

A boat of the Roman period found at Bruges, Belgium, in 1899, and related types

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Introduction

An ancient boat found at Bruges, Belgium, in 1899, has now been dated by C-14 to the 2nd or early 3rd centuries AD. The surviving fragments of the Bruges boat are described in this paper, and are compared with the Blackfriars ship of the 2nd century AD from London, to which it is a very close parallel.

In general terms it seems that the Bruges and Blackfriars vessels represent a local tradition of Celtic shipbuilding, perhaps located west of the Rhine, which was different from the non-Celtic clinker tradition of Scandinavia and the carvel tradition of the classical Mediterranean cultures. They were part of a more general group of Celtic shipbuilding traditions which existed in central and north-west Europe showing some considerable variations in ship form, though there were technical similarities, as is exemplified by the recent discovery of river barges at the Rhine mouth in the Netherlands and in Switzerland.

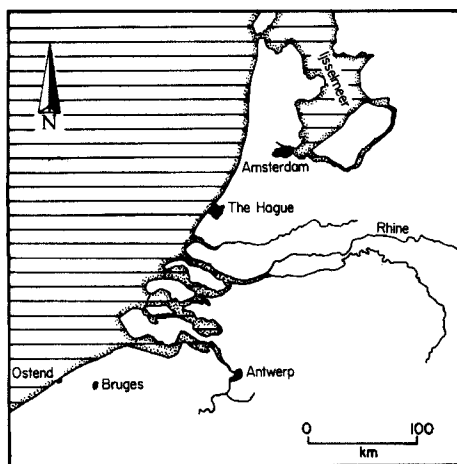


Figure 1. The location of Bruges, Belgium.

Since its discovery the boat has been an archaeological enigma periodically giving rise to speculation concerning its significance (Fig. 1). As a result of important new information, however, it is now possible to make a more accurate assessment of its significance and to reopen the discussions which have continued intermittently for more than three-quarters of a century.

The early investigations

The following account of the investigations which were carried out before 1973 is based upon a review and assessment of the evidence for the boat which was published in 1954 by M. Nagelmackers (1954).

Discovery

At the end of August 1899 a M. Rutot was informed that an ancient boat had been discovered during excavations to dig a canal at Bruges, at a point about 500 m from the sluice gates of the Ostend canal (Fig. 2). Accompanied by Baron A. de Loë of the Museum of Decorative Arts, he visited the site on 29 August. One end of the vessel had been destroyed, and the two men in the morning before they left the site quickly made a record of the geological deposits in which the vessel lay (Fig. 3). They tried immediately to arrange for the preservation of the boat, but having been away from the site for only about one hour, on their return they were extremely astonished to find that the mechanical excavator, which, that morning had been over 100 m away from the site of the boat, had been brought up to the site in haste and had just reduced what was left to dust. The damage was done; there was nothing left to do but to withdraw indignantly.

This is reminiscent of the tactics sometimes employed nowadays by contractors on building sites where the discovery of some archaeological feature threatens to delay their construction. Nevertheless, although the boat had been destroyed, a variety of fragments were collected, and a little later sketches and measurements were made by M. E. Jonckheere, a geologist, – apparently while the timbers were still wet and therefore not shrunken or distorted. Eventually the timbers were placed in the Gruuthuse museum in Bruges, and in recent years were transferred to the National Schepvaartmuseum in Antwerp.

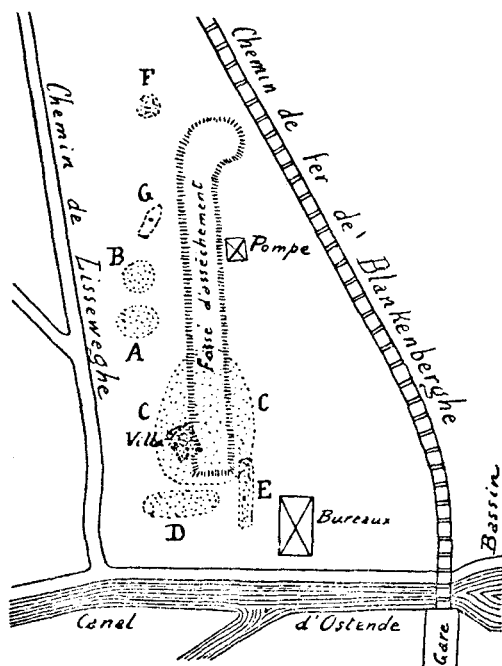


Figure 2. Plan showing the proximity of the Bruges boat (G) to the Roman villa (C). The other sites marked are A, a pre-Roman site; B, a Gallo-Roman site; D, E, F, medieval sites. (From the *Bulletin de la Société d'Anthropologie de Bruxelles* reproduced in Nagelmackers, 1954.)

Preliminary dating of the boat in 1899

The boat lay at the bottom of a thick layer of loose, coarse gravel which, just north of the vessel, also filled a hollow or valley (Fig. 3, layer C). This was one of several valleys which

were up to 10 m deep, the bottoms of which contained clods of turf and fallen tree trunks, and had been eroded into gravels and clays of Eocene and recent times (Fig. 3, layers D and E). At the base of layer C and close to the ancient boat were found the remains of a Roman villa upon what was an elevated piece of ground between the later valley erosions. M. Rutot concluded that, as the coarse gravels that overlay the villa and in which the boat lay were deposited during the second marine encroachment, the vessel must date from the time of that encroachment which was then believed to be in the 11th or 12th centuries AD. Much later the date of the encroachment was revised to between the 4th and 8th centuries AD but, unfortunately, pottery found on the site was not helpful as it ranged in date from Neolithic times to the medieval period. The recent C-14 dating of the boat to the Roman period, however, suggests that the vessel either lay in a deposit associated with the villa, or that the date of the erosion needs to be revised.

The boat *in situ*

Very little information exists to show what the boat was like as it lay *in situ*, though the sketched cross-section made by M. Rutot (Fig. 3) does show a slightly rounded bottom and a fairly sharp turn of the bilge.

M. Rutot believed the boat to have been quite small, and estimated that it could have been about 7 m long. His description states that it had a flat bottom, and a shallow draught which he considered to have been 1.20 m. He noted a large timber which contained a step socket; and also the discovery of a mast, probably originally 5 or 6 m long, which was found lying down and detached from the boat. After the mast had been found a steering oar was also discovered.

Baron de Loë believed the boat to have been somewhat larger, its length being about 15 m and its width 4 or 5 m. He reported that the boat was constructed entirely of oak, and that the planks were fastened by wooden pegs, some of which were completely impregnated with pyrites and hardened to look like iron. He too mentioned the mast, and noted that it was found broken into six pieces, and that originally it could have measured 7 or 8 m in height.

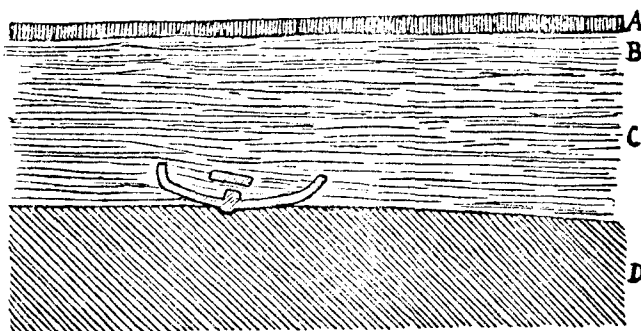
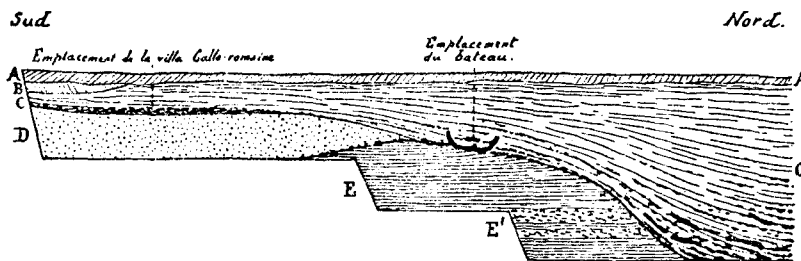


Figure 3. Sections across the Bruges boat *in situ* made in 1899 by M. Rutot and Baron de Loé. (From the *Bulletin de la Société d'Anthropologie de Bruxelles* reproduced in Nagelmackers 1954.)

It is clear that the lack of agreement by the only two people who saw the boat *in situ* and who reported what they saw, indicates that at no time was the boat sufficiently uncovered for its main dimensions and construction to be recorded. Indeed, apart from the sketched cross-section made of the boat *in situ* (Fig. 3), any reconstructions of the vessel must be based solely upon the loose surviving fragments.

Early reconstructions of the boat

Jonckheere, who sketched the fragments just a few days after they had been found and while they were still on the site, was the first to reconstruct a cross-section (Fig. 4) of the vessel (Nagelmackers, 1954: fig. 4). He considered that the Bruges boat was the 'twin brother' of the Anglo-Saxon boat found at Snape in Suffolk though it is difficult to determine on what basis this judgment was made, especially as little was then known about the rounded impression of the completely decayed Snape boat, except that the regular rows of iron rivets clearly once held its strakes to each other clinkerwise. In spite of the fact that

no rivets were noted as having been found in the Bruges boat, and that the vessel had a flat bottom, Jonckheere felt justified in reconstructing the boat with clinker built sides, though he did give it a flat carvel-built bottom (Fig. 5).

Somewhat later W. K. Versteeg used both the Snape boat, and the Nydam boat of the 4th century AD (Åkerlund, 1963) as the basis for his new reconstruction (Fig. 5) in which he considered that it was both clinker built and had a rounded bottom (Nagelmackers, 1954: fig. 7). The assumption that the Bruges boat was clinker built is understandable for until 1965, when the Romano-British boat from New Guy's House, London, was published, the only known early vessels of northern European construction and dating from the Roman period were clinker built.

The first examination of the timbers of the Bruges boat in recent times was by Ole Crumlin-Pedersen who discovered that two of the fragmentary timbers (Fig. 4: 1 and 6) were, in fact, parts of the same rib which had been broken along the grain. This break had certainly

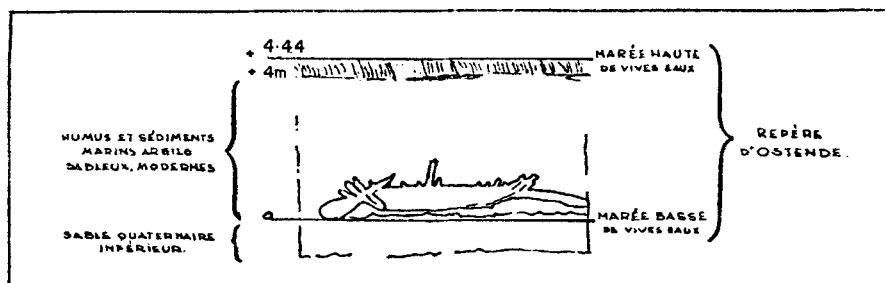
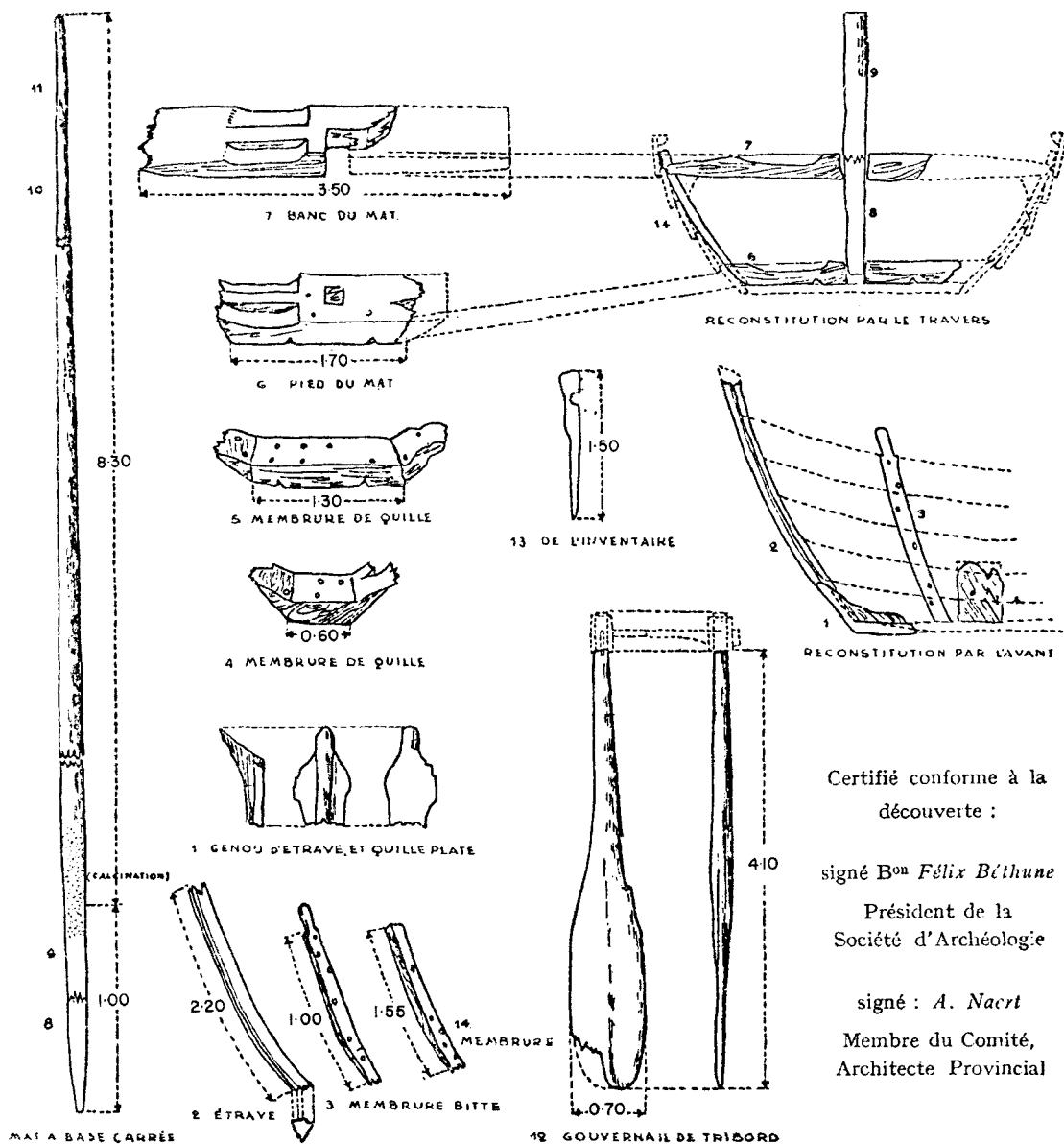


Figure 4. Sketches of the fragments of the Bruges boat made by E. Jonckheere. (From Jonckheere, 1903.)

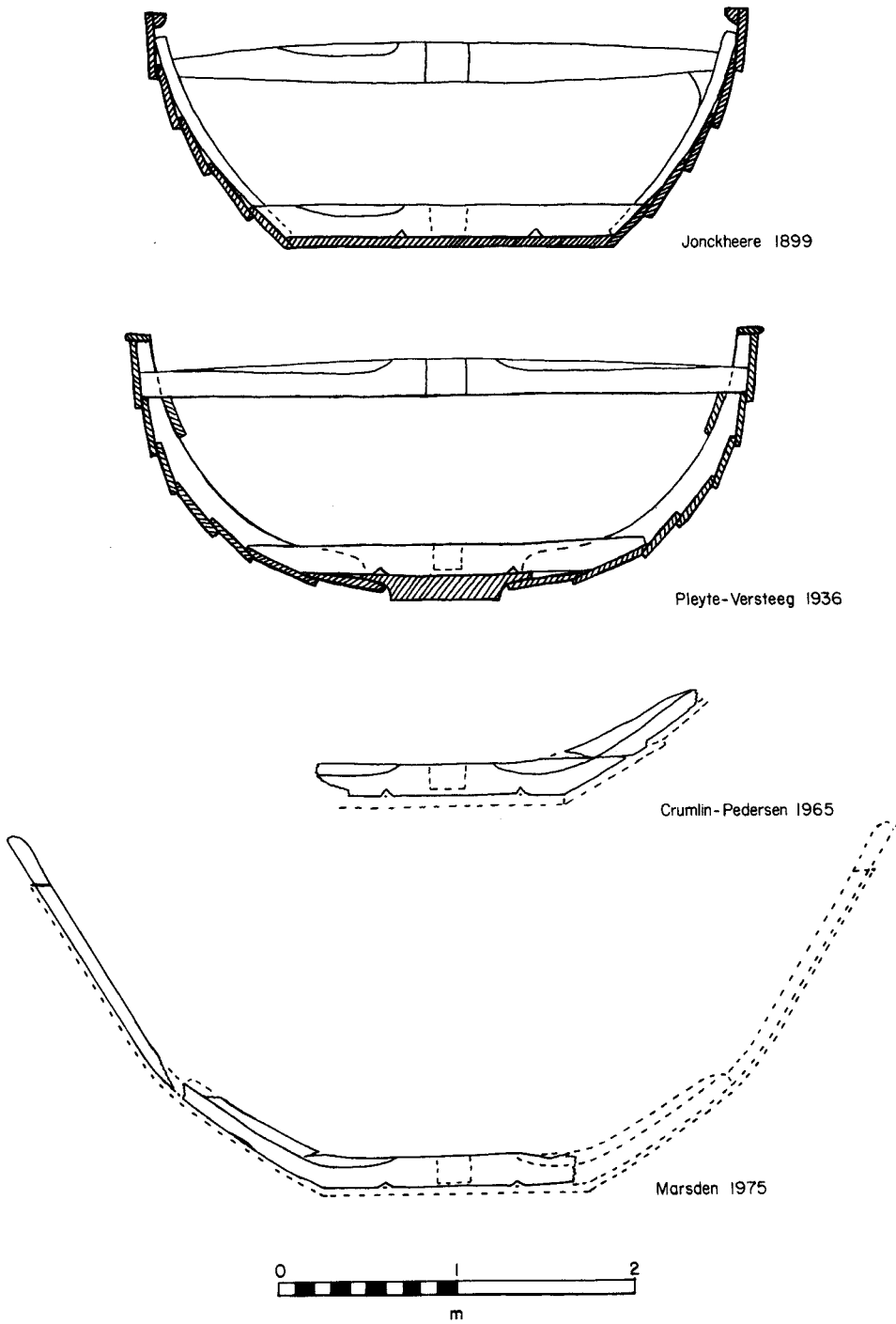


Figure 5. Various reconstructed cross-sections of the Bruges boat.

occurred before Jonckheere drew them, for he was unaware that they fitted together (Crumlin-Pedersen, 1965: 99). When joined together they showed that the rib which contained the mast-step socket was almost identical to the mast-step timber in the ship of the Roman period from Blackfriars, London (Fig. 26; Marsden, 1966). On the basis of this important discovery, which gave a profile of the bottom part of the Bruges boat, Crumlin-Pedersen attempted a new reconstruction of the cross-section of the boat (Fig. 5) in which he suggested that a step in the external profile of the rib may indicate that the Bruges boat had an outer skin of reverse clinker planking in which the lower strake overlapped the upper. In the full publication of the Blackfriars ship in 1966 it was suggested that, because of the striking similarity between the mast-step timbers in the Bruges and Blackfriars vessels, future research might show that there was a definite relationship between the two vessels (Marsden, 1966: 30). This further research occurred in 1973 and confirmed the suggestion.

Recent investigation of the boat

In 1973, with a grant from the former Guildhall Museum, now merged with the London Museum to form the Museum of London, the writer visited the National Scheepvaartmuseum in Antwerp and spent two days studying and recording the fragments of the Bruges boat. It is thus a pleasant duty to record grateful thanks to J. van Beylen and his staff of that museum for their great help, particularly in moving the timbers from their place of storage to more accessible positions. Grateful thanks are also extended to Max Hebditch, then Director of the Guildhall Museum, and to the Corporation of London not only for the grant which made this study possible, but also for financing the dating of the Bruges boat by C-14. Thanks are also extended to George Willcox, environmentalist of the Department of Urban Archaeology in the Museum of London, who kindly identified samples of wood from some of the timbers; and to Miss Jane Weeks who helped with the preparation of some of the drawings.

The date of the Bruges boat

The method of dating the boat by its stratigraphical situation was clearly unsatisfactory, and its similarity of construction to the ship

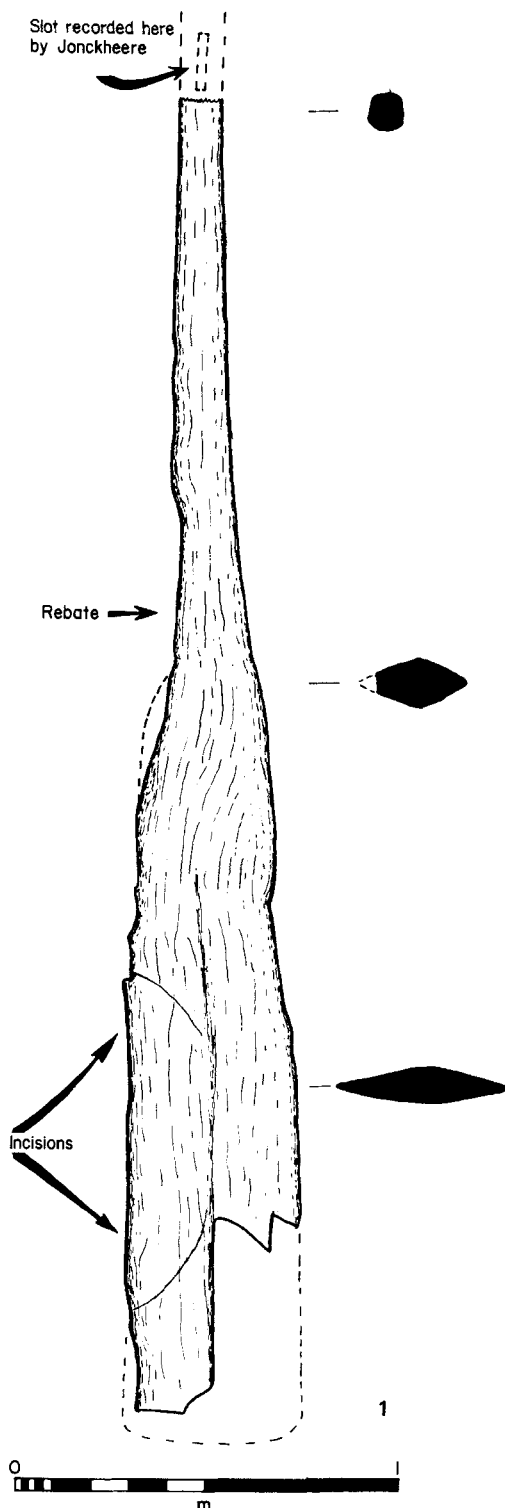


Figure 6. Bruges boat: steering oar.

of the 2nd century AD found at Blackfriars in London (Marsden, 1966: 44–7) indicated that it could have been even earlier than the 4th to 8th centuries AD which had been previously suggested.

A sample of most recent wood growth was taken from one of the ribs of the Bruges boat and was submitted to the Carbon 14-Tritium Measurements Laboratory at Harwell. The sample (HAR-472) gave a date of AD 180 $\pm$ 80 years.

This date is so remarkably close to that of the Blackfriars ship, which accidentally sank in the late 2nd century AD, as to indicate that the Bruges and Blackfriars vessels were very probably contemporary.

Description of the boat fragments

It must be remembered that the fragments of the Bruges boat described below were drawn and measured in their dried-out condition and that they will have been distorted to some extent, having shrunk radially and tangentially but not longitudinally. The only drawings and measurements of the timbers which were made before they had dried out were by Jonckheere, and although very roughly executed they are of some use as will be shown below.

1. *Steering oar* (Fig. 6). Probably of oak. The loom is roughly circular in section and the blade is diamond shaped in section. Both upper and lower ends of the oar are broken, the total surviving length now being 3.46 m; the breadth of the loom being about 0.14 m, and of the blade 0.46 m. The thickness of the blade is 0.10 m. As the lower end of the blade has split along the grain and has opened up to give a particularly distorted shape, it has been drawn with the split in a closed position. At the junction of the loom and the blade is a rounded rebate in the side of the oar, this probably being a deliberate shaping perhaps to hold a rope which lashed the oar to the side of the boat. On the blade are two curved incisions, the age and purpose of which are unknown. The steering oar has apparently suffered since it was recovered, Jonckheere having recorded its length as 4.10 m (Fig. 4: 12), which shows that there has been a subsequent loss of 0.64 m. At the top of the then surviving length of the loom Jonckheere shows the bottom of a square or rectangular hole cut at a right angle to the blade of the oar, this presumably originally held the tiller.

2. *Side frame* (Fig. 7). Sample identified as oak (*Quercus* sp.). This is broken at both ends, and contains several nail holes. Most of the external surface is straight except at the end where it is clearly curved; here most of the nail holes occur. Jonckheere shows this curve on his drawing (Fig. 4: 14), so, therefore, it presumably reflects the profile of the boat – a conclusion supported by the similar shape of the other surviving side frame (Fig. 7: 3). The rib now measures 0.10 m wide, 0.06 m thick, and 1.39 m long – a reduction in length of 0.16 m since Jonckheere measured it, presumably due to breakage as this is along the grain.

3. *Side frame* (Fig. 7). Sample identified as oak (*Quercus* sp.). Now rectangular in section and measuring 0.16 m wide, 0.07 m thick, and 1.72 m long. Most of the surface, which was presumably attached to the outer skin of the boat, is flat, except at what is presumably its lower end where a distinct curve exists (cf. timber no. 2). This curve is shown in Jonckheere's drawing (Fig. 4: 3), so it may be presumed to reflect part of the lower profile of the boat (Fig. 21). The curved lower end of the rib is broken, while the upper end is complete and terminates with a short 'post' which is circular in section (Fig. 8). The 'post' seems to be worn on its inside as if it had projected above the gunwale and had been used for lashing a rope to the side of the boat. The oblique angle of the top of the rib at the base of the 'post' is possibly indicative of the level of the gunwale, and of the outward sloping angle of the side of the boat (Fig. 21). In support of this view it is clear that at this angle the side frame almost exactly and smoothly continues the form of the profile of the bottom rib or floor-timber which contained the mast-step (Fig. 21). Several nail holes exist in the side frame, most of them about 0.01 m square, but one of roughly equal size is circular. The holes indicate that the nails were of iron, but as there were no small nail holes in the inner surface of the rib, it is unlikely that the nails which held the strakes to the side frame had been clenched over the inner face of the frame, as was found in the New Guy's House boat (Fig. 30; Marsden, 1965), or that there was an inner skin or ceiling of planking.

4. *Shaped object of indeterminate purpose* (Fig. 7: 4). Probably of oak. Its purpose is unknown, but attention is drawn to a somewhat similarly shaped wooden object attached to the upper end of the inner face of the stempost of the medieval cog from Bremen (Fliedner, 1969: pls 107–10). The purpose of

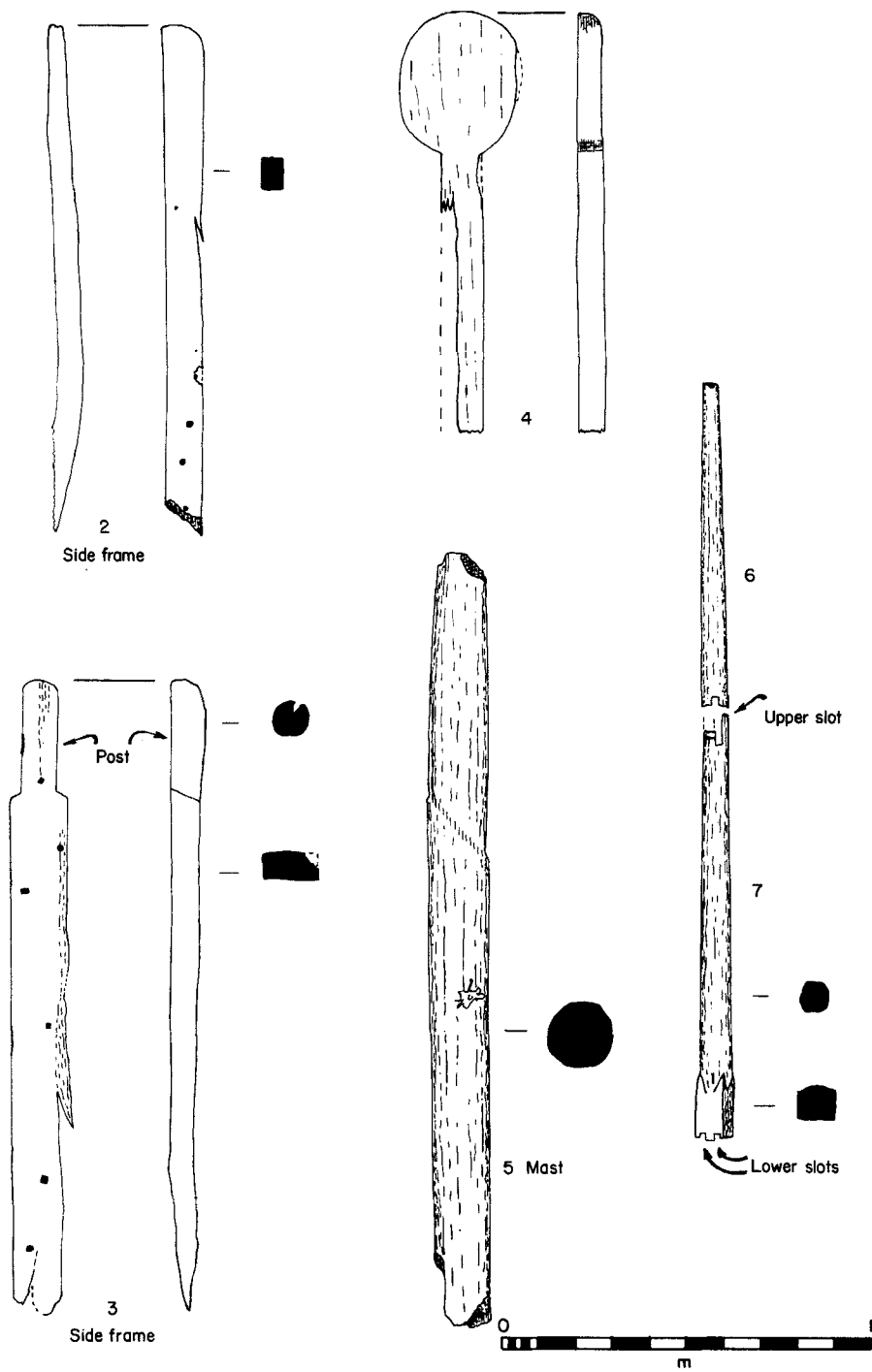


Figure 7. Bruges boat: nos 2, 3 – side frames; 4 – unidentified timber; 5–7 – mast fragments.



Figure 8. Bruges boat: 'post' at the top of the side frame, timber no. 3 (Fig. 7). Note the diagonal upper end of the rib at the base of the 'post'.

the Bremen object is uncertain, but it may have been a rope lashing point. The object from the Bruges boat was not sketched by Jonckheere.

5. *Mast* (?) (Fig. 7). Circular in section, and now 0.065 m in diameter. A sample of the timber has been identified as oak (*Quercus* sp.), and thus may be part of the mast (Fig. 4:8–11).

6. *Mast* (Fig. 7). Sample identified as oak (*Quercus* sp.). This is circular in section, and is clearly the top of the mast. The top is flat and 0.04 m wide, and in it is a small cupped hollow 0.015 m wide and 0.0125 m deep, the purpose of which is unclear. The lower end of this fragment is broken at a point where the mast is pierced by a slot 0.025 m wide, and it is possible that this contained a small pulley wheel. This fragment was drawn by Jonckheere (Fig. 4: 11).

7. *Mast* (Fig. 7). This fragment, which has been identified as oak (*Quercus* sp.), is clearly a continuation of fragment no. 6 described above, not only because it has the correct diameter, but also because it preserves the lower end of the slot seen in fragment no. 6. At the lower end of fragment no. 7 the mast departs from its circular section to take on a square form (Fig. 9), this square portion containing two slots, which perhaps held pulley wheels, and presumably had been used to contain the halyards or ropes for lifting the yard (see Fig. 23). The diameter of the mast at this point was 0.08 m, and each slot was about 0.02 m across. The mast was drawn by Jonckheere (Fig. 4: 8, 9, 10 and 11) who described it as being 9.30 m long, although it was broken into several pieces. Its maximum diameter, judging from his sketch, was probably about 0.16 m. Only fragments 10 and 11 survive in the Maritime Museum at Antwerp.

8. *Thwart* (?) (Fig. 10). Sample identified as oak (*Quercus* sp.). This timber seems to have been originally carved as a floor-timber with a mast-step for a vessel of larger size than the Bruges boat, but it was probably never completed and used as such and was modified perhaps to form a thwart to help support the mast in the Bruges boat. The reason for believing that this was originally a floor-timber containing a mast-step is that it is very similar to the mast-step floor-timber (Fig. 10: 9) from the Bruges boat. Not only does it preserve traces of the actual mast-step socket (Fig. 12), but it also has the medial ridge on its upper surface (Fig. 11), these being features which are so distinctive of this type of vessel and occur both in the Bruges boat, and in the Blackfriars ship from London (Fig. 26). The conclusion that this timber was for a vessel of larger size

than the Bruges boat is based upon the greatly increased width of the flat bottom of timber no. 8 (now about 2.50 m) over that of timber



Figure 9. Bruges boat: square form of mast above the two slots which probably contained the halyards (Fig. 7, no. 7; Fig. 23).

no. 9 (now 1.40 m). The suggestion that the floor-timber was never completed as such is based upon its reuse, and upon the absence of limber holes for the flow of bilge water as are found in the mast-step timbers of the Bruges boat (Fig. 10: 9) and in the Blackfriars ship (Fig. 26); and also on the absence of nails, or nail holes, in the rib to show that it was once attached to the strakes. Instead two iron nails had been driven into one of the vertical faces of the rib. Finally as the boat already contained one mast-step timber it is unlikely that it would contain another.

This timber was drawn by Jonckheere (Fig. 4: 7) who considered that it had been used as a thwart to help support the mast, the cutaway mast-step presumably originally containing the mast.

9. *Floor-timber containing a mast-step* (Fig. 10). This timber is now in two fragments, and samples from each have been identified as oak (*Quercus* sp.). Raised medial ridges extend away from the raised mast-step area on the upper surface of the rib (Figs 13 and 14), while near the edge of each side is a row of corroded nails, the holes of which contain a grey-white substance somewhat resembling lead corrosion. The substance has not been analysed. Three of the nail holes are definitely square and each nail had been driven up the centre of a circular treenail, a sample of which has been identified as Birch (*Betula* sp.), each of which is now about 0.02 m in diameter. This is possibly the treenail impregnated with a formation of pyrites which was noted by Baron de Loé. It seems that to carry out this construction it was necessary for a hole to be drilled through the rib for the treenail to be inserted, and once in place a smaller hole was drilled up the centre of the treenail so that the nail, presumably of iron, could be driven through the rib. This is almost exactly the same process that was used to insert nails into the ribs of the Blackfriars ship except that there the treenails were of oak (Fig. 18). Since the treenail did not extend into the outer skin planking of the Blackfriars ship, the shipwright presumably being satisfied that this was not essential to enable him to drive a long nail through the fairly thin planking, it might be supposed that the treenails did not pass through the planking of the Bruges boat, but, unfortunately, the evidence does not survive. In the raised central area of this floor-timber it seems that two of the nails had originally been clenched over the upper surface of the timber as in the Blackfriars ship (Fig. 26), the evidence in the Bruges boat is the existence of small nail

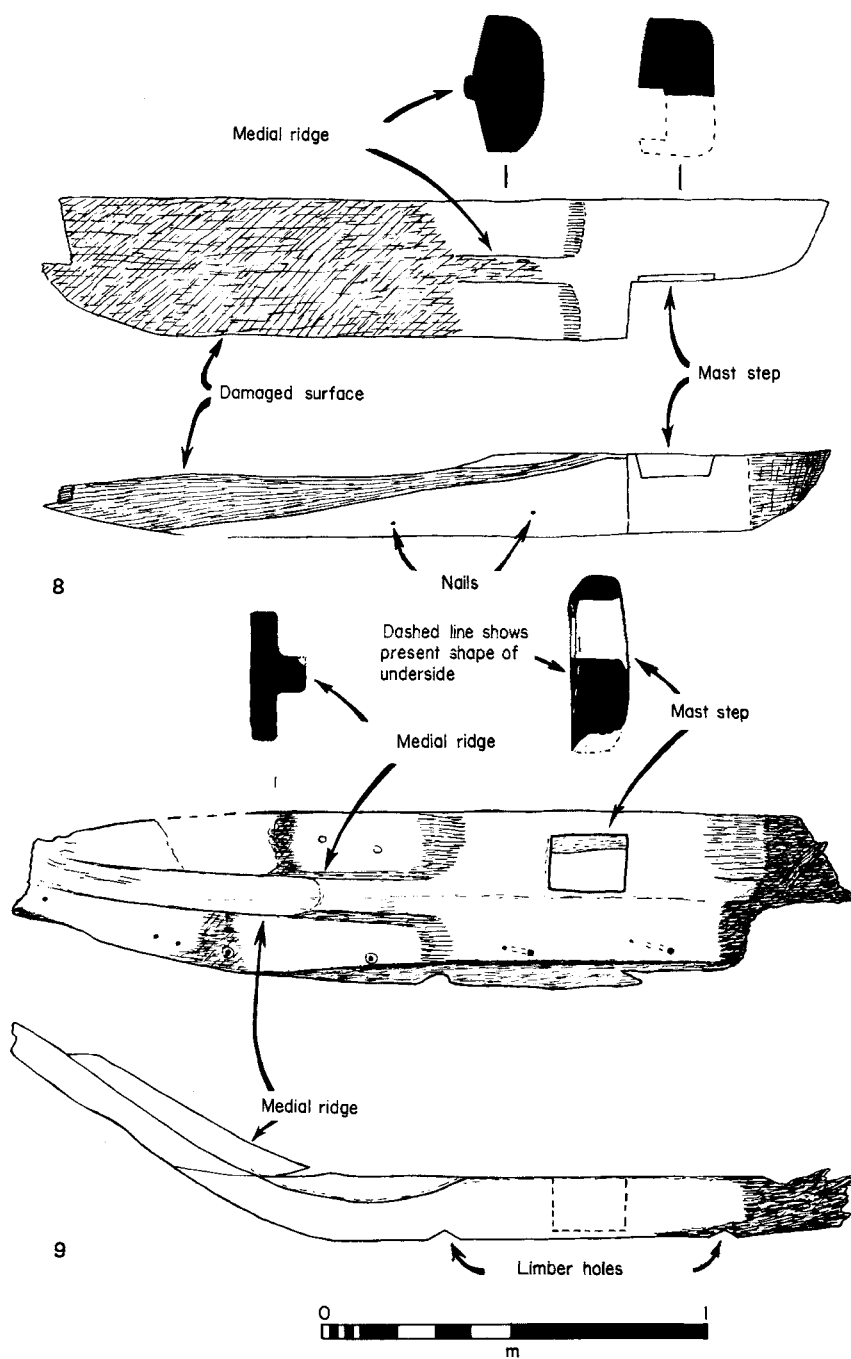


Figure 10. Bruges boat: no. 8 – re-used mast-step rib; 9 – mast-step rib.

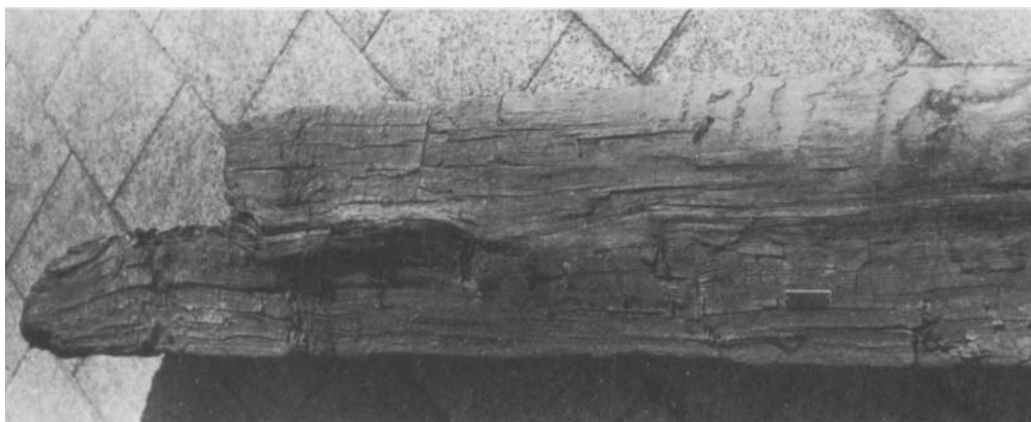


Figure 11. Bruges boat: the upper surface of the ? re-used floor-timber, showing traces of the medial ridge (Fig. 10, no. 8).

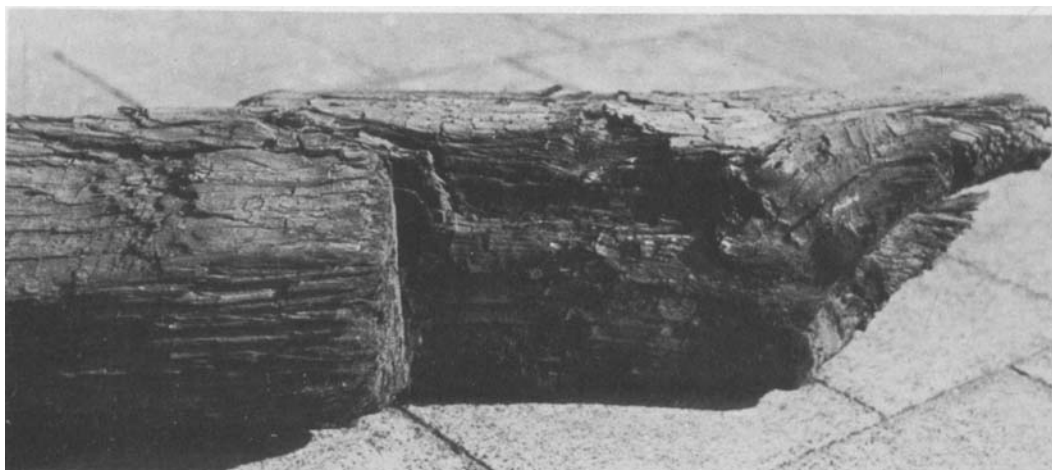


Figure 12. Bruges boat: traces of mast-step socket in the ? re-used floor timber shown in Fig. 11.

holes in the upper surface of the rib indicating where the point of the nail had been clenched down.

The elevation of the timber (Fig. 10: 9) clearly shows the form of the vessel in cross-section, and that it had a flat bottom about 1.40 m wide (this measurement being taken along the grain and, therefore, along the line of minimal shrinkage). The side then inclined up at an angle of about 32° , having formed an angle or chine with the bottom. In cross-section the central portion of the floor-timber was not horizontal but curved, so that the underside arched upwards in section. This arching is probably not as the timber was originally shaped, but is due to unequal shrinkage

resulting from its drying out. As if in confirmation of this the two limber holes follow the upward curve (Fig. 15), a factor which is wholly pointless had the underside of the timber been carved in the arched form. To make the final drawing less misleading the cross-section of the timber has been shown here as if it were flat on its underside, though a cross-section is included to show the actual shape (from Crumlin-Pedersen, 1965: fig. 10). As a check on the original form of this timber it is desirable that at some future date a careful study should be made of the tree-rings and the lines of maximum and minimum shrinkage, with a view to reconstructing more accurately its original size and form.

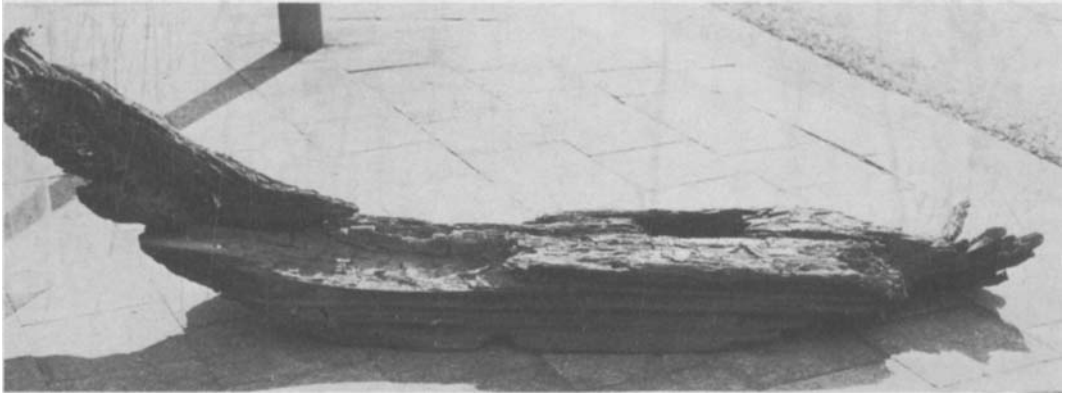


Figure 13. Bruges boat: the floor-timber containing the mast-step (Fig. 10, no. 9).

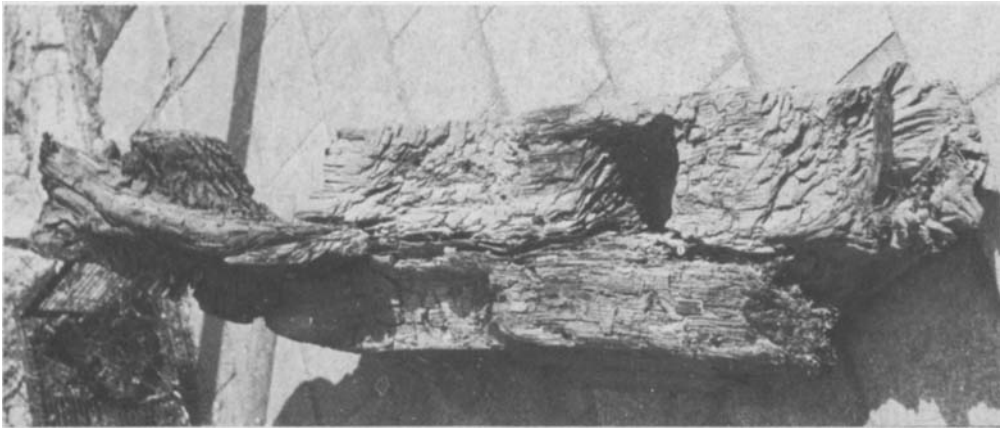


Figure 14. Bruges boat: the floor-timber containing the mast-step (Fig. 10, no. 9).



Figure 15. Bruges boat: underside of the floor-timber shown in Figs 13 and 14 showing *continuous timber holes* for the flow of bilge water. At the extreme right end there is a modern saw cut.

The mast-step socket is rectangular in plan and now measures 0.20 m by 0.145 m, the length being the same as that of the mast-step socket in timber no. 8. It is interesting that the step lies towards one side of the medial ridge line of the floor-timber as also occurred in timber no. 8, and, though to a less extent in the Blackfriars ship where the mast-step socket was situated towards the forward side of the rib (Fig. 26). The reason for this is perhaps to give strength to the afterside of the floor timber, to counteract the pressure aft of the foot of the mast caused by the leverage forward of its

upper part, the deck acting as a pivot (Fig. 19). Jonckheere drew this floor-timber believing that the two fragments (Fig. 4: 6 and 1) belonged to different parts of the vessel. In spite of the distortions resulting from drying there is no serious doubt that the two fragments belong to the same floor-timber. Jonckheere recorded that the flat bottom of this timber between its chines was 1.70 m long, whereas now it is 1.40 m. But as this measurement was made along the grain where shrinkage would have been very small indeed, it seems likely that Jonckheere confused the



Figure 16. Bruges boat: side view of floor-timber (Fig. 10, no. 9), the arrow indicating the suggested reverse clinker construction.



Figure 17. Bruges boat: underside view of the timber shown in Fig. 16, the arrow indicating the suggested reverse clinker construction, and showing that the 'step' in the rib is not continuous across the floor-timber. At the extreme right end is a modern saw cut.

measurement with that of the total length of the large fragment which is about 1.70 m long.

More recently, Crumlin-Pedersen has suggested that what appears to have been a notch in the side of the floor-timber (Figs 5 and 16), may indicate that the boat had reverse clinker planking (Crumlin-Pedersen, 1965: fig. 10). Quite apart from the fact that there are no other notches in this or in the other boat fragments to suggest clinker planking, a careful study of timber no. 9 does show that this notch only occurs at one edge of the floor-timber, and that it is probably due to unequal splitting and shrinkage in an area of particularly complex tree-ring form (Fig. 17).

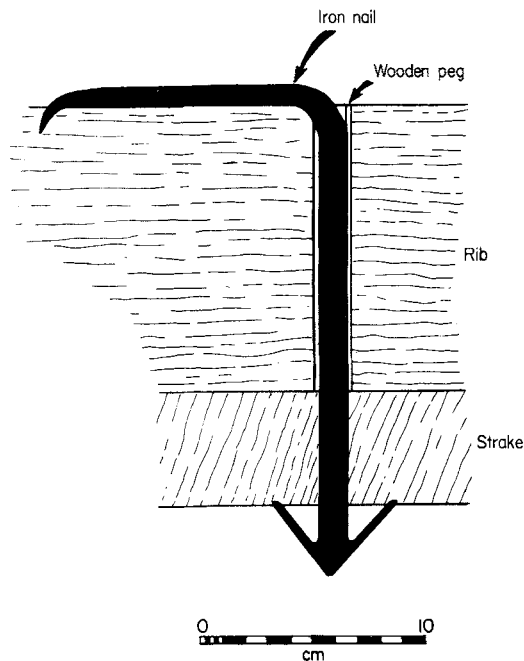


Figure 18. Blackfriars ship, London: section to show method of attaching plank (strake) to the rib.

10. *Floor-timber* (Fig. 20). The curving form in elevation of this timber, and its tapering at each end in plan, suggests that this was a floor-timber originally located near one end of the boat. The timber, which is probably of oak, has an uneven profile in elevation and it is not clear exactly what point overlay the centre line of the boat, especially as both ends of the timber are broken. A series of nail holes pierce the timber, and these are concentrated towards one end.

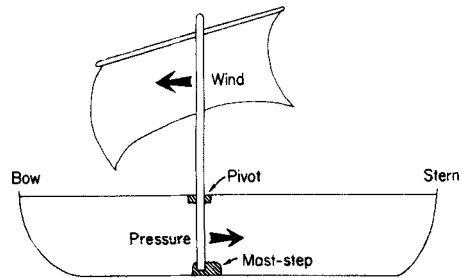


Figure 19. Sketch to suggest the reason for the mast-step socket being off-centre in the ribs of the Bruges and Blackfriars ships.

Jonckheere seems to have recorded this timber (Fig. 4: 4), but his impression bears little relationship to what now exists.

11. *Floor timber* (Fig. 20). This timber, which is probably of oak, is pierced by a series of nail holes from top to bottom. On its underside are two limber holes about 0.65 m apart, a measurement which is slightly shorter than the distance between the limber holes in the mast-step floor-timber (Fig. 10: 9). In spite of the fact that floor-timber no. 11 has almost certainly been considerably distorted, it seems that it may reflect a rounder bottom profile for the boat than is indicated by timber no. 9, and it is likely, therefore, that timber no. 9 was located nearer the centre of the boat than no. 11. Of particular interest are the slight changes in angle in the underside of the rib, these presumably reflecting the edges of the strakes below.

This timber was sketched by Jonckheere (Fig. 4: 5), who correctly recorded the width of the flat bottom as 1.30 m.

12. *Sternpost or stempost* (Fig. 20). Sample identified as oak (*Quercus* sp.). The timber has been so badly damaged that much of the evidence of its original form is now missing. Nevertheless it is clear that its curved longitudinal form is original since this is shown by Jonckheere (Fig. 4: 2), and that on each side there was a rabbet into which the strakes were fastened. Several nail holes exist in this rabbet indicating that the ends of the strakes were fastened with small iron nails. At one end the underside of this stem/sternpost has a pronounced V-profile, while the other end is clearly rounded. This may be compared with the stempost of the Blackfriars ship which was similarly shaped, the rounded part being at the lower end where it joined the bottom planking of the vessel.

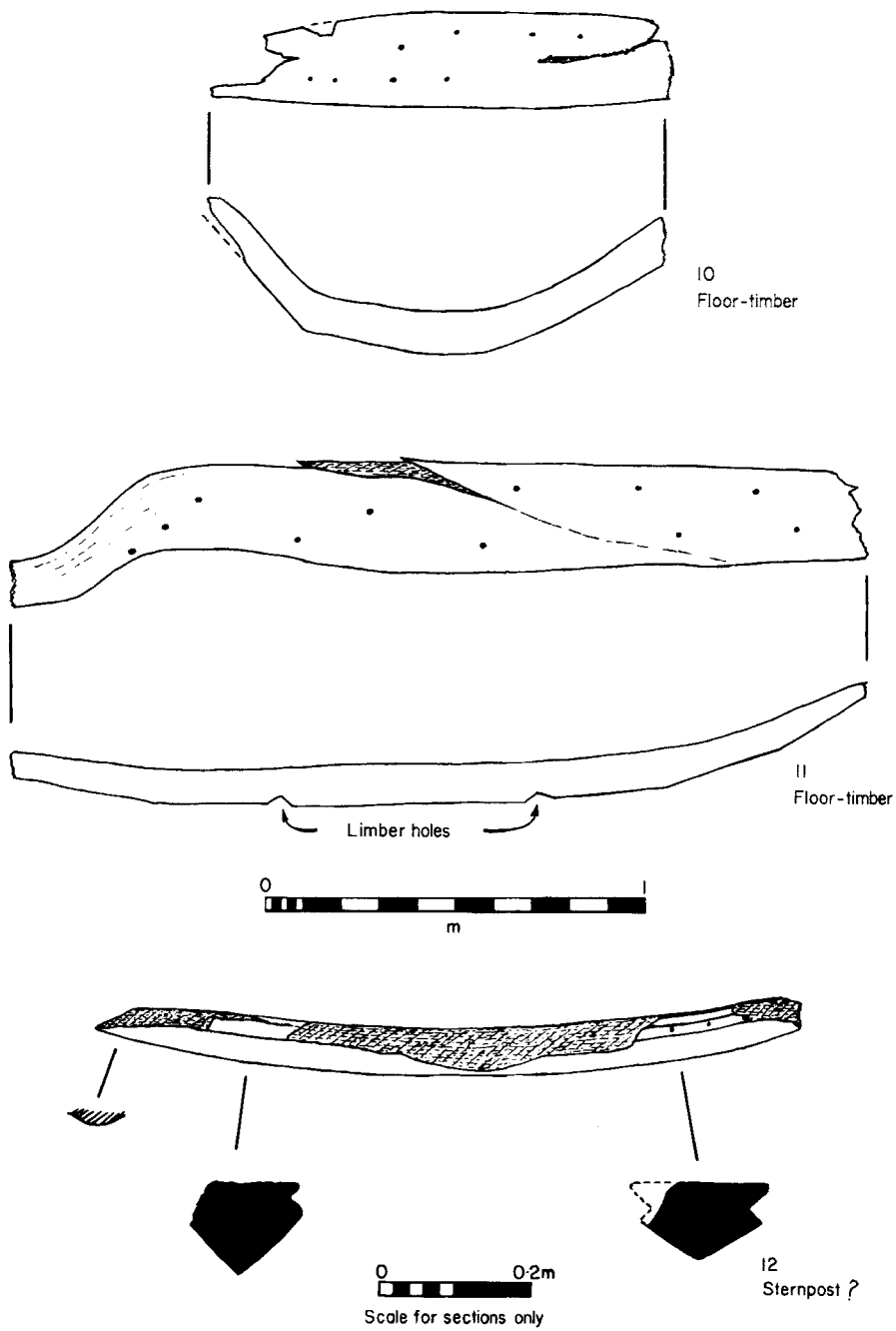


Figure 20. Bruges boat: nos 10, 11 – ribs; 12 – sternpost (?).

Jonckheere's drawing of this timber (Fig. 4: 2) is very poor as are all his sketches, and it does not show the rabbet. Nevertheless, he does record its length as 2.20 m, which shows that about 0.34 m is now missing from the ends.

13. *Two pieces of planking* (not illustrated). Two pieces of wood were recovered and are believed to be fragments of strakes. Both are of somewhat irregular shape, one being 1.44 m long, 0.24 m wide and 0.033 m thick; the other being 1.30 m long, 0.18 m wide and 0.05 m thick. There is no clear evidence of the places in the boat where these fragments were used.

Reconstruction and significance of the Bruges boat

Of the various attempts to reconstruct a cross-section of the Bruges boat, that which was briefly made by Ole Crumlin-Pedersen was until recently the only one which has been based upon a detailed examination of some of the timbers themselves (Crumlin-Pedersen, 1965: 142). Nevertheless, an extended study in detail of all the fragments does make it possible to draw alternative and more certain conclusions, particularly after the publication of the Blackfriars ship, the only parallel to the Bruges boat, since Crumlin-Pedersen's study. It must be remembered, however, that all of the pieces of wood must have shrunk and possibly been distorted due to drying, which increases the difficulty of making an accurate reconstruction.

Cross-section

The reconstruction of a cross-section of the

boat must depend upon the use of either of the two main floor-timbers (Fig. 10: 9 and Fig. 20: 11), though the latter seems to be somewhat distorted; and upon the two side frames (Fig. 7: 2 and 3). If the apparently relatively undistorted mast-step floor-timber (no. 9) is used, it is clear that the boat had a fairly flat bottom, and that the sides met that bottom to form an angle or chine of about 32° . Both side frames (nos 2 and 3) preserve at their lower ends a curving profile above which the sides are fairly flat. It is not known if the side frames were attached to the floor-timbers, or if they were located between the ends of the floor-timbers, as occurred in the Blackfriars ship; but whatever the case the side frames must largely reflect the form of the boat above the floor-timbers, though their level above the bottom of the boat is uncertain. As the dimensions of the boat were probably fairly small, to judge from the narrow flat bottom, it is likely that the gunwale was not much higher than is shown in Fig. 21. The oblique upper end of the frame (Fig. 7: 3) suggests that the side of the boat was inclined outwards at an angle as shown in Fig. 21.

The section of the boat *in situ* drawn by Rutot and de Lo   (Fig. 3) suggests that the vessel may have had a keel and a keelson. As the mast-step was situated in the floor-timber it is unlikely, though not impossible, that there was a keelson. On the other hand there is no other evidence to indicate whether or not the vessel had a keel, though the absence of a piece

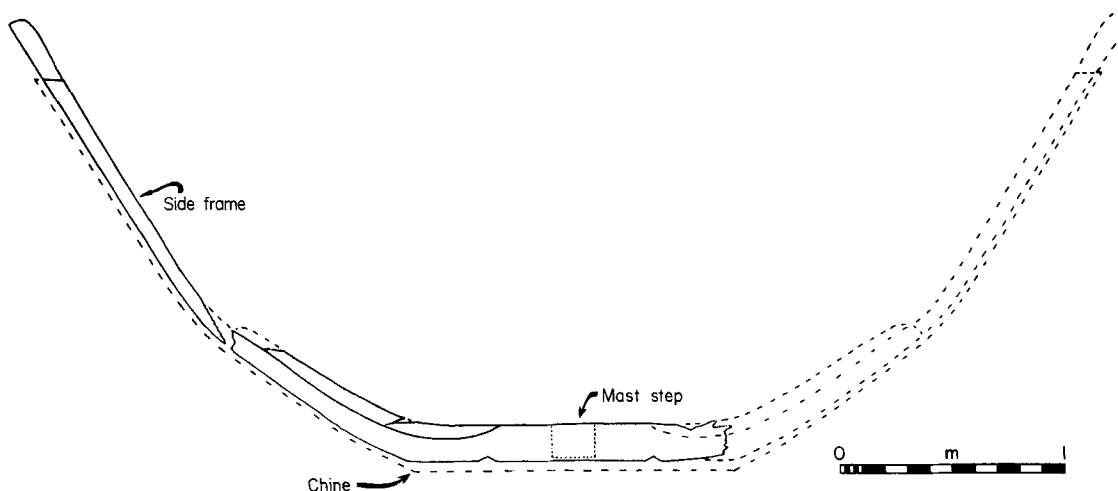


Figure 21. Bruges boat: suggested reconstructed cross-section.

of the keel, which would have been one of the longest timbers in the boat, amongst the pieces drawn on the site by Jonckheere, and the absence of a keel in Jonckheere's reconstruction (Fig. 4) made immediately after the discovery, does suggest that there was no keel. Perhaps the bottom of the boat was similar to that of the Blackfriars ship which only had broad bottom boards thicker than the other planks in the vessel, and it is possible that this is the significance of the thicker of the two fragments of planking (no. 13).

Stem or stern

The stem or sternpost (Fig. 20: 12) is of limited value as an indicator of the form of that end of the craft. Nevertheless, it is clear that the end was pointed, and that the post curved upwards from the flat bottom. The end of the craft from which this timber came is perhaps most likely to have been the stern, for apparently the other end had been destroyed before the boat was discovered, and, therefore, the steering oar could only have been found near the end from which the stem/sternpost timber (no. 12) was recovered; the oar, of course, may have drifted from its original position; its location in the wreck is no certain proof that it lay at the stern.

The form of planking

Because all previous reconstructions of the Bruges boat have assumed that the vessel had clinker planking (Fig. 5) it is necessary to consider why this is unlikely. Essentially there are two forms of evidence, firstly, the actual timbers which preserve no trace of having included clinker planking and, secondly, because the boat is of a type which is closely paralleled by the carvel built Blackfriars ship in London.

The evidence of the boat fragments indicate that the vessel was carvel built, for the ribs are smooth where they originally lay adjacent to the outer skin planking, and have no trace of steps to take overlapping strakes as is normally found in clinker built craft. In addition, it is likely that if the vessel had been clinker built some of the rivets would have been retained, though it is remotely possible that the clinker planking could have been held together by wooden pegs or by being sewn. On balance,

however, apart from the possible reverse clinker construction suggested by Crumlin-Pedersen and discussed above, there is absolutely no evidence to suggest that the Bruges boat was other than carvel built.

Steering

The method of steering the boat was evidently by the great steering oar (Fig. 6: 1), which, judging from the tiller position recorded by Jonckheere (Fig. 4: 12), was mounted on the quarter. No certain trace of any fittings were seen either on or in the oar to indicate how it was attached to the side of the boat; as it was measured and drawn while on display and attached to a wall of the Museum in Antwerp, it was possible to see only one face. The recessed area at the junction of the loom and the blade may have existed to take a rope lashing by which it was held to the side of the boat, and it is possible that the post at the top of the side frame (Fig. 7: 3) was one of the fittings to which the steering oar was tied. It is perhaps worth mentioning here that the steering oar seems to be rather large for the size of boat envisaged, though otherwise there is no reason to doubt that the oar belongs to the boat.

Mast

It was normal for small sailing vessels within the Roman Empire to have a single mast on which was mounted a square sail, and it would seem that even in the northern provinces where local shipbuilding traditions existed, this was still the normal practice. It is worth noting a variation of this type of rig which is known only from contemporary Roman representations discovered in the Rhineland region. They show two vessels which carried square sails braced with several transverse beams or stretchers (Fig. 22) somewhat as occurs in the sail of a Chinese junk. Detlev Ellmers has suggested that the sails were made of leather, which is a novel and convincing idea to explain a most curious rig (Ellmers, 1969: pl. 16.1).

The discovery of most of the mast of the Bruges boat renders this vessel unique amongst excavated ships and boats of the Roman period, and it is a great pity that only the top of the mast now survives. Nevertheless, this is probably the most important part for it makes

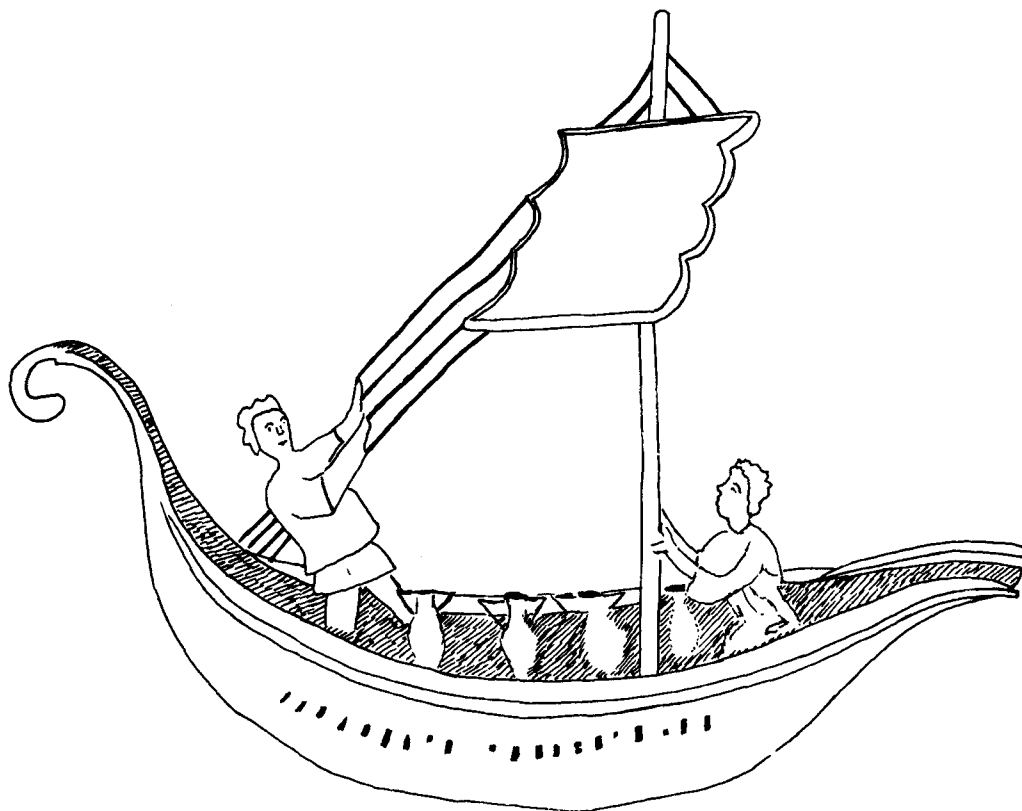


Figure 22. Boat with possible leather sail and a cargo of amphoras, from a mosaic of the mid-3rd century AD at Bad Kreuznach, Germany. (From a photograph in Ellmers, 1969)

possible an attempt to reconstruct some aspects of the rigging. Although Jonckheere shows that the mast was broken into several pieces and was at least 9.30 m in length (Fig. 4: 8–11), he misses a feature that was fairly prominent. This is the square shaping around a pair of slots located near the top of the mast. His drawing does show, however, the single slot that lay above this, and it is likely that he is correct in representing the mast as generally circular in section.

The single slot passing through the mast just below its top is probably best interpreted as containing the stay or fore-and-aft cable which helped to keep the mast in a central, upright position, the ends of the cable being fastened to the stem and stern. Below this the two adjacent slots in the square thickening of the mast probably contained the halyards by which the yard was hauled up the mast; and it may be assumed that there was some form of loose attachment, such as a loop of rope, by which

the yard was held close to the mast (Fig. 23). It is at present impossible to judge if any of the slots contained pulley wheels, though closer examination of the single upper slot may give an answer. Particularly interesting is the axis of the lower slots which is a little different from that of the upper slot, and it may be inferred that the rest position of the yard at an oblique angle to the central axis of the vessel was intentional (Fig. 23).

Other early craft in central and northern Europe

The Bruges boat is one of at least 14 plank-built vessels of the 1st to the 4th centuries AD which have been found in central and northern Europe. Amongst them, however, there is only one certain parallel, and that is the ship of the 2nd century AD which was found in the bed of the Thames at Blackfriars (Figs 24 and 25), London (Marsden, 1966).

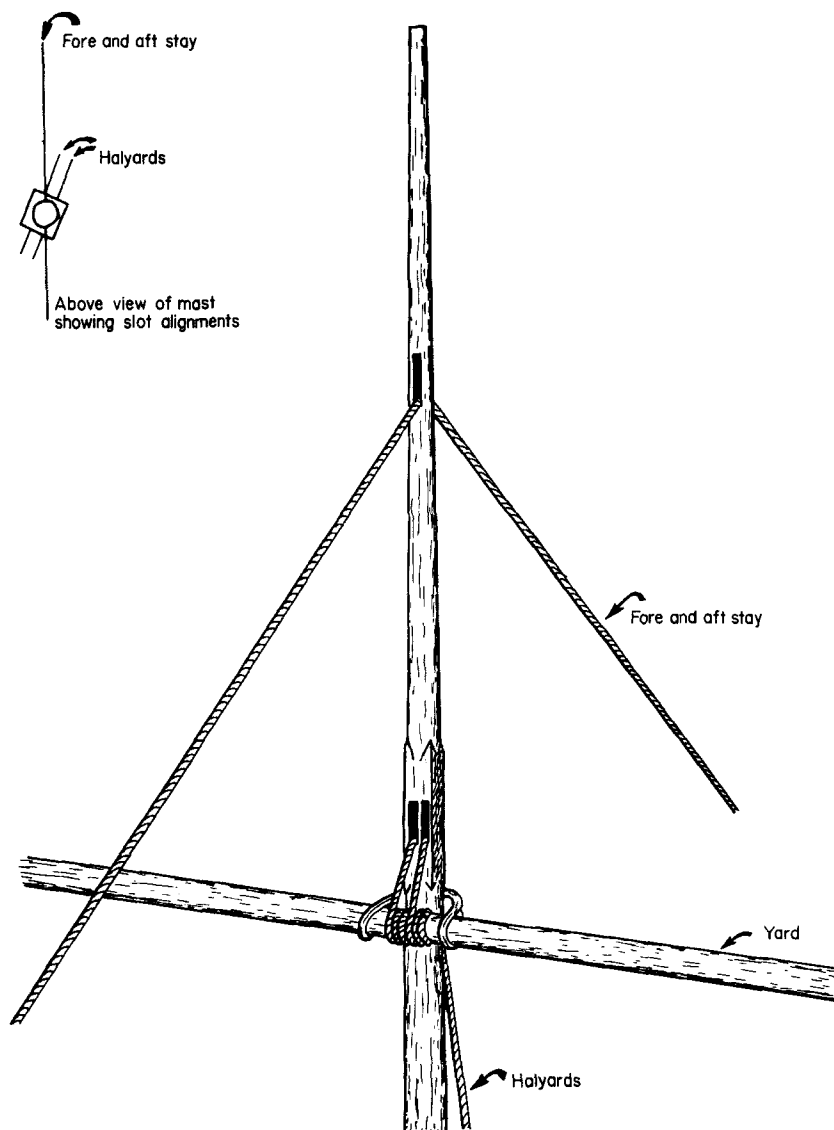


Figure 23. Bruges boat: reconstruction of mast-head.

The distinctive features which the Bruges and Blackfriars vessels have in common are:

1. The unusual shaping of the floor-timber containing the mast-step.
2. Clenched iron nails which have been driven through wood pegs already inserted into the floor-timbers.
3. Massive size of the timber elements.
4. The flat bottom and the sides which meet it to form chines.
5. Pointed bow and/or stern.

6. Carvel planking.

7. No keel (?).

These are features which collectively do not occur in either the early Mediterranean or in Scandinavian ships, and there can be little doubt that they represent a Celtic shipbuilding tradition which was native to some part of north-west Europe. It is difficult to define the region, however, because the Blackfriars ship and probably the Bruges boat were sea-going craft and there is no means of knowing how

far they had travelled from their area of construction. Indeed, the planking of the Blackfriars ship contained borings of the marine creatures *Teredo* and *Limnoria* showing that it had been working in a marine environment for some time prior to its loss in London while carrying a cargo of building stone from quarries near modern Maidstone, in Kent (Marsden, 1966: 39–41). There is thus no evidence to show that the ship had even been built in Britain.

A sufficient number of ships of the Roman period have now been found to suggest a meaningful distribution, particularly as some vessels were river craft and thus their region of construction is limited to the rivers in which they were found. There are, however, huge

areas of north-western Europe, particularly France, western and northern Britain and Ireland, where no vessels of this period have been found and therefore little or nothing is known of the boat types which frequented those regions. The best hope for finding the region in which ships of the Blackfriars and Bruges type were built lies in the probability that the yards in which they were constructed also produced local river craft, and that these vessels included some of the distinctive elements that were used in the sea-going vessels.

The discoveries of plank-built vessels dating from the 1st to 4th centuries AD and found in central and northern Europe, may be classified into six main types, each with its own distinctive form and construction (Fig. 27). The

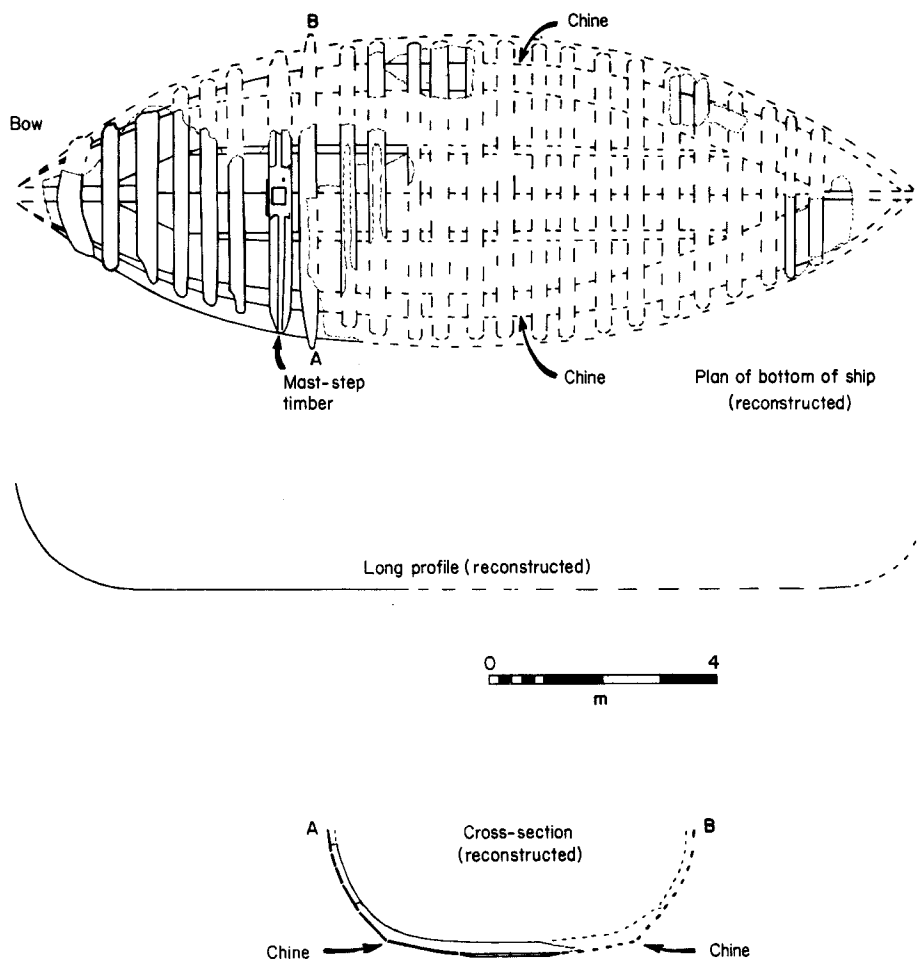


Figure 24. Blackfriars ship: partly reconstructed plan, long profile, and cross-section of this 2nd century ship.

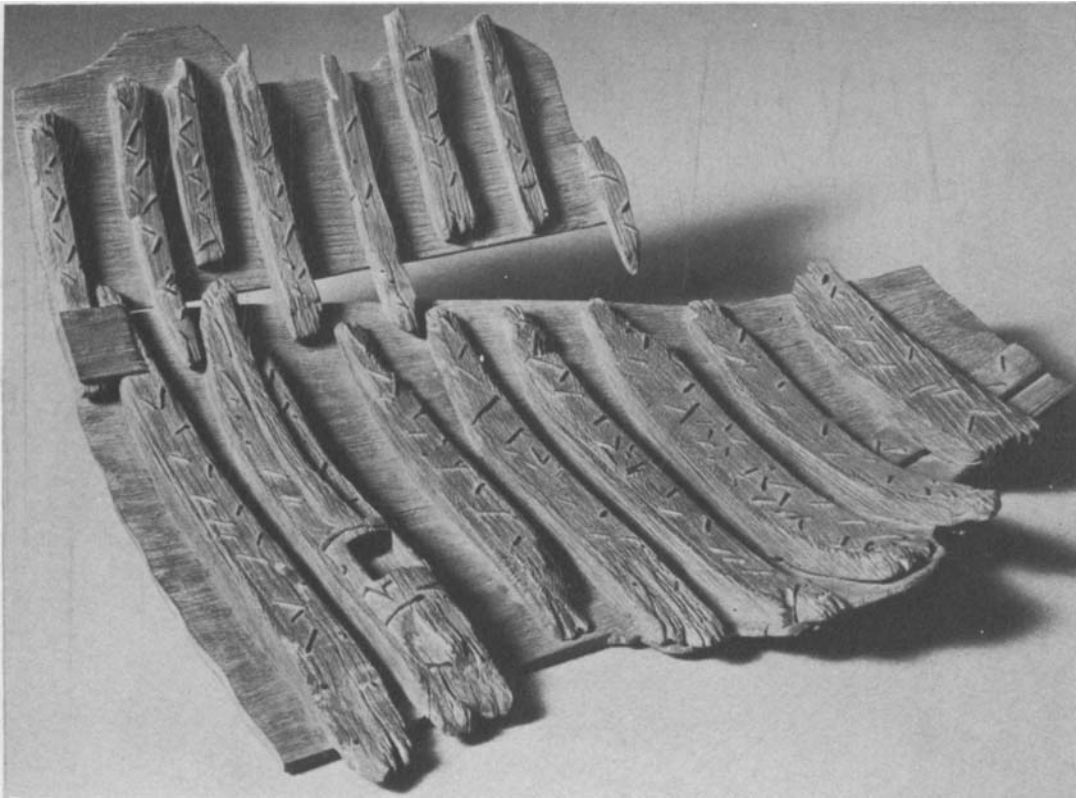


Figure 25. Blackfriars ship: model made by the Science Museum of part of the ship remains, including the mast-step floor-timber (second rib from left). The bow is to the right. (Courtesy of the Science Museum.)

types described here are as follows — Blackfriars type, Zwammerdam type, New Guy's House type, Utrecht type, clinker type and Mediterranean type.

Blackfriars type

The distinctive features have already been described and discovered vessels of this type are:—

1. Blackfriars ship, London (Fig. 24). A sea-going sailing ship of the 2nd century AD (Marsden, 1966).
2. Bruges boat, Belgium. Probably a sea-going sailing vessel, dated by C-14 to AD 180 $\pm$ 80 years (ref. this report).

Zwammerdam type

The name of this type is taken from the modern settlement of Zwammerdam, near Rotterdam, in the Netherlands, which lies on

the old silted course of the Rhine. On the former south bank of the river lay the 1st century Roman fort of *Nigrum Pullum*, and at its edge the remains of three Roman vessels of this type have recently been found and studied by Amsterdam University.

Ships of this type were long, flat-bottomed river barges, with no keel, and which could be of very great size. They had long, low, vertical sides which were often parallel to each other and sometimes built of overlapping planks (Figs 28 and 29). The ribs mostly comprised single pieces of L-shaped timber which were sometimes used in pairs, though the long side of each was attached to the bottom of the boat by iron nails, usually clenched, while the short, vertical pieces of each pair supported opposite sides of the vessel (Fig. 29). An additional side timber sometimes existed to strengthen the unsupported end of the L-frame. A particularly distinctive feature of this type of vessel was the

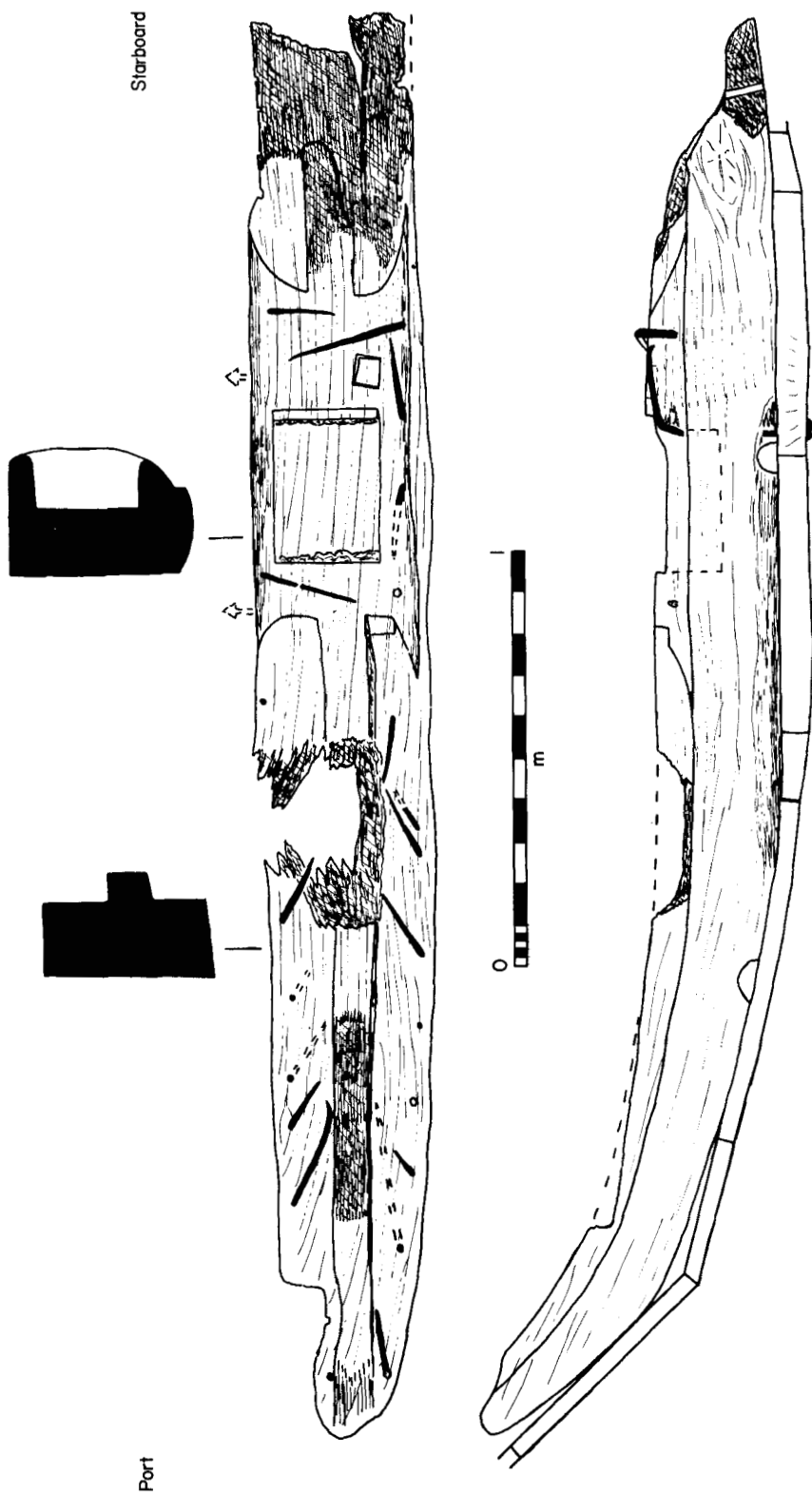


Figure 26. Blackfriars ship: the mast-step floor-timber or rib, and the underlying planking.

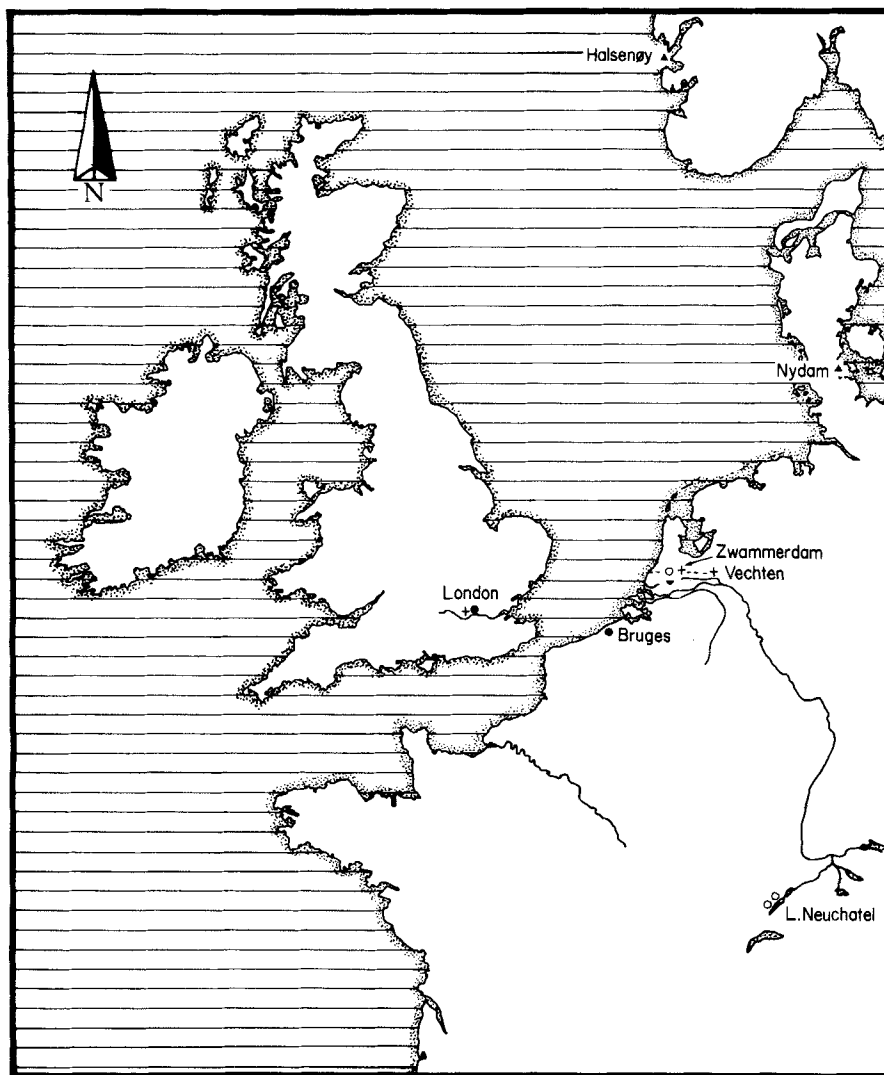


Figure 27. Distribution of ship types of the 1st to the 4th centuries AD in central and north-west Europe.
 ●, Blackfriars; ○, Zwammerdam; ▲, Clinker; +, Mediterranean; ▼, Utrecht.

plank which was L-shaped in section and was cut from a single piece of timber to form the right angled junction between each side and bottom of the craft. This suggests that the Zwammerdam type belonged to a very primitive group of vessels which had developed from dugout craft of the 'Utrecht type', the dugout having been split longitudinally to form the two L-shaped planks, so that additional planks could be inserted between them to give the vessel a wider bottom (Landström, 1961:

54, no. 129). Near one end of each of these vessels is sometimes found a small, rectangular socket, its small size being out of all proportion to the size of the vessel. This socket was cut either into a keelson or into a rib and it is presumed that this once contained a small mast or a towing post. The socket cut into the floor-timber (Fig. 28) is somewhat similar to the mast-step timbers in the Bruges and Blackfriars ships, in that it usually lies in a raised central part of a rib.

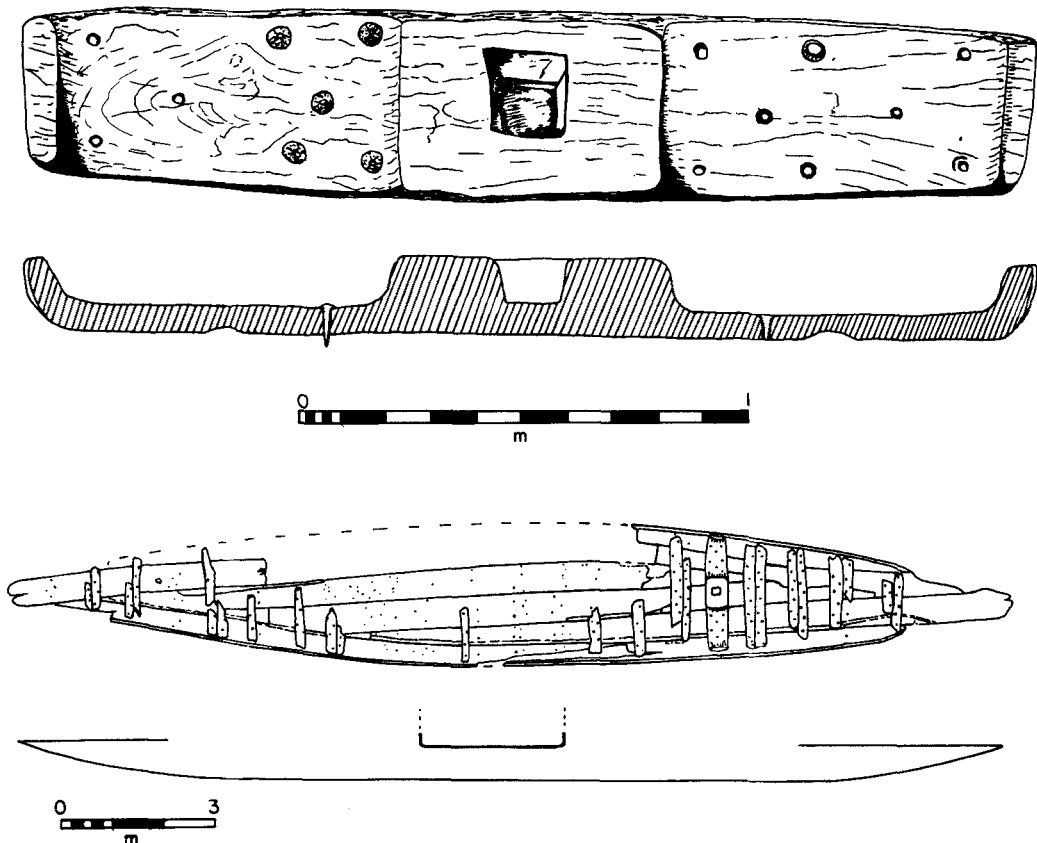


Figure 28. Bevaix boat, Switzerland: the mast-step timber (upper drawing), and a plan with long and cross profiles of the boat (after Arnold, 1974).

Discovered vessels of this type include the following:—

1. Zwammerdam ship 2 (Fig. 29). A medium sized Roman river barge more than 22 m long, the 'mast-step' of which was located in a keelson (de Weerd & Haalebos, 1973: 393–5).
2. Zwammerdam ship 4. A very large Roman river barge about 37.50 m long, the mast-step of which was situated in a rib (de Weerd & Haalebos, 1973: 397).
3. Zwammerdam ship 5. Another large Roman river barge which is mostly unexcavated (unpublished information from M. de Weerd).
4. Kapel Avazaath ship, near Zwammerdam, Netherlands. A large river barge, originally probably about 35–40 m long, which is dated by C-14 to AD 130 ± 30 (Kooijmans, 1968).
5. Bevaix boat, Lake Neuchâtel, Switzerland (Fig. 28). A medium sized river barge about 19.40 m long, which has been dated by C-14 to AD 90 ± 60. The 'mast-step' is located in a rib (Arnold, 1975).
6. Yverdon boat, Lake Neuchâtel, Switzerland. A river barge about 20 m long, which is of 1st century date (Weidmann & Kaenel, 1974).

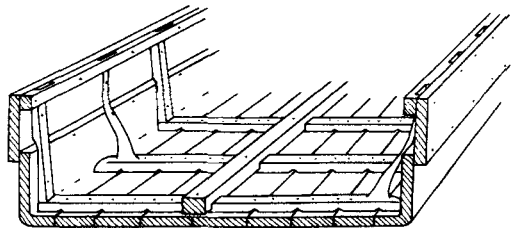


Figure 29. Zwammerdam ship 2, Netherlands: construction drawing (after de Weerd & Haalebos, 1973.)

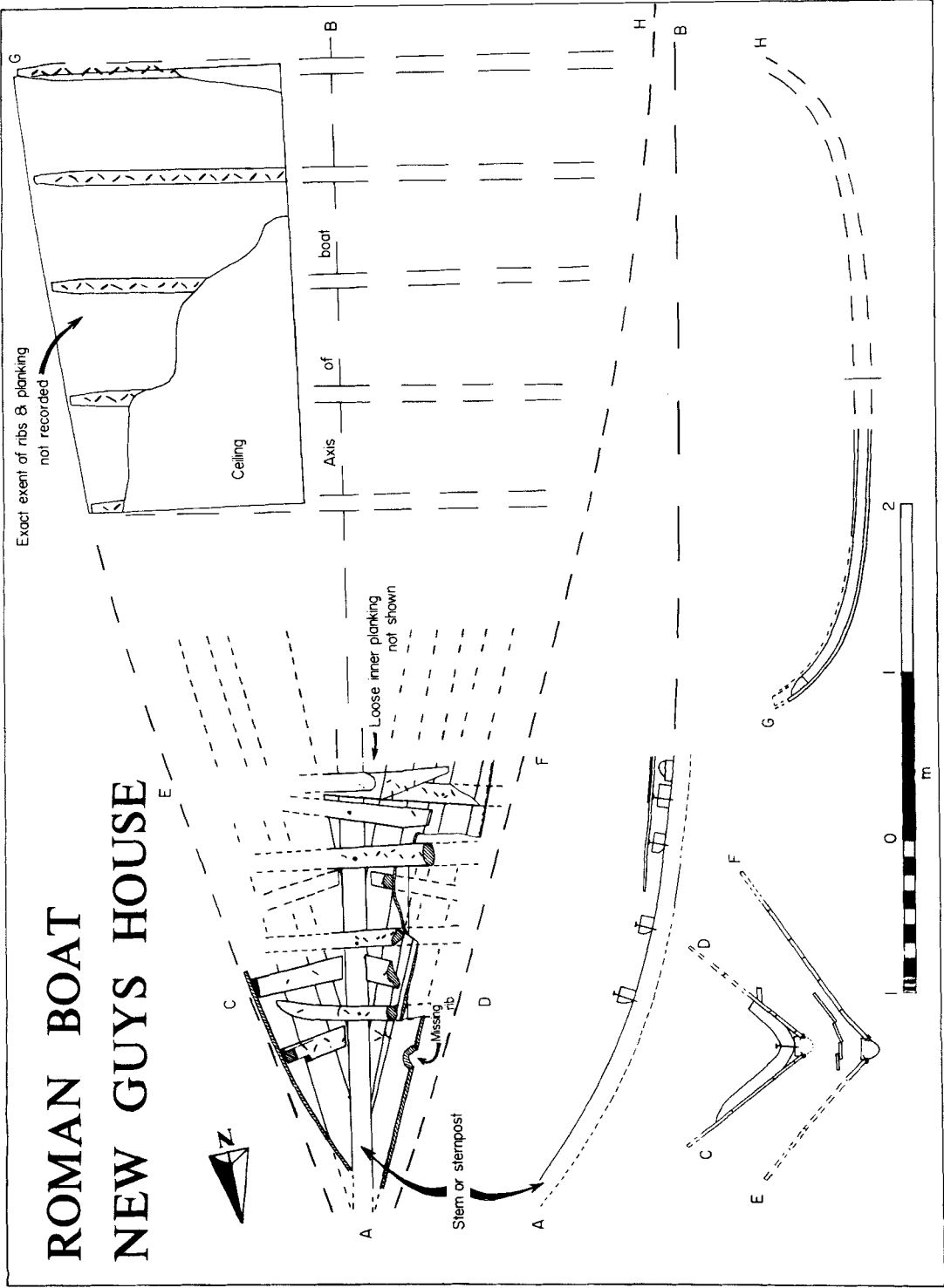


Figure 30. New Guy's House boat, London: river barge of the 2nd century AD.

New Guy's House type (Fig. 30)

This type is named after the site at Guy's Hospital, London, where the only example has been found. It was a river barge with a low freeboard, and was dated by pottery to the 2nd century AD. Unfortunately, it has only been partly excavated, but this preliminary work has shown that it was carvel built, and that its sides curved down to form the bottom of the vessel. In plan the sides seem to be of rounded form. It is not known if it had a keel, or if it was propelled by sail or oar. On the other hand it had an upward curving stem or sternpost, unlike the Zwammerdam type of ship, but its planks were held to the ribs by clenched iron nails like the Zwammerdam and Blackfriars ships.

New Guy's House boat (Fig. 30). A river barge of the 2nd century AD (Marsden, 1965).

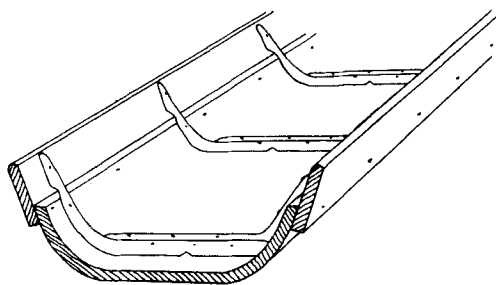


Figure 31. Zwammerdam boat 3, Netherlands: construction drawing (after de Weerd & Haalebos, 1973.)

Utrecht type

The name of this type is taken from a post-Roman vessel which was found in Utrecht, Netherlands, in 1930, and was preserved in the Centraal Museum in Utrecht (Philipsen, 1965). Although of later date (8th or 9th century AD) than the period under study, it is basically of the same type as a boat of the 2nd century AD which was found at Zwammerdam, nearby, in 1971–2 (de Weerd & Haalebos, 1973: 396). The type is extremely primitive in shipbuilding for it is essentially a craft with a dugout bottom and plank-built sides (Fig. 31). In the case of Zwammerdam boat 3 each side was heightened by one plank which overlapped and was nailed to the upper edge of the dugout. The much larger ship of

this type from Utrecht has been dated by C-14 to AD 790 $\pm$ 45 years, and was a vessel 17.8 m long and about 4 m broad. This had three 'planks' above its dugout bottom, and the dugout itself was an enormous single piece of oak measuring 14.3 m long and up to 1.93 m broad. The type continued in use into the Middle Ages as is indicated by the discovery of a boat, believed to be of the 11th century, found at Antwerp in 1905 (Hasse, 1907: 8–14; Ellmers, 1969: fig. 10). The only example of this type dating from the 1st to 4th centuries AD is:

Zwammerdam boat 3 (Fig. 31). A boat of the 2nd century AD, measuring 10.50 m long (de Weerd & Haalebos, 1973: 396).

It is of interest to note that a dugout canoe, also of the 2nd century AD, was found at Zwammerdam (boat 1) and that as this had no planking to heighten the sides, it might be considered to be the ancestral type from which Zwammerdam boat 3 developed (de Weerd & Haalebos, 1973: 392).

Clinker type (Fig. 32)

The only nearly complete example of this type, dating from the 4th century AD, is the Nydam boat from near the German-Danish border (Fig. 32); while from about two to three centuries later there are many more boat finds, particularly in graves, which show that the clinker tradition represented by the Nydam boat was then widespread in Scandinavia (Müller-Wille, 1974). Dating from the 1st or 2nd centuries AD, traces of a decayed clinker built boat have been found at Halsenøy, south of Bergen, Norway, in which the planks had been sewn together (Christensen, 1972: 162–3). Indistinct traces of other early vessels of the 1st and 2nd centuries AD are said to have been found on the Danish island of Bornholm (Christensen, 1972: 162), though due to decay their details of construction are unclear.

The characteristic feature of the clinker type of ship tradition is the overlapping planking, each of which was held to its neighbour either by iron rivets or by sewing. The strakes and ribs were tied together to create a hull form that was curved in section without a flat bottom. Examples of this type are:

Halsenøy boat, Norway. 1st–2nd century AD (Christensen, 1972: 162–3).

Nydam boat, N. Germany (Fig. 32). 4th century AD (Åkerlund, 1963).

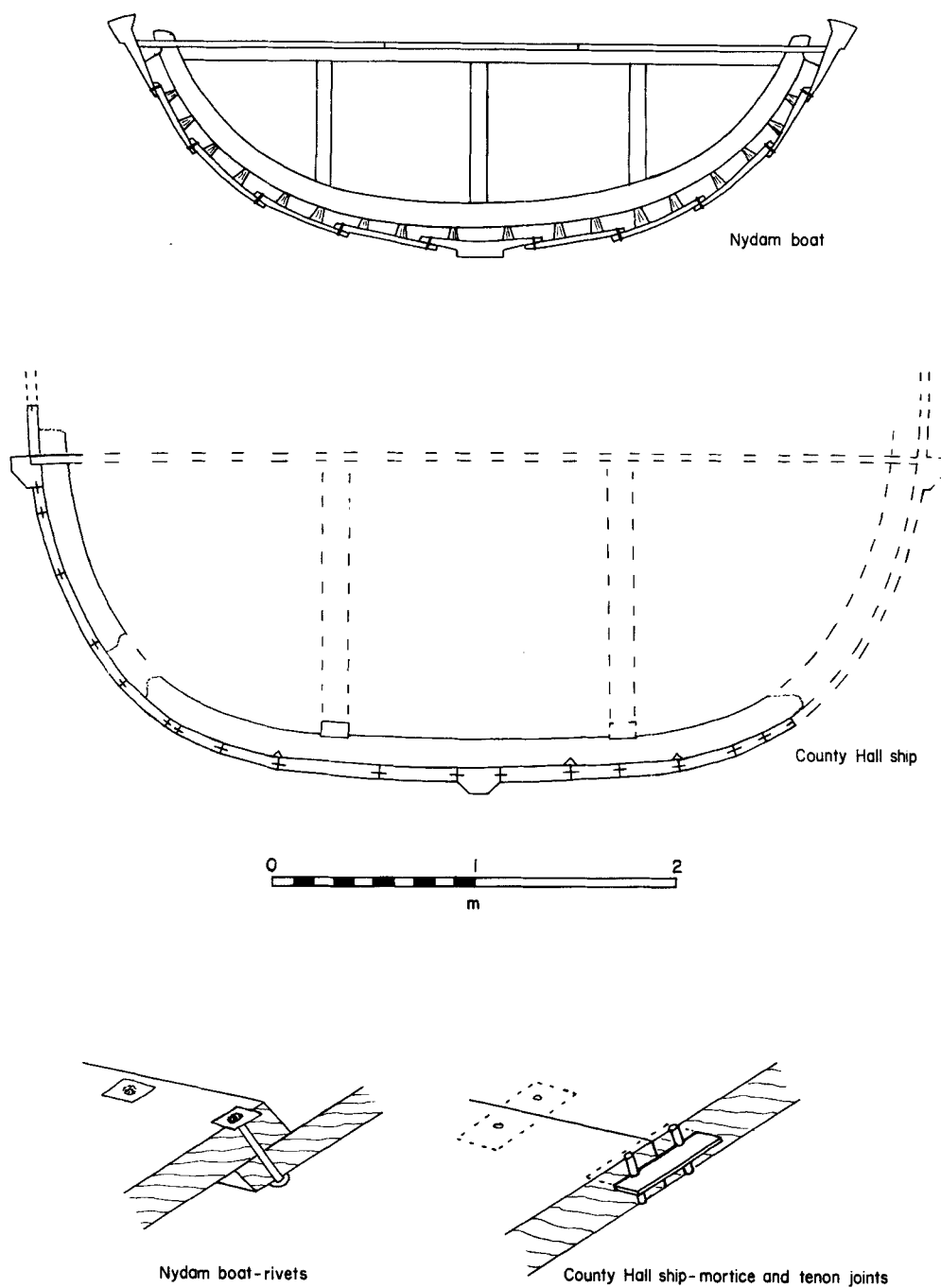


Figure 32. Cross-sections of the Nydam boat and the County Hall ship, with sketches (not to scale) showing the methods of holding the planks together.

Mediterranean type (Fig. 32)

Vessels of the Mediterranean shipbuilding tradition have been found in north-west Europe within the bounds of the Roman Empire, and it is to be expected that some examples of this otherwise alien tradition should be found in the northern provinces. The characteristic feature of this tradition, the carvel planking held edge-ways by mortise-and-tenon joints (Fig. 32), has occurred in all Greek and Roman ships so far found in the Mediterranean basin, dating from as early as the 4th century BC (Throckmorton, 1972). Parts of three vessels of Mediterranean type have been found in north-west Europe, while in addition a fine steering oar with this mortise and tenon construction has been found at Zwammerdam, Netherlands. The ships are as follows:

County Hall ship, London (Fig. 32). A ship with a beam of about 5 m, dating from the 3rd century AD (Marsden, 1974).

Vechten boat, near Utrecht, Netherlands. A small boat of the 1st century AD (Müller, 1895).

Zwammerdam ship 2a, Netherlands. A small portion of planking of a Roman vessel (de Weerd & Haalebos, 1973: 395–6).

Discussion

Ships of the Blackfriars, Zwammerdam, Utrecht and New Guy's House types seem to be examples of a family of Celtic shipbuilding traditions, which, although varying in form and construction, contain many similarities in construction technique which link them together into a general group. It is these similarities which set the Celtic traditions far apart from the distinctive clinker tradition of Scandinavia, and the carvel tradition of the classical Mediterranean.

The major difference between the Celtic traditions and the clinker and Mediterranean traditions is that in the two latter the ships were largely 'shell-built', while the former was built in a complex and different method for which there is no single descriptive term, though it included elements of 'skeleton' construction.

The construction of the 'shell-built' boats of Scandinavia and the Mediterranean, which required the hull to be built firstly of planks to

which the ribs were added as strengthening pieces, depended upon the planks being attached to each other, in the case of the carvel built Mediterranean ships by mortise-and-tenon joints (Fig. 32), and in the clinker boats by sewing or by iron rivets which held the overlapping planks together (Fig. 32). Rivets, sewing and mortise-and-tenon joints are completely absent from Celtic ships so far discovered, though the side planks in some of the Zwammerdam ships, and in the vessel of Utrecht type from Zwammerdam, were nailed together in an overlapping, though not truly clinker form (Fig. 29), indicating that they were built by a completely different method of construction from that of Scandinavia. Instead, their flat bottoms were built somewhat like rafts with massive planks nailed to ribs to hold them in position, while the side planks generally seem to have been nailed to a pre-erected 'skeleton' of ribs (Fig. 33).

Here, however, a word of caution is required for it is *just possible* that the Blackfriars ship was partly 'shell-built', the side strakes possibly having been held to each other by temporary nailed-on wooden battens which were removed after the ribs had been inserted (Hasselöf, 1963: fig. 8). However, this is unlikely to have happened if one considers the thick planking, and the system of frames which seems to have been designed to support the side planks rather than hold them in position during the construction stage. The possibility of battens having been used can only be resolved by trying to detect the small nail holes on the exterior surface of the planking, but this requires a degree of detailed study which has not been possible with the Blackfriars ship.

A careful study of the various Celtic vessels indicates considerable similarities in the construction methods used — especially in the bottoms of the ships. Although fragmentary the timbers of the Bruges boat indicate that the method of construction was probably no different from that of the Blackfriars ship. In the latter vessel it seems that the constructional procedure was as follows (Fig. 33): 1. The bottom planks and stem and sternposts were laid out first so that there was access for working below to hammer nails into the hull. 2. Next the floor-timbers or bottom ribs were laid on top of the bottom planks and were nailed in position. 3. The lowest strake of each

side was nailed to the upward angled ends of the floor-timbers. 4. The lower ends of the side-frames were nailed to this strake, presumably while being braced by thwarts or deck beams at the top. 5. Finally, the side strakes were nailed to the side frames.

Unfortunately, not enough has been excavated of the New Guy's House boat to show how it was built (Fig. 30), but the fact that its strakes were fastened to the ribs by clenched iron nails does indicate that it was built somewhat similarly to the Blackfriars ship.

The construction of the Zwammerdam type of vessel is rather different, for although the

bottom planks, including the L-shaped chine timbers, were laid out in position so that there was working space below (Fig. 33, lower 1), before the ribs were nailed into position to hold the bottom planks together as in the Blackfriars ship (Fig. 33, lower 2), it seems that the sides were a little differently built. The ribs themselves were L-shaped, the short end being used to support the sides, and in Zwammerdam ships 2 and 4, it was to these that the planks were joined so that they overlapped each other (Fig. 29) and were nailed together. This method of construction is completely different from the Scandinavian clinker built boats, for the ribs were already in position before the side planking was erected (de Weerd & Haalebos, 1973: fig. 13).

In the case of the Bevaix and Yverdon boats, however, the strake above the L-shaped chine timber, although missing in the Bevaix boat, was clearly fitted edgewise to the L-timber (Fig. 33, lower 3) because traces of caulking were found on the upper edge of that timber in the Bevaix boat (Arnold, 1975: 123); the upper strake was found in the Yverdon boat, and the upper planks could only have been held in position by pre-erected ribs. It would be particularly interesting to know exactly how the sides of the Zwammerdam ships were fastened so as to understand if the planks were overlapped primarily for strength or for water tightness, though the carvel construction of upper planking in the Bevaix and Yverdon boats suggests that the latter was more important.

The stages in the construction of the Utrecht type are uncertain and must depend upon a detailed study of Zwammerdam boat 1, and a re-appraisal of the Utrecht ship. Nevertheless, it seems probable that the ribs were inserted into the dugout bottom before the side planks were added.

Thus although it is clear that the Blackfriars type of vessel was unlike either the clinker or the Mediterranean shipbuilding traditions, there are strong similarities, particularly between the Blackfriars, New Guy's House and Zwammerdam types. Much more study is required of the Utrecht type before it can be fully considered. The features that the Blackfriars, Zwammerdam and New Guy's House types of vessel seem to have in common may be summarized as

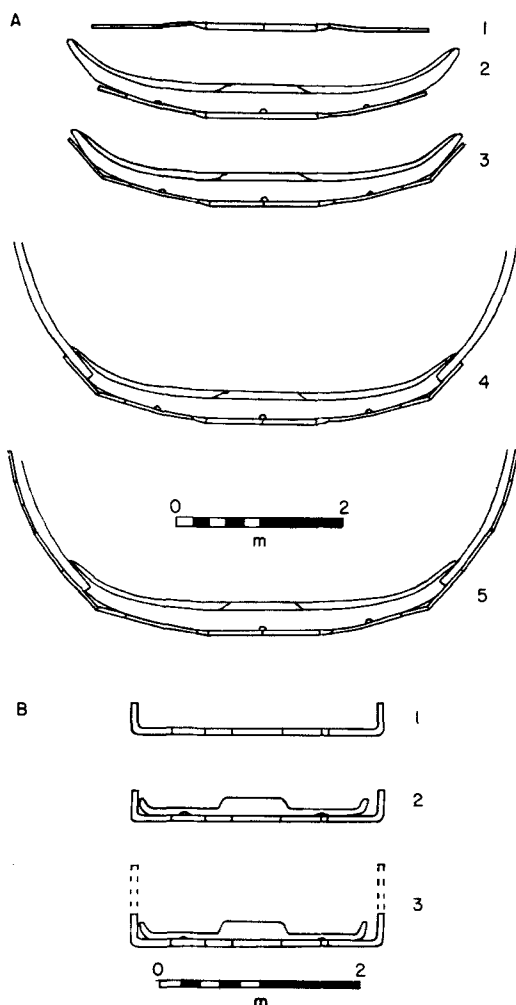


Figure 33. Probable stages in the construction of the Blackfriars ship and the Bevaix boat.

follows: firstly, with the exception of the New Guy's House boat which has not been fully studied, the bottoms of the ships have a similar planks first construction with no keel; secondly, the sides seem to have had a ribs first construction; thirdly, the timbers used are usually of massive proportions for the size of vessel; fourthly, the ribs and planks are usually held together by clenched iron nails; and fifthly the masts (or in some cases possibly towing posts) of four of the ships (Bruges, Blackfriars, Zwammerdam 4 and Bevaix) were surprisingly situated on ribs, the three published mast-step ribs (Bruges, Blackfriars, Bevaix) having a somewhat similar unusual form, each with a central raised area, suggesting a common ancestry. In addition, except for the New Guy's House boat, the vessels all have chine-built sides and reasonably flat bottoms.

The similarities between the Blackfriars and New Guy's House types seem to be stronger than those between the Blackfriars and Zwammerdam types. Not only did both the Blackfriars and New Guy's House types have upward curving stem and/or sternposts, but they were also very beamy for their length and carvel built throughout. Both the New Guy's House and Blackfriars ships have an unusual caulking material of hazel twigs, which is perhaps indicative of a common source, though, alternatively, this may only reflect the area in which the vessels worked, since the caulking may have been a later repair to both vessels. On the other hand it can be argued that the New Guy's House boat must have been built on the Thames or one of its tributaries, because its low freeboard would make it unlikely to have sailed in the sea, and the hazel twig caulking should, therefore, have been undertaken in that region. The Blackfriars ship, which was very carefully investigated and dismantled for study, was extensively caulked with hazel twigs and it is likely that at least some of this was original caulking. If this is correct it suggests that the ship may have been built in the same region as the New Guy's House boat. The caulking of hazel twigs certainly contrasts with the Zwammerdam vessels which were caulked with other materials such as moss; and it is in such minor details as this that there are probably the strongest pointers to the region in which the shipbuilding tradition was practised. This emphasizes the

need to take special note of the apparently small constructional details during the investigation of early ships such as these.

Clearly more early ships need to be found in north-west Europe especially west of the Rhine, before anything more than a very tentative conclusion can be reached; but on the basis of the present evidence it seems reasonable to conclude that the Blackfriars, Zwammerdam and New Guy's House types of vessel all belonged to a family of Celtic shipbuilding traditions, and it is likely that others existed, such as the *pictae*, a native type of vessel used by the Romans in Britain during the 4th century AD (Vegetius, *De re militari*, iv, 37; Lewis, 1958: 45–8). It would also seem that the Blackfriars and Bruges boats have more affinities with south-east England than with the Rhineland. Indeed, it is likely that here we have a measure of confirmation for Julius Caesar's comments about the ships of the Veneti in north-west Gaul, whose massive oak constructions with large iron nails, and whose flat bottoms accord well with what is known of the Blackfriars type of ship (Caesar, *De bello gallico*, III.13).

The possible significance of these Celtic ships in the overall history of shipping is at present difficult to assess. The suggestion that the late Bronze Age boat from Brigg in Yorkshire may have been ancestral to the Blackfriars ship tradition (Basch, 1972: 42; Wright, 1947, 1965) requires comment, for without denying this attractive possibility it is perhaps unwise in our present limited state of knowledge concerning pre-Roman craft, to link two vessels whose ages are probably between 700 and 1000 years apart (McGrail, 1975) without having some other boats to help bridge the time gap. Once again this underlines the need for more ancient craft to be investigated.

On the other hand there are rather more vessels of the Roman period and later in northern Europe, and basing his argument primarily on these Crumlin-Pedersen has pointed out that the Bruges boat is representative of the basic form from which the medieval cog might have developed (Crumlin-Pedersen, 1965: 142). Recent investigations tend to confirm this, even though definite 'missing links' between the Roman period and the Middle Ages need to be found, particularly

in England and in the Low Countries. Not only was the flat bottom widely used in the ships of Celtic peoples in Europe, but also some of the Zwammerdam type vessels show that the overlapping planking, though not of the clinker type which was found in the medieval cog, was not completely alien to the regions south of Scandinavia during the period under study. In

conclusion, therefore, it is clear that in the Blackfriars and Bruges vessels we have the only pre-medieval candidates so far known which might be considered to have been the ancestral ship form which developed into the cog, a type of vessel which was to become one of the most important trading craft in medieval Europe (Flidner, 1969).

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Glossary

Chine	The angle of intersection between the sides and bottom of a flat-bottomed boat.
Floor-timber	The lowest transverse rib in a ship.
Keelson	A fore-and-aft member of a ship's structure, lying on the bottom of the vessel and usually on top of the ribs.
Limber holes	Channels or waterways cut in the underside of a rib to allow bilge water to flow to a central collecting point where it may be pumped overboard.

Loom of an oar	The shaft between the blade and the handle.
Mast-step	The socket to receive the heel of a mast.
Rabbet	A channel or longitudinal recess cut in the face of a timber to receive another timber or plank.
Side frame	A rib supporting the side of a ship.
Strake	A line of planks running the length of a ship.
Thwart	Transverse timbers between the side of a ship, sometimes used as seats.
Treenail	A wooden peg.