that these were all probably locally built and could not have sailed from the Mediterranean. The four vessels found on the European mainland date from the 1st - 2nd centuries AD and were associated with military forts, and it now seems probable that their Mediterranean type of construction was due to their having had an "official", usually military, use.

The absence in central and northern Europe of any discovered vessels that had been built in the Mediterranean region would seem to suggest, then, that Roman trading ships did not generally sail around Spain to the north. This view is supported by a separate study of the find spots of goods, particularly amphorae and certain other types of pottery, that were imported from the Mediterranean to the northern provinces (Peacock 1978). Their distribution pattern has suggested that the trade was carried by ship on the main rivers of Gaul and Germany. But for this to be conclusive, however, much more information is needed about the distribution of these goods in Portugal, Spain and western France for it could be argued that the absence of find spots there is due to a lack of archaeological recording. Nevertheless, there is an undoubted concentration of finds beside the Rhone and the Rhine indicating that these rivers were important shipping routes. In contrast it seems significant that only one amphora with goods from Portugal has yet been identified in Britain to attest an Atlantic trade (Britannia 5, 1974, 467, n. 41). If this theory is correct then it indicates that in central Gaul the navigable heads of rivers draining into the Mediterranean, particularly the Rhone, probably marked the limit of the voyages of ships of the Mediterranean tradition (Fig. 1). The lands beyond, whose rivers, such as the Loire, Seine and Rhine, drained into the northern seas, were inhabited by Celtic peoples, and it now seems that there the native traditions of shipping prevailed. This will explain why almost all of the ships found north of the Alps are of Celtic type.

Quite apart from these cultural reasons for differences in shipbuilding methods between northern and southern Europe in Classical times, there is important new evidence to show that the environment also played a significant part. In particular we are beginning to understand the methods of berthing at ports. At London (Londinium), the major port of the Roman province of Britain, extensive excavations on the Roman waterfront have shown that the River Thames was then tidal, but with a maximum depth of water beside the timber quays at high tide of less than 1m. during the 1st and 2nd centuries AD. This shallow depth is puzzling for in the 1st and 2nd centuries AD the city received its greatest quantities of imported goods, including great barrels of wine, olive oil and wine in amphorae, and stone for buildings and monuments. So the shallow depth of water at high tide at the London waterfront may well have created berthing problems. Building deeper water berths with jetties or moles could have been one solution, but only one jetty extending into deeper water had been found. Another solution would have been for seagoing ships to moor in the tidal stream and offload into barges. Alternatively, seagoing merchant ships may have all had relatively broad flat bottoms that did not draw much water when laden. There is evidence to suggest that all of these solutions were adopted, and it means that instead of studying ship construction it now becomes important to consider the design of ships to study how they might have worked. In other words, shape instead of structure becomes significant.

Fortunately, the hydrodynamic analysis of reconstructions of ancient hull forms is now made relatively easy by the availability of computer programs. These enable the theoretical design of ancient ships to be considered in terms of stability and performance as if they were modern vessels on a drawing board, for the rules of hydrodynamics apply as much to ancient ships as to modern vessels (Marchaj

1986; McGrail 1987, 12-22). As Sean McGrail has pointed out (McGrail 1988, 35), this type of theoretical analysis is considerably cheaper and quicker than building full-size working reconstructions, though in certain circumstances the latter forms the ideal system of analysis. This makes it necessary to consider how theoretical analyses should be published, for although some specialists publish the specifications and calculations in detail, others give only their conclusions, and this makes it difficult to make comparisons between vessels. It is also important to know how valid is any reconstruction, for if there is too much speculation it is hardly a valid basis for hydrodynamic analysis. It seems that the minimum amount of information required before attempting the reconstruction of a whole vessel should include at least some indication of length, form of the ends, midship beam, midship form, height of the gunwale amidships, height of the deck, position and size of the hold, the total weight of the ship and the average hull density per square metre. Also there should be an indication of the methods of propulsion and steering, and if there was a cargo, then the weight of the cargo needs calculation, both as individual items and in total. Finally, care should be taken to look for traces of ballast which if found should be weighed.

There are various computer programs available which allow the hydrodynamics of theoretical reconstructions of ships to be examined, and for comparisons to be made between ships. I have been using "Boatcad" (manufactured by the Aluminium Boat Company, Trewen Road, Budock Water, Falmouth, Cornwall, TR11 5DY, England) which is quick, easy to use, and is well suited to archaeological purposes. Apart from plans, elevations, and hydrostatic analyses it also calculates and plots strake diagrams, cross-profiles at any point, and waterlines, buttock lines and the distribution of volume in the hull. With this it has been possible to consider classifying hull shapes by their volume distribution and show, for example, that the reconstruction of the Romano-Celtic seagoing trading ship from Blackfriars, London, was stable in the "lightship" condition (i.e. not fitted out or containing cargo and supplies) at a draught of about 0,67m. and that it could carry a cargo weighing about 50 tones at a draught of 1,5m. Such figures are, of course, only approximate since they depend upon the accuracy of the reconstruction. This ship may have been typical of Romano-Celtic vessels generally in that it had a flattish bottom and was ideally suited to sitting on tidal shores at low water for loading and unloading (Fig. 2a, b). Such beach berths may well have been the most common feature of prehistoric and Roman ports in northern Europe, for they have been found at Hengistbury, a late Iron Age port of the 1st century BC beside the English Channel in southern England (Cunliffe 1990), and in the initial settlement phase at Roman London, about AD 50.

A particularly valuable clue to determining the maximum possible original draught of an ancient ship is the graph of its righting moments, for in the case of the Blackfriars ship this (Fig. 3) shows the draught (about 1,5m.) at which the maximum righting force occurs, and this is linked to displacement (about 80 tones) and load (about 50 tones). It is presumed to be unlikely that a ship's master would have loaded his vessel beyond the point of maximum righting ability, for although he would not have known this point in a scientific way it is likely that experience will have established how his ship behaved safely.

Rarely is there sufficient archaeological information to carry out a complete ship reconstruction, but in contrast to the Romano-Celtic ship from Blackfriars there is also the hull of the Anse des Laurons ship of similar date which was found off southern France. Of Mediterranean construction the Anse des Laurons ship is as close to the ideal amount of evidence that is ever likely to survive. By using the excellent interim published report (Gassend et al 1984) it has been possible to undertake a reconstruction of the hull form in the computer (Fig. 4a, b), and then to make a hydronynamic analysis. For a more accurate analysis further information is needed, but even this limited published study shows that the maximum righting moment reaches its peak when the ship and its load totals about 50 tones (Fig. 5), at a waterline of about 1,45m. Assuming that the approximate weight of the ship, its equipment, crew and their possessions was about 20 tones, this would give a cargo weight of about 30 tones. In contrast to the Blackfriars ship this vessel is close to being unstable in its "lightship" state, at a draught of 0,78m. The ship would be close to heeling over because of the high Centre of Gravity relative to the transverse Metacentre, but it could be made more stable by adding a suitable cargo or ballast. It had flaired sides, as also had the Yassi Ada 7th century ship, whose reconstruction was also reported to have been unstable in the "lightship" state, though this too could have been overcome by adding some ballast (Marean 1987). Both vessels therefore were designed for the Mediterranean environment with no tides, in contrast to the Blackfriars ship which was designed for the tidal northern seas. Just how typical of Mediterranean ships these are cannot be judged until many more vessels have been carefully excavated and evidence for their hull forms reconstructed.

It is important to remember that the shape of a ship enables it to harnes considerable forces that are vital to its stability, performance and use. The construction simply gives the shape strength, and, of course, this is achieved in different ways according to the shipbuilding tradition. Therefore, as there is a relationship between the weight of a ship and its cargo load relative to its stability and performance, even when the upper part of a hull is missing, the discovery of a relatively undisturbed cargo and the bottom of a ship, as for example at Madrague de Giens, should make it theoretically possible to reconstruct on the computer a hull size and shape that embraces all that is known, including the weight of the cargo and the hydrodynamic "rules". This would then give a scientific basis for any reconstruction of the missing hull structure. It would then be possible to assess the ship for a range of typical loads, as well as in the lightship state and at its maximum righting arm.

The view that the tidal range in northern seas was an important factor in determining how ships were loaded and unloaded is also suggested by heavy individual items or packages, such as stone blocks or barrels of wine that were once shipped but are now found on land. None has yet been recorded in Britain weighing more than 1.5 tones, as if the berthing and loading and unloading facilities were restricted, as at Roman London. This contrasts with sites in the Mediterranean region where much heavier individual items of cargo are found both on land and in Roman wrecks, and show that there were some very large ships indeed. The 40 tones block of marble in the 3rd century wreck off Marzamemi, Sicily, is an extreme example (Throckmorton & Parker 1987, 76), and indicates the existence of comparitively advanced methods of cargo handling.

The tidal range in the north suggests that the total cargo of about 50 tones that the Blackfriars ship could have carried may have been typical for that region, and that more substantial cargoes were rare. In this respect it is noteworthy that the recently excavated Romano-Celtic ship of the 3rd century AD from St. Peter Port, Guernsey, Channel Islands (Rule 1990), was of similar capacity to the Blackfriars ship. In contrast, estimates of whole cargo weights in Classical wrecks in the Mediterranean show that there were some particularly large vessels: Torre Sgarrata, Italy (stone, *c.* 170 tonnes); Marzamemi, Sicily (stone, *c.* 190 tonnes); St. Tropez, France (stone, 200+ tonnes); Mahdia, Tunisia (stone, *c.* 240 tonnes); Isola delle Correnti, Sicily (stone, *c.* 350+ tonnes); Madrague de Giens, France (amphorae *c.* 325 tonnes); and Albenga, Italy (amphorae, *c.* 550 tonnes) (Gianfrotta & Pomey 1981, 282-284). The contrast between the Mediterranean and the northern provinces, therefore, suggest that the tideless Mediterranean was better suited to the construction of deeper water berthing facilities than were the northern tidal seas.

But the County Hall ship, found in London in 1910, is different from the remaining vessels with a "Mediterranean" type of construction found in central and northern Europe. It is later, larger and not known to have been associated with a military fort. Reconstructing the original dimensions of the ship is not as easy as might be thought for only part of the hull remained. The remains were about 13m long and comprised the hull bottom and one collapsed side up to the gunwale, from the widest part of the ship towards one end. But both ends were lost. By reconstructing the side onto the bottom the beam is found to be about 5.06m, with the gunwale originally at about 2m. above the bottom of the keel. There was a deck at about 1.5m above the top of the lowest frames of the hull, and although the hull strakes were held by mortice-and-tenon joints no parallel to its deck support structure is reported from the Mediterranean.

It is the length of its hull that is difficult to assess, and to estimate this it has been necessary to consider not only the discovered hull form, but also the forms of other Roman ships. Since the gunwale of most excavated ships is normally missing the only means of establishing what was the normal breadth - length ratio of Greek and Roman vessels is to measure the ratio at the turn of the bilge. This, of course, is not a specific spot so it is not possible to be exact, but if it can be approximately established then this would be a point for comparison with the County Hall ship. A study was made of eleven ships found in the Mediterranean area which gave the following rough breadth - length ratios at the turn of the bilge: Fiumicino 1 (1:3.2), Fiumicino 2 (1:3.2), Fiumicino 3 (1:3.3), Fiumicino 4 (1:4), Fiumicino 5 (1:2.5), Nemi 1 (1:3.4), Nemi 2 (1:3), Nemi 3 (1:3.5), Kyrenia (1:4.1), Kinneret (1:3.6), and Yassi Ada 7th cent. (1:4.8). Although not necessarily typical of Mediterranean ship proportions this range of 1:2.5 - 1:4.8 gave an average of 1:3.5, and if this ratio is applied to the County Hall ship then its length should be approximately 10.64m. This is far too short, for the discovered parts of the ship suggest a minimum length of 19.1m. This would give a breadth - length ratio of about 1:6.3, which is well outside the range found in the Mediterranean amongst the wrecks cited. What can this mean? Perhaps the comparisons in the Mediterranean region were too few or too varied as ship types to be valid. Alternatively, perhaps the County Hall ship had some form of "official" use which made it narrower than usual relative to its length. In this possible context it should be borne in mind that the recent tree-ring dating shows that it was built around south-east England not earlier than AD 285, at which time Britain had been declared independent from the Roman Empire by the usurpers Carausius and Allectus. Could the ship have been associated with the restoration of Britain to the Empire under Diocletian after AD 296? Or is a suggestion made in 1912, that the vessel might have been used as a warship, the answer? Parallels to its deck support construction have not been noted amongst Greek and Roman ship finds in the Mediterranean region, and this author would welcome a notification of any parallels (Shipwreck Heritage Centre, Rock-a-Nore Road, Hastings, TN34 3DW, England). It is otherwise interesting to note that the recent full-sized working reconstruction of the Greek trireme Olympias, shows a deck structure similar to that of the County Hall ship, indicating that the possibility that it was a warship should be considered. However, the sides of the County Hall ship were not parallel, and there is no evidence for the seating, footrests and oarports that would have been necessary for rowers. So, although the reconstruction of this ship is still uncertain, it does open up the possibility that it had an official Roman use, and future discoveries in the Mediterranean region may help with its interpretation.

Although the majority of Roman ships in central and northern Europe appear to have been Celtic, there are hints that the Roman economy, shipbuilding methods and religion may have influenced Romano-Celtic ships and shipbuilding. For example, so far no immediately pre-Roman plank built ships of the Celts have yet been found in Europe north of the Alps, and yet there are there a considerable number of plank-built vessels of the Roman period suggesting that the Roman economy was responsible for a massive increase in shipbuilding in the Celtic region. This too might have led to the fairly simple native vessels being constructed to greater sizes than before the Roman invasions, particularly on the Rhine where very large barges existed, as at Zwammerdam, Netherlands, where the largest was 34m. long, 4,4m. wide and only 1.2m high (de Weerd 1988). Moreover, the Celts sometimes used hooked iron nails to hold planks to frames in some of their ships at least during the Roman period, and as these were bent in exactly the same way as were nails, normally of bronze, used in some Mediterranean ships, it is possible that this technique was copied from the Mediterranean (Casson 1971, 207). Finally, the use of the votive coin in the mast-step of the Romano-Celtic Blackfriars ship was probably derived from the Mediterranean for ships found there as early as the 1st century BC also sometimes include coins (Casson 1971, 232). In order to solve some of these queries we urgently need to find examples of native ships in western, central and northern Europe dating from the immediately pre-Roman period, from a time before Roman influences took effect. At present all we have are descriptions by Julius Caesar and Strabo, and a few tiny pictures on Celtic coins (Fig. 6) (Allen 1971; Muckleroy *et al* 1978; McGrail 1990, 43-44).

We are still only beginning to understand how ancient ships were used, and the full-size reconstructions of the Kyrenia merchant ship and the Greek trireme are extremely important in giving us a major insight. Nevertheless, it is clear that, although a broad pattern of shipbuilding traditions in Roman Europe is emerging, there is still much fundamental data to be found and understood. There is no better example of this than a small logboat, with mortice-and-tenon fastenings to hold side strakes, that was found in an inland lake, Lough Lene, in central Ireland. This has led to a suggestion, supported by a Carbon 14 date of 400-100 BC on a piece of Yew heartwood which might date the vessel perhaps as late as the 1st century AD, that the vessel could be of the Mediterranean shipbuilding tradition even though it lay well outside the Roman Empire (Farrell 1989; Brindley & Lanting 1991). Since the local boatbuilding methods of Ireland at that time are completely unknown, it is unwise to concude on the present published evidence that this vessel was built by a Roman shipbuilder from the Mediterranean, as has been suggested. But, just how the construction of this curious boat can be otherwise explained is far from clear - until there are further boat finds in the region.

A major research and publication programme, due to end in 1996, on the many remains of ships, waterfronts and cargo goods found in London dating from the 1st - 17th centuries AD, is helping to clarify the broad picture. Already it shows that the history of nautical tradition and practice, in which the Mediterranean played and important part, was much more complex than anyone realised. An underlying feature of the ancient port of London from the 1st to the 11th centuries AD is that almost all known major shipbuilding traditions of Europe are represented in locally built vessels - traditions of Greece and Rome, of Scandinavia and the Slavic lands around the southern Baltic, as well as of the native Celts. The explanation is no doubt that this port was cosmopolitan from the beginning about AD 50, and it has now become particularly significant that one of its founding merchants was Aulus Alfidius Olussa, of the Pomptine tribe, who was born in Athens at the time of Crist and died in London aged 70. His tombstone (Fig. 7), found by the Tower of London in 1852, is preserved in the British Museum.

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ILLUSTRATIONS

1. Distribution of ship-finds of the 4th century BC - 4th century AD of the three major shipbuilding traditions: Mediterranean, Celtic and Scandinavian.
2. (a) Computer view of a reconstruction of the 2nd century AD Romano-Celtic ship from Blackfriars, London. (b) End elevations (i.e. "body plan") of the ship as reconstructed.
3. Heeled righting moments of the Romano-Celtic ship from Blackfriars, London. The maximum righting moment occurs at a displacement just above 80 tones and suggests maximum load that the ship would normally carry.

4a, b. Computer generated reconstruction of the small Roman merchant ship from Anse des Laurons, southern France.

5. Heeled righting moments of the Laurons ship as reconstructed, showing that at a displacement of 50 tones the ship was at its most stable.

6. Small pictures of ships on Celtic coins of the pre-Roman Iron Age (1st century BC/AD) from southern England and northern France.
7. Tombstone from London of "A(ulus) Alfid (ius) Olussa, of the Pomp(tine) tribe; set up by this heir in accordance with his will; aged 70; born at Athens; he lies here".

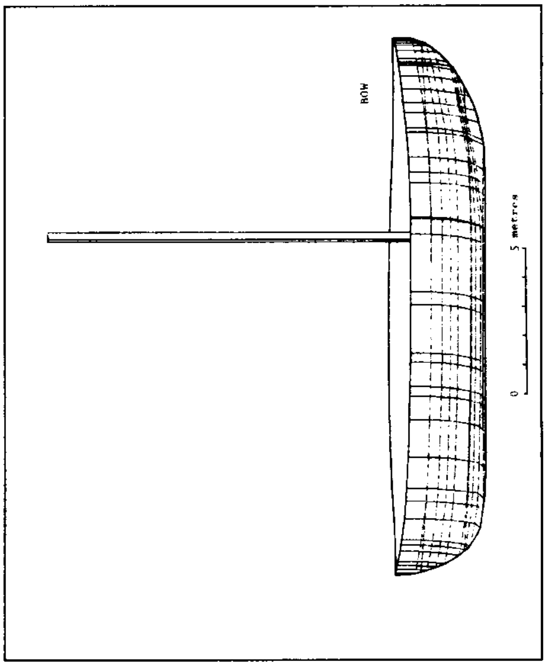

FIG. 2a

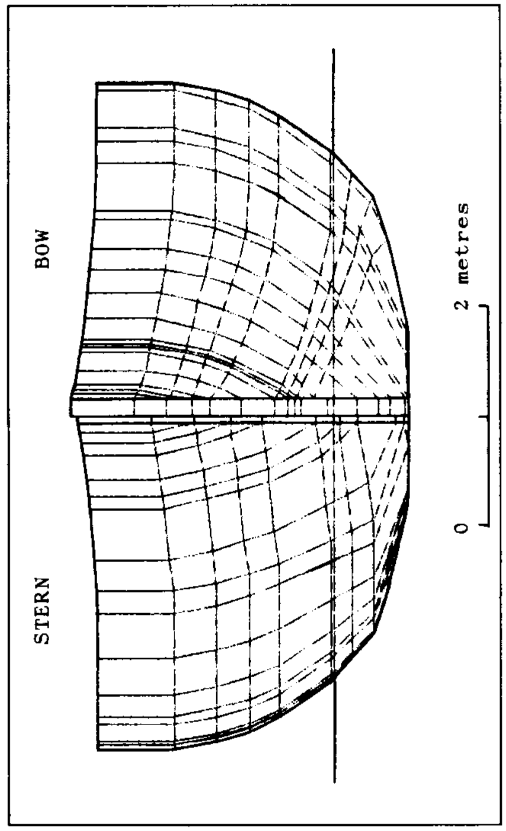

FIG. 2b

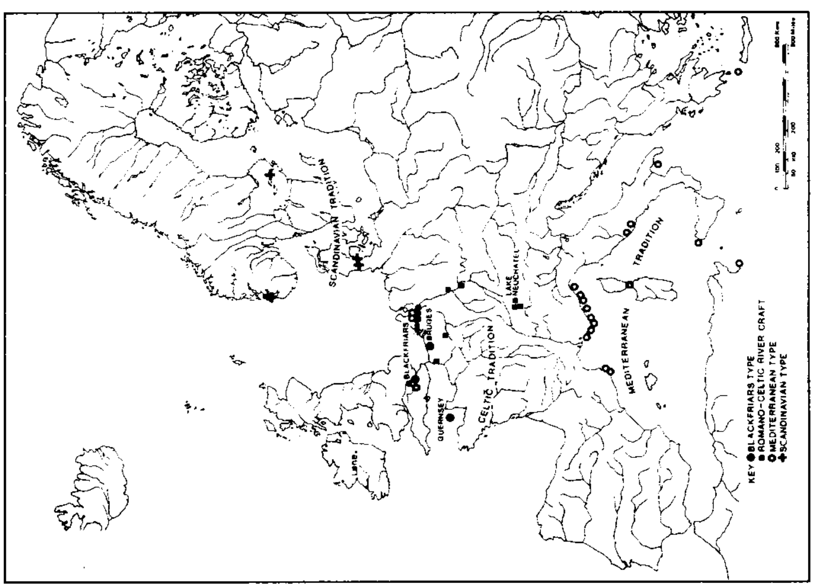

FIG. 1

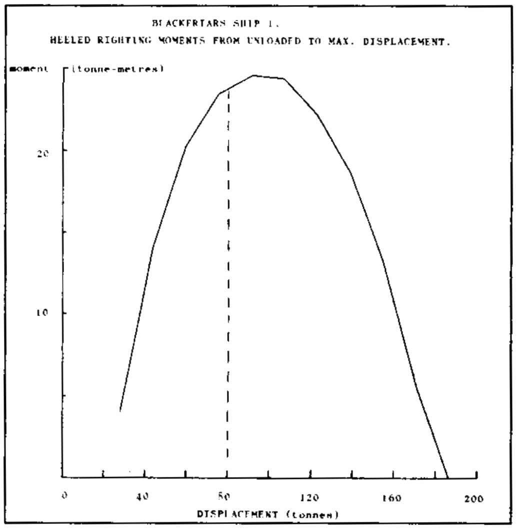

FIG. 3

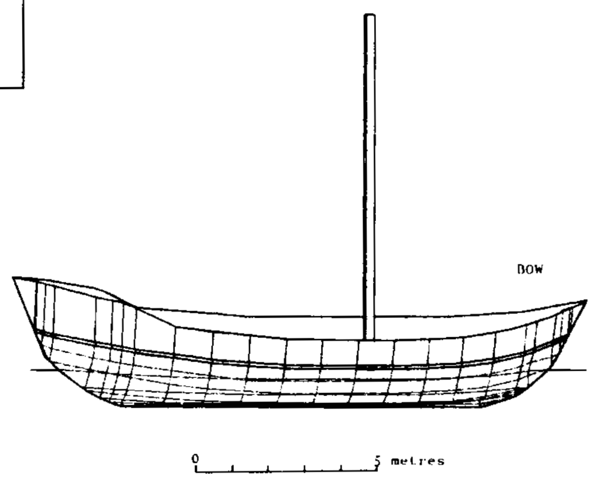

FIG. 4a

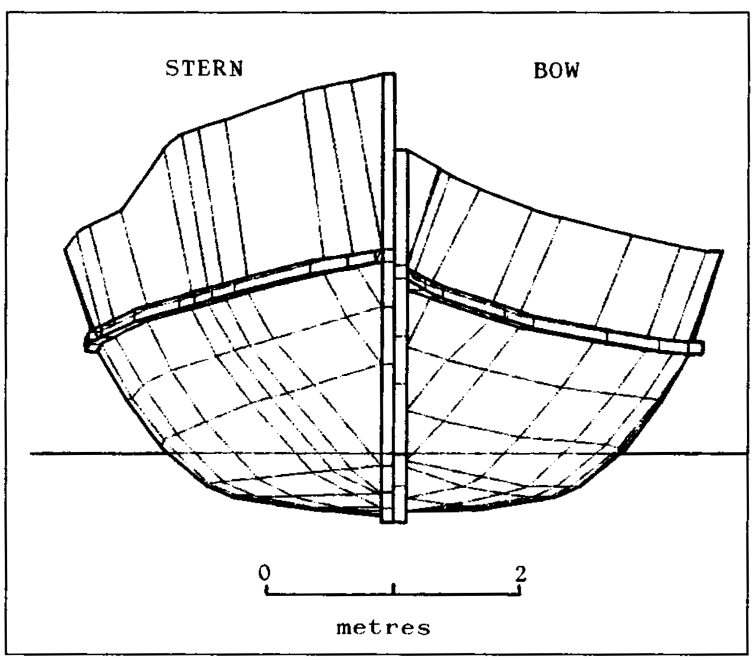

FIG. 4b

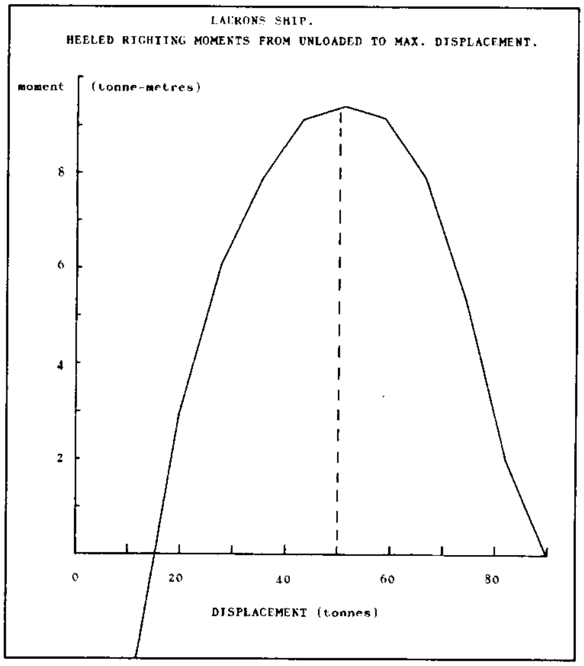

FIG. 5

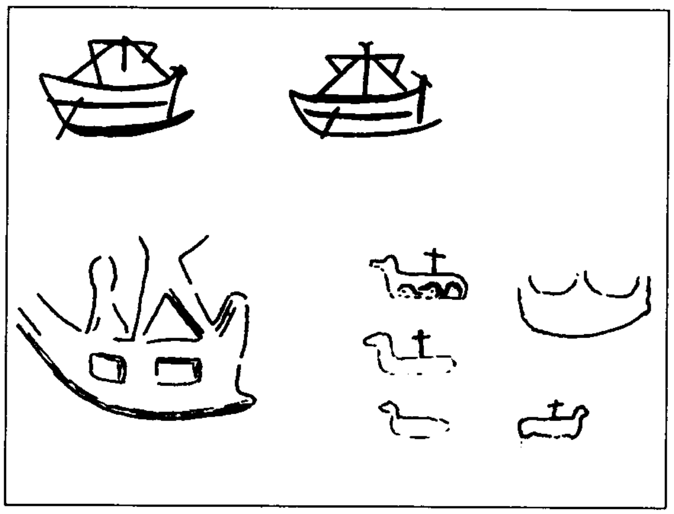

FIG. 6

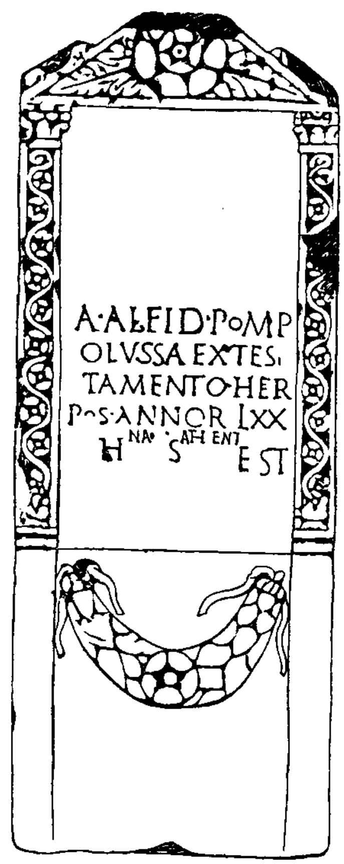

FIG. 7