Fig. 36. Skuldelev 2. The stern part of the ship as exhibited in the Viking Ship Museum.

### 5.2.3 Reconstruction of the ship in torso

Skuldelev 2 was the last and most difficult ship to reconstruct in torso display in the Viking Ship Museum. The general shape of the bottom and the stern of the ship were known features and could be restored following the same principles as for the other ships (Figs 36-37), but the original overall shape and size of the ship had to be estimated by the study of individual features of the floor timbers and other elements found scattered around the ship during the excavation. This study had begun but was not completed at the time the remains were built together in the museum between 1977-1982 and 1986-1993. Some of the observations presented above result from the final processing of all data from this find. Therefore, they were not all taken into account at the time the ship was displayed (Fig. 38).

As with the other ships, the presentation of Skuldelev 2 in this chapter is based entirely on the evidence provided by the pre-conservation documentation of those parts of the ship that are actually preserved to the present day. These parts are a combination of 'Wreck 2', 'Wreck 4' and 'Wreck N', as well as the many loose parts of the ship that were found within the area excavated. The 'torso reconstruction' pre-

Fig. 37. Skuldelev 2. The midship part of the ship as exhibited in the Viking Ship Museum.

*Fig. 38. Skuldelev 2. Overall view of the ship in the museum exhibition.*

sented here is based on the descriptions given above, and consequently leaves several aspects of the construction open for further analysis in Volume II, presenting a hypothetical reconstruction of the ship on paper and the preparations in Roskilde for the launching of a reconstruction at full-scale.

*Models*

A cardboard model of Skuldelev 2 at scale 1:10, with scaled-down planking and frame-timbers mounted into a wooden frame (Fig. 39), was constructed in 1994-95 by Erik Andersen and Sune Villum-Nielsen.

As a starting point, the planking of the two coherent sections of the ship was mounted. In the area from 3A to 9F, the planks' edges were extensively damaged, so that the fitting together of the individual strakes depended instead upon the location of the floor timbers. The orientation of the notches on the central part of these floor timbers gave a clear indication of the angle of the garboards. For strakes three to six, the frames provided guidance for their relative orientation, but not for their absolute orientation to the keel and first strakes, as all the floor timbers from this area had been severely damaged and most broken by the load of stones. Therefore, determining the original cross-section of the ship up to the seventh strake remained to be solved.

Further information on this topic could be found, however, in the study of the side timbers and stringers. The angles between strakes five to seven could be studied in the best-preserved side timbers, and the cross-sections of the stringers gave a guideline for the angle between strake seven and the horizontal level of the *biti*. By piecing together these bits of information it was possible to establish a relatively precise cross-section of Skuldelev 2 amidships up to the seventh strake.

With the planking and floor timbers of this area of the ship in position, a scale version of the keelson could then be inserted in the model. In this way it was possible to mark out the position of the frame stations outside the area of the preserved planking of 'Wreck 2', where the frame stations were known between 8A and 10F.

Aft in the ship, the planking was better preserved, making it possible to assemble the greater part of the scaled-down port planking as a coherent panel between frame stations 11A and 21A. It was then also possible to connect this

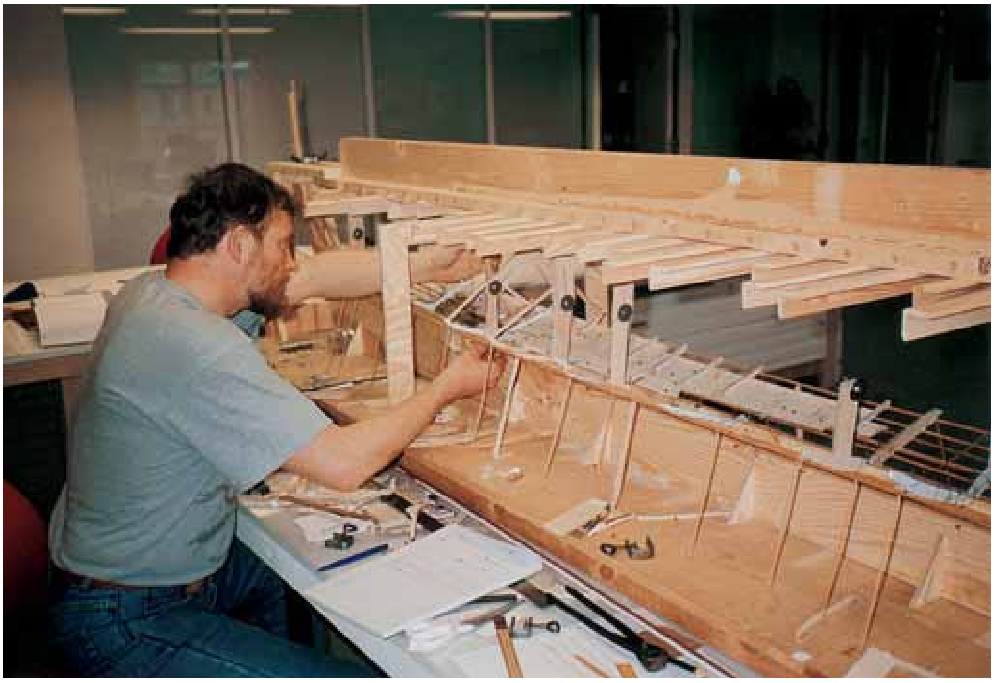


*Fig. 39. Skuldelev 2. Working-model at scale 1:10 under construction.*

*Fig. 40. Skuldelev 2. After part of the working-model.*

planking panel to the stem, and to place it at the correct distance from midships as recorded during the excavation. The three-dimensional orientation of this planking panel was determined in two stages. First, the after stem was mounted in the centre plane of the model and the relative position and angle of stem and planking was varied by trial and error so that a good fairing of the lines could be reached. In the position chosen, the lines of the planking onto the stem and multiple hooding end planks matched the external lines of the planks of the panel with the strakes nicely faired over the small gap between the two elements (Fig. 40).

Then these lines were extended by means of thin battens over the larger gap to meet the lines of the planking amidships. In this process the orientation of the panel of stem and planking aft was adjusted to provide for a continuous and well-faired set of lines for the curvature of the keel and the first seven strakes on the port side. The floor timbers which had been found loose but which evidently came from the after part of the ship gave some guidance in this process so that the general lines of the bottom part of the ship could be established from amidships to the stem aft.

At this stage, the distance from the middle of the mast-step at frame 0 to the after stem could be measured on the model as 1.56 m, corresponding to 15.6 m at full scale. If the mast had been placed precisely amidships, the total length of the original ship would then have been 31.2 m.

Thin battens following the edges of the strakes from the panel of planking amidships to 10F were then continued forward to meet 1:10 scaled versions of the floor timbers found in the areas A and B that originated from the forward part of the ship. These floor timbers were mounted in the model in such a way that they gave a well-faired set of lines for the curvature of the keel and the first seven strakes with the spacing of the floor timbers similar to that found elsewhere in the ship.

In this process, the variations in the shape and plank widths of the floor timbers found loose confirmed their initial categorisation. The deformation of several of the floor timbers gave rise to discussions as to the possibility of the hull having been built asymmetrically aft, as mentioned in Section 4 of the present chapter, and for a long time this was considered to be the case. The final analysis presented above, however, does not support this idea.

With the floor timbers from the forward part of the ship mounted at the positions given for these in Table 3, the battens gave a nice fair run of the strake lines which ended in a curved fore stem similar to the one aft (Fig. 41). Thus the cardboard model had provided the possibility for a three-dimensional analysis of the interrelationship between the individual elements of Skuldelev 2. The resulting general layout of the bottom part of the ship up to the seventh strake and the after stem is thus defined with a high degree of certainty. An overall length of the ship of ca 29.2 m, based on measurements from the model, is the minimum length that allows for a fair set of lines in the bow-area. To judge from the model, it might have been possible to extend the forward part of the ship to a total length of ca 29.9 m (or less likely to ca 30.6 m) by adding a further ca 0.7 m corresponding to one (or two) extra frames.

As is evident from the description above of the few elements from the upper part of the ship that are presently preserved, there remains not much evidence from this wreck on which to base the reconstruction of the hull above the waterline. The stem aft, the knees and the side frame, however, have served as guidelines to establish a set of hypothetical lines for the original upper part of the hull. According to these, Skuldelev 2 originally had 11 or 12 strakes, a width amidships of ca 3.7 m and a depth of the hull to the underside of the keel amidships of ca 1.8 m. The workingmodel clearly indicates that the hull was deeper aft than forward.

*Fig. 41. Skuldelev 2. The working-model completed.*

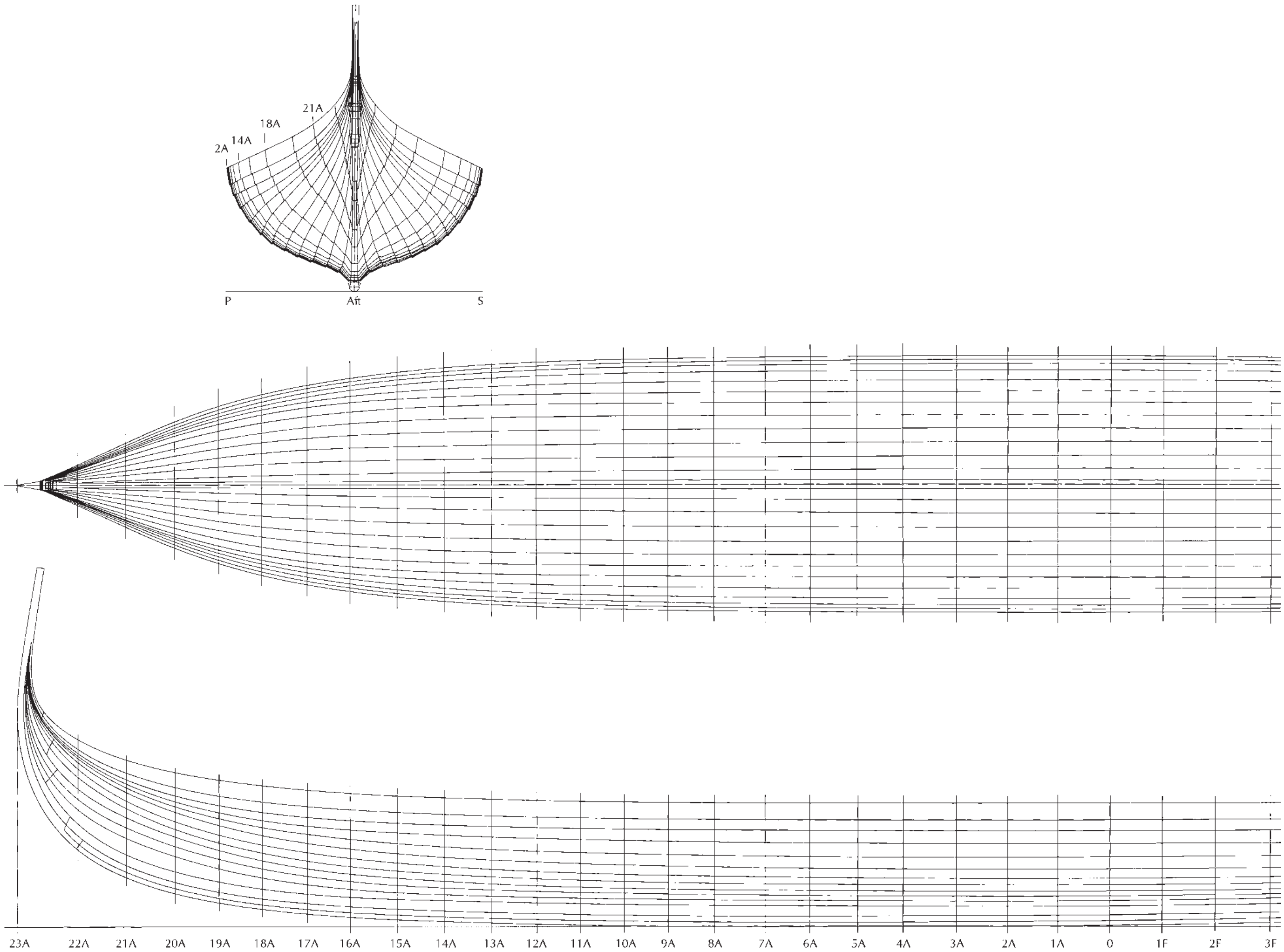
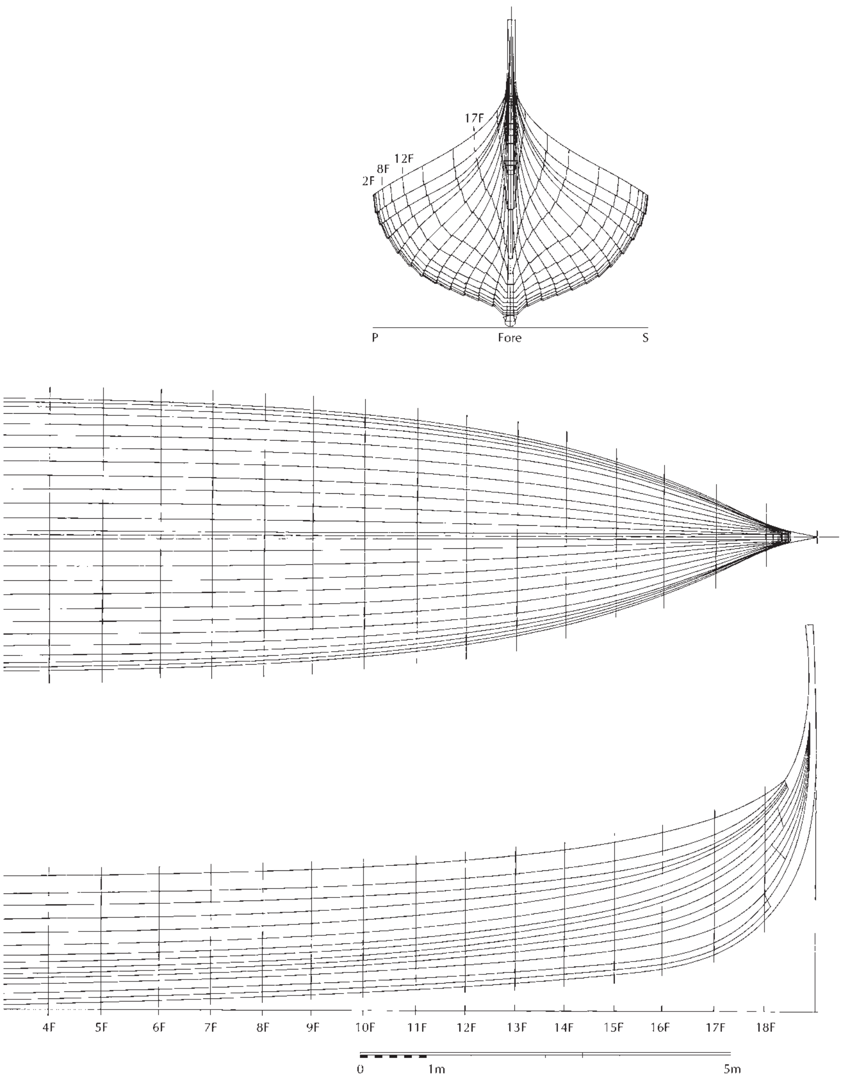



*Fig. 42. Skuldelev 2. Hypothetical plan and sections in the ship as reconstructed in the working-model on the basis of the preserved parts as the minimum-size longship of a total length of 29.2 m. Scale 1:80.*

*Lines and torso-drawing*

Having finished the analytical work with the workingmodel of Skuldelev 2, the lines of the keel, stems, and the individual strakes were taken off the model, and an inner edge line plan of the strakes was drawn by Sune Villum-Nielsen and later revised to level out the asymmetry aft caused by the distortion of the floor timbers there (Fig. 42). This plan is hypothetical as regards the upper part of the hull and the exact length of the forward part of the ship, but more certain as to the shape of the bottom and stern sectors of the ship that are well documented in the original parts of Skuldelev 2.

Based on these lines, a 'torso-drawing' of the preserved parts of the ship, mounted at their original or most likely positions in the hull, was drawn by Sune Villum-Nielsen and later revised by Vibeke Bischoff (Fig. 43). This drawing is the basis for the reconstruction of the ship as a complete and functional vessel, as described in Volume II.




*Type and size of the ship*

The previous sections have demonstrated that, by applying a strict methodology in the analysis of the many scattered parts of Skuldelev 2 and their interrelationships, which also included 3D-modelling, it has been possible to establish a coherent picture of the complete bottom part of the ship and of important features of its upper parts.

The analysis above indicated that by positioning the mast at exactly amidships in relation to the overall length of the ship, the maximum possible length of the vessel would be ca 31.2 m. In addition, a minimum length of ca 29.2 m for the vessel was needed to provide space for the floor timbers without creating irregularities in the fairing of the lines of the lower strakes. If the minimum length of the ship is ca 29.2 m, there would be room for a total of 21 frame stations aft and 16 forward of the mast, with the mast-step situated 1.0 m, or 4.2% of the total length, in front of the mid-point of the ship. If there are 17 frame stations forward and a length of ca 29.9 m, these figures are 0.65 m and 2.2%; and if there are 18 frame stations forward and a length of ca 30.6 m, they are 0.3 m and 1.0%. Thus the overall length of the original ship is evidently well defined to lie within the range of 29.2 m to 31.2 m. In the calculations below, an overall length of 29.28 m for the vessel, taken from the torso-drawing, has been used.

The maximum width (B) and depth (H) of the hull amidships, as recorded on the torso-drawing, 3.76 m and 1.77 m, respectively, will have to be taken as a best guess on the basis of the currently available evidence, but these dimensions are less certain than the calculated original length of the vessel. Using these figures, the L/B ratio is 9.3 and the L/H ratio is 16.5, indicating that this ship was a real longship, combining propulsion by oars and sail. In comparison, the small warship Skuldelev 5 and the very slender longship Hedeby 1 had a L/B ratio of 7.3 and 13.1 and a L/H ratio of 14.4 and 19.2 respectively.[4]

Regarding oar propulsion, the spacing of the frame stations, and consequently also the distance between the rowers along the ships' sides in Viking-Age ships of the Nordic tradition, was gradually reduced from 1.04 m in the early-ninth-century Oseberg ship to 0.84 m in the Hedeby 1 ship of the late tenth century.[5] With these other measurements in mind, the average frame spacing of only ca 0.7 m in Skuldelev 2 is remarkable. Was this simply a way of squeezing a maximum number of rowers into the ship? Was it possible to row with the same rowing technique here as in the other ships, or did the oarsmen use a different technique in this ship? Or did the division of the upper part of the ship with its oarports for the rowers not match the division of the bottom part of the ship with its frame stations?

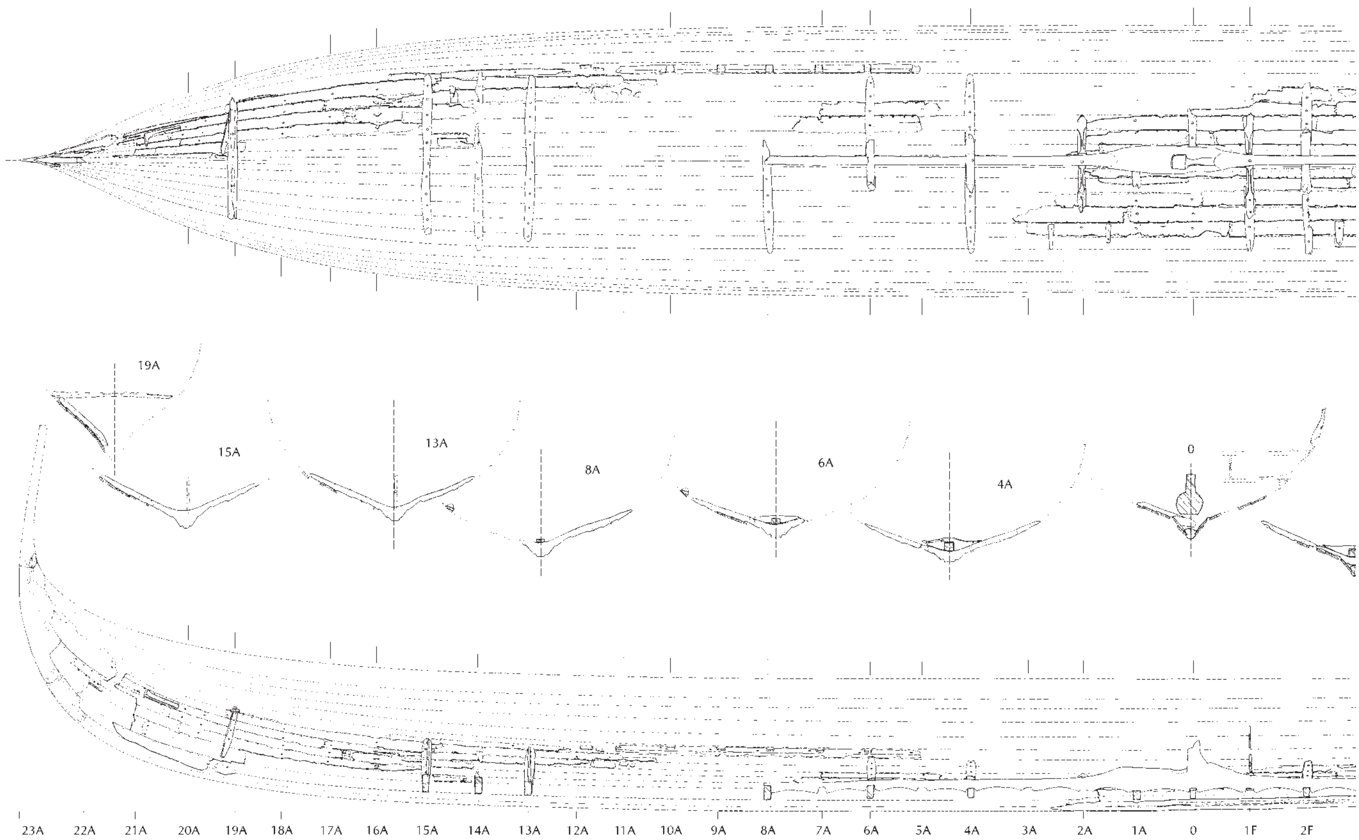
These questions will be discussed in Volume II in relation to the reconstruction of the fully functional ship as a

4. Jensen 1999: B 22, 26, 34
5. Crumlin-Pedersen 1997a: 92

1:10 model and as a full-scale hypothetical reconstruction. Here, it will suffice to note the fact that the few elements found from the upper structure in the ship include a *biti* with holes for stanchions to support a light beam or thwart positioned above the *biti* at the same frame station. There is also a number of stanchions which probably include some specifically for this purpose. This evidence strongly indicate that the general system, known from the Skuldelev 5 and Hedeby 1 ships, where the position of the thwarts follows that of the *biti*s, is also used in Skuldelev 2, and that the rowers here actually would have had an average spacing of only ca 0.7 m between them.

Consequently, assuming one rower was placed on each side between each set of frames from 16A to 13F, 60 men would be required in the ship for a full crew of rowers. With the helmsman and additional crew members such as look-outs, etc., a full crew would then number ca 65 men who served as seamen onboard and warriors ashore.

The relatively sharp bottom with an angle of 90° or less between the strakes on either side of the keel, as well as the



strong keelson are a clear proof, however, that Skuldelev 2 was constructed primarily for propulsion under sail on the open sea. None of the elements from the ship give direct reference to the size of the sail or the details of the rig, except that the diagonal of the step for the mast in the keelson is ca 25 cm long and this indicates a mast of this diameter as minimum, and this would consequently be strong enough to carry a sail of a large size appropriate for the ship.

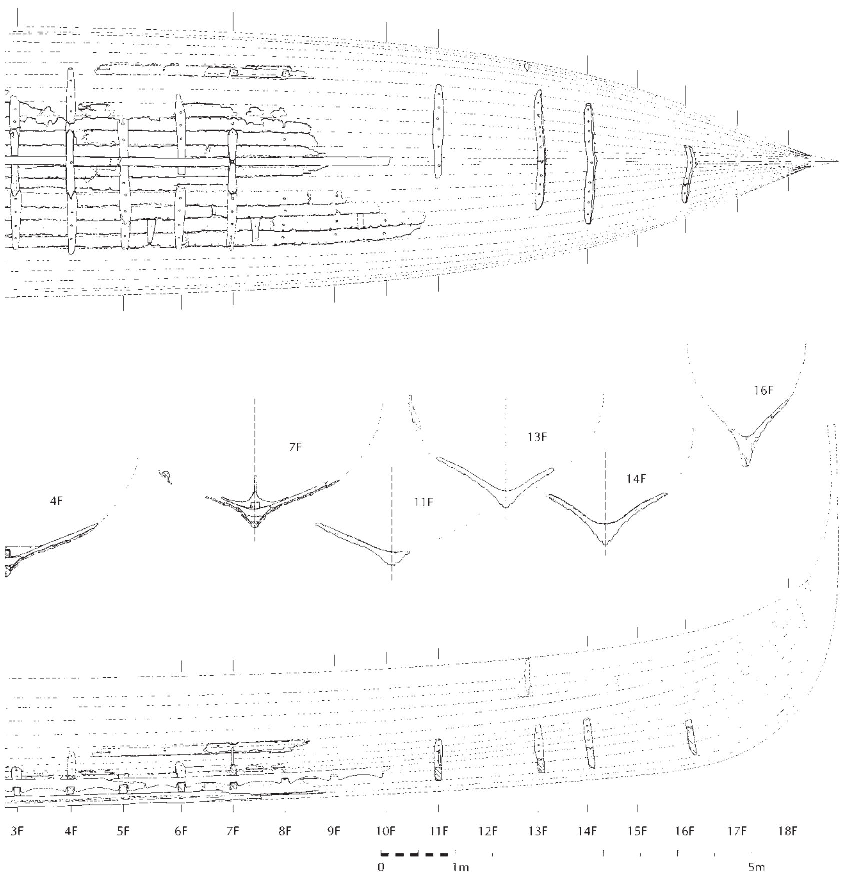



*Fig. 43. Skuldelev 2. Torso-drawing showing the preserved parts mounted in the ship in their original or most likely positions. Scale 1:80.*

## 5.2.4 Analysis of the ship from construction to scuttling

In the case of Skuldelev 2, the limited extent of the preserved original structure of the ship, as well as the extensive damage to these parts caused by the ship's exposed position in the barrier, limit the possibility of studying in detail the individual history of this ship during its construction and repair phases. Instead of lamenting these lacunae, it is rewarding to concentrate on the potential of the extant remains of the ship (Fig. 44).

As described in Chapter 3.3 and discussed below in the present chapter, dendroanalysis has provided important information for the origin of, and dates for, the ship. This analysis clearly points to the Irish Sea region, more specifically the Dublin area, as the origin of the timber for the ship. This is the case for the samples from the original planking whereas the repair planks inserted into the ship long after it was built probably came from the British side of the sea. Therefore, the hypothetical possibility that Skuldelev 2 was constructed in Denmark from imported Irish timber can be ruled out completely. The theoretical possibility remains, however, that the ship might have been built somewhere on the Scottish Isles with no local supply of timber but close contacts with Ireland for the provision of building materials. The most likely explanation, however, is that Skuldelev 2 was actually constructed in the Dublin region for a local or foreign customer and that Dublin actually served as its base during most of its active life.

*Building phase*

The study of the construction phases of this ship is not as detailed as most of the other Skuldelev ships, as only about 20% of the hull of Skuldelev 2 has survived. The extant materials, however, can illustrate some of the aspects of the selection of materials, sequence of construction, etc.

Planks

All planks known to have come from this ship are made of straight-grown, radially split oak. Sapwood has not been found in any of the dendro-samples taken from the planking, except on one of the repair planks, indicating a relatively high set of standards applied by the shipwrights in their selection of materials. The fact that a plank, P606, with a knot, weakening the plank severely, was accepted in the planking, however, indicates that some materials of secondary quality were accepted during the construction phase, just as well as some sapwood was accepted in repair planks.

It is likely that some very broad and long lengths of planks were used at the upper level over the midship part of Skuldelev 2, strengthened by one or more stringers. This part of the ship is not preserved, however, and only the bottom planks up to the sixth strake are available for analysis of their original dimensions (Fig. 45). The planks found *in situ* all seem to represent the construction phase, except for the repairs to the first strake port and starboard, and thus their lengths and widths - in so far as they are preserved intact - represent the dimensions as originally chosen by the shipwrights.

The graph of the dimensions of the individual planks (Fig. 46) includes several lengths of planks that are only partially preserved. The colour codes mark out the degree of preservation of the planks in order to allow a distinction

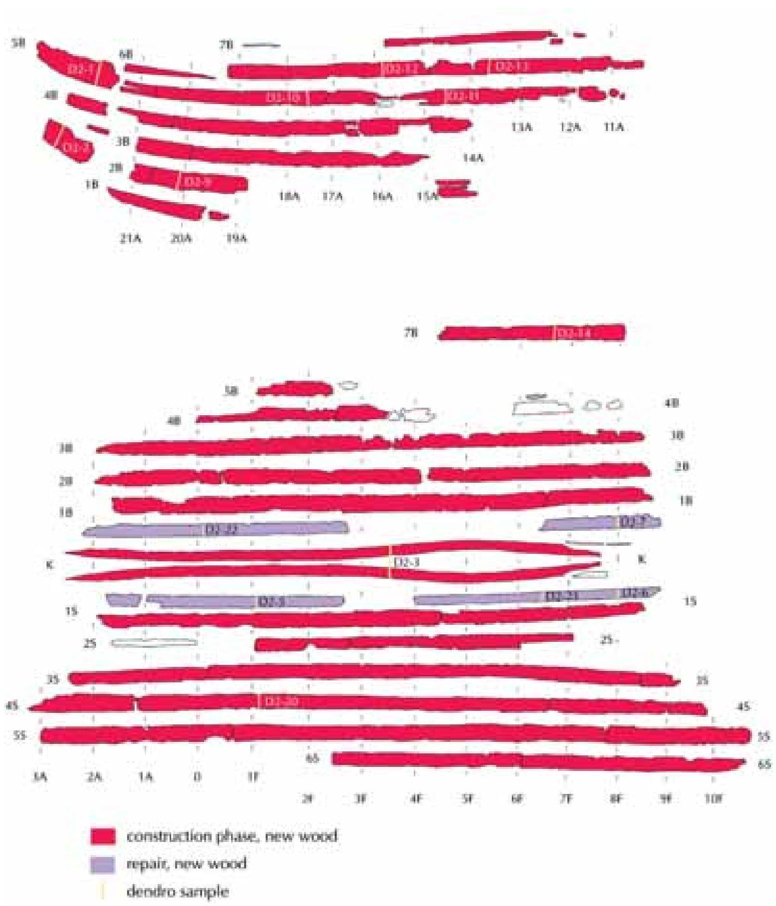
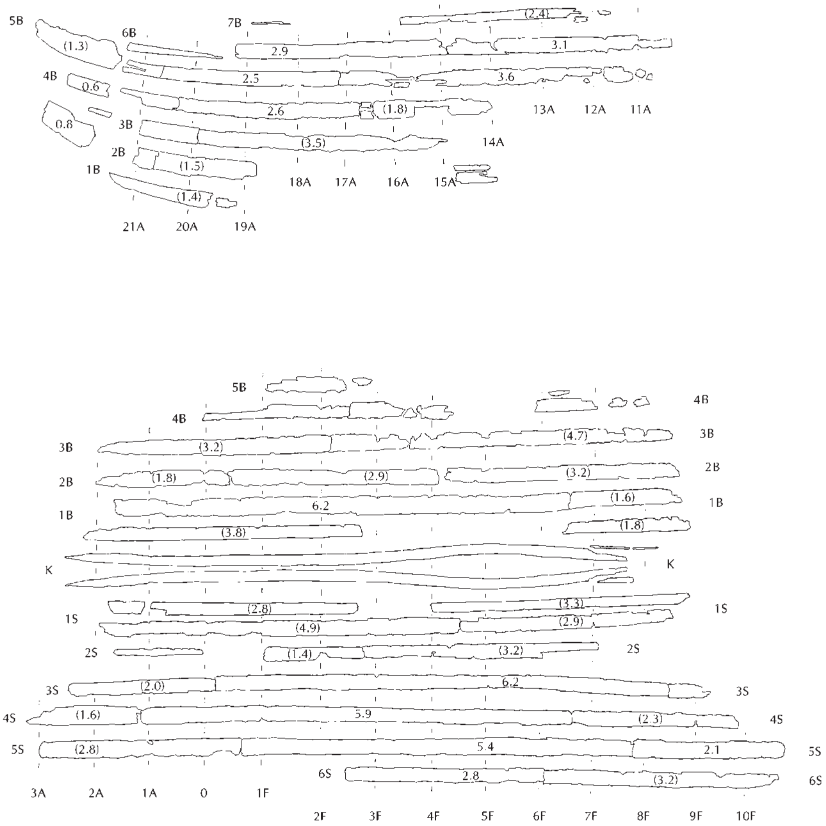



*Fig. 44. Skuldelev 2. Planking with the repair elements and the position of the dendro-samples marked out in blue and yellow, respectively.*

Fig. 45. Skuldelev 2. Lengths in metres of planks as found. Figures in brackets are for planks of incomplete lengths.




between planks of full original length (blue and green dots), and of full original width (blue and yellow dots). The red dots indicate planks for which neither lengths nor widths are fully preserved but which may still contribute to the overall picture. The graph shows that all planks of full length and width from the construction phase are between 20 cm and 26 cm in width and between 2.1 m and 6.2 m in length. The overall impression of the graph is that the bottom planking was constructed from a mixture of planks of a length between 2 m and 4 m, and another group of planks over 5 m in length, here recorded up to 6.2 m.

The scarfs between the individual lengths of planks in neighbouring strakes are generally spaced ca 1 m or more apart, but there are a few exceptions, especially in the panel of planking up to the after stem.

Skuldelev 2 is not sufficiently well preserved to enable an estimate of the total requirement of parent trees originally needed for the planking. Among the planks actually found there are none of exceptional length or width. Those found may all have come from straight oak tree trunks of a diameter of 0.7-0.9 m and lengths of ca 4 m and ca 6.5 m. The planking in the sides of the ship above the waterline, however, would probably have been made from much larger trees in order to ensure the longitudinal strength of the longship. The dendroanalysis (cf Section 5.2.5 of this chapter) has shown that the parent trees had an average growth rate of 1.8 mm/year for the planks from the construction phase and 0.9 mm/year for those used in the repairs.

The multiple hooding end planks aft are considerably wider than the other planks and they would have required a thicker tree of a minimum diameter of ca 1.0 m, but only with a length of 2 m or less. Trunks of a similar size would have been needed for the central part of the stem fore and aft.

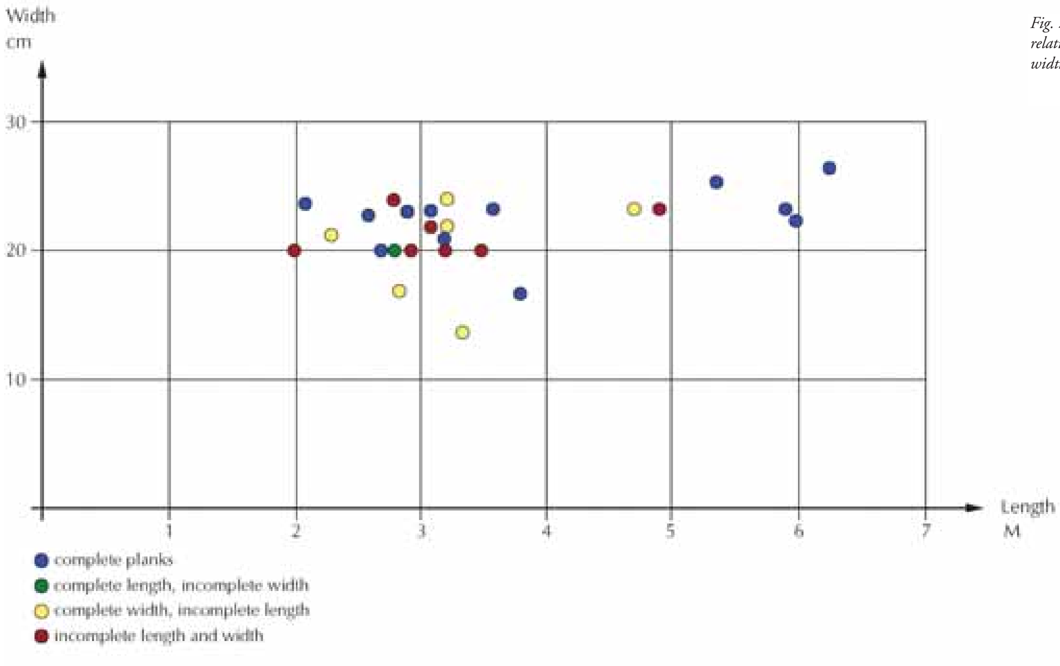



*Fig. 46. Skuldelev 2. Graph of the relationship between length and width for planks found* in situ.

Internal timbers

Skuldelev 2 was built with 38-40 floor timbers, a similar number of *biti*s and beams/thwarts, each with two knees, and a smaller number of timbers of various shapes to strengthen the bow and stern. For all these frame timbers, trees were selected that had grown to a shape that was optimal to ensure that almost no fibres were cut across in the process of shaping the frame element. To find the many crooks of individual shapes was, no doubt, a difficult task, requiring extensive searches in the woodland for trees and branches of the desired shapes and sizes.

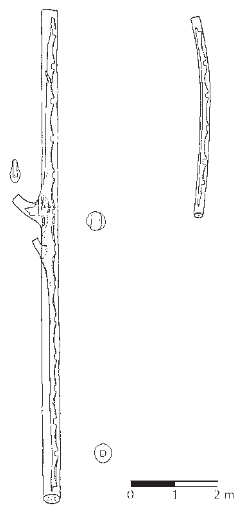
As mentioned in Section 2.4 of this chapter, the wood technological character of six of the floor timbers from the after part of the ship have been studied in detail.[6] The analysis has shown that these were cut from oak trees with trunks of a diameter of at least 0.3-0.4 m. In one case, a curved tree trunk was used, and in five other cases the floor timber was cut from the trunk and a thick branch (cf Fig. 23).

The wood fibres in a branch differ in character between the upper fibres that are exposed to traction and the lower ones that are under compression. Therefore, the side of a floor timber cut from the branch is likely to react differently to changes in humidity and load, and thus be less rigid than the side cut from the trunk of the tree. In the case of the five floor timbers of this character studied in Skuldelev 2, they had all been fashioned in such a way as to avoid the traction-wood of the upper part of the branches.

Long lengths of relatively young oak trees were needed for the keel, which probably consisted of a long middle part and two or more shorter, curved lengths that connected to the stems. In order to account for the length of the ship, the middle part of the keel may have been at least 15-18 m in length, although trees of this size would probably have been hard to locate, even in dense primeval forests.

In addition, a long tree was needed for the keelson. A wood-technology investigation,[7] combined with the dendroanalysis of a cross-section cut from the thick middle section,[8] shows that the keelson was cut from a 103-year-old tree with a trunk that was at least 10 m in length and had a diameter of ca 40 cm at its middle. In this case, the sapwood had not been removed at the central part of the keelson. The tree had been specially selected, demonstrated by the fact that it had a major side branch at a distance of 5.7 m from the lower end of the trunk that projected in front of the maststep in order to facilitate the raising and lowering of the mast. Two other branches were removed completely when the keelson was shaped from the tree (Fig. 47). The separate forward length of the keelson was cut from a tree that was at least 3.8 m in length and 0.2 m in diameter.

*Fig. 47. Skuldelev 2. The orientation of the keelson in the parent tree.*



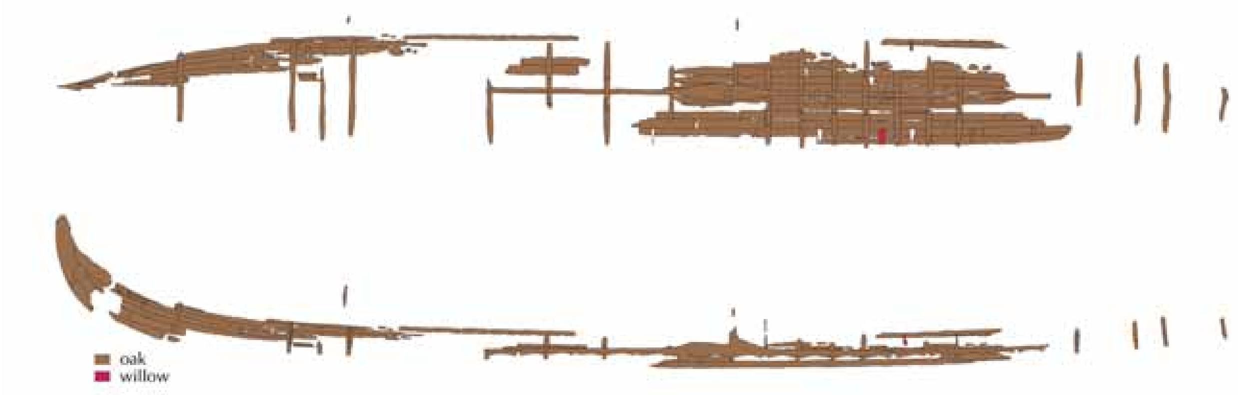



*Fig. 48. Skuldelev 2. Wood species used in the construction and repairs of the ship.*

Although oak is completely dominant as the standard wood species used for the construction and repair of Skuldelev 2 (Fig. 48), willow was also used for some side timbers (cf Table 7) and as treenails. For the side timbers, this species may have been selected in order to provide a flexible element with which to connect the bottom part of the ship with its sides. In the longship Hedeby 1, these elements were of the same slenderness but made of ash and alder.[9] Willow seems to have been the most commonly used species of wood for treenails in the eleventh century in southern Scandinavia and Ireland.[10]

Building principles

The details of the construction of Skuldelev 2 clearly reflect basic late Viking Age or Norse shipbuilding traditions. These traditions are found in all the other Skuldelev ships, as well as in other finds of ships of the tenth to twelfth centuries within the areas settled by people of Scandinavian descent. The basic concept of a double-ended hull, built with a backbone of keel and stems, clinker-laid planking, and a regular system of symmetrical floor timbers and *biti*s is found in all these vessels. However, there is a certain amount of variation in the way the upper part of the hull is shaped and strengthened, according to the purpose for which the ship was built. These ships have decorative mouldings along some or all of the edges of planks and timbers, they also have a limited quantity of woollen material inserted in a shallow groove in the plank overlap, and they are fastened together with iron rivets with rectangular roves.

As is clearly reflected in the five Skuldelev ships, the same basic construction concept may still lead to very different shapes and sizes of ships, due to the specialisation of ship types. It is very likely that there were also different regional variations in the way ships of the same type and size were built. Such variation is evidently the case in regards to the wood species chosen for the construction, but it may also be a relevant factor for the way certain details were made, which followed local traditions or were influenced by foreign traditions.

On the basis of these considerations, the present author tentatively suggested, at an early stage in the study of the ship and before the dendroanalysis had been carried out, that Skuldelev 2 had been built by Vikings or their descendants somewhere in the British Isles. The low and broad floor timbers in this ship might reflect an impact of Anglo-Saxon or earlier shipbuilding traditions in this area.[11] This assumption as to the origin of the ship has later been confirmed by the dendroanalysis which shows that the ship was actually built from, and repaired with, materials from the forests around the Irish Sea. In hindsight, the assumed link to an older British tradition may be a weak or even non-existant one, since the general shape of the floor timbers, including their 'butterfly shape' as seen from above, has no parallels in pre-Viking British finds.

Apart from the broad, flat, and arched cross-section of the arms of the spring-like floor timbers amidships in Skuldelev 2, no deviations have been observed in this ship from the construction principles otherwise known from Scandinavian ships of the period. This does not, of course, exclude the possibility that there may have been features of the upper part of Skuldelev 2 that would have been recognised in the eleventh century as indicative of the ship's origin in Ireland.

6. Claus Malmros: Træteknologisk undersøgelse af seks agter-bundstokke fra Skuldelev vrag 2/4. 19/7 1994. NMU archive
7. Claus Malmros: Undersøgelse af kølsvinet i Skuldelev vrag 2/4. 12/12 1994. NMU archive
8. Bonde 1999
9. Crumlin-Pedersen 1997a: 230
10. Crumlin-Pedersen 1997a: 123. McGrail 1993: 47
11. Crumlin-Pedersen 1988: 152

As a consequence of this strong link to contemporary building traditions in the Viking homelands, the same phases are reflected in the construction of Skuldelev 2 as in the other ships in the present study. However, only the first steps in the construction up to the seventh strake can be followed in the case of Skuldelev 2. As the floor timbers were placed over several of the rivets in the planking, it is evident that these frame elements were not inserted into the hull until the plank-shell had been built up to the sixth strake. The next strakes were then fashioned and mounted in position and the side timbers fitted from the fifth strake upwards in between the position of the floor timbers. The fact that some of the side timbers were scarfed and fastened with a rivet on the sixth strake under the stringer shows that the stringer was not mounted until the hull had been built up as far as the side timbers. Not until this time were the stringers, *biti*s, and *biti*-knees inserted as elements in the very supple internal framework.

Considering the length of ca 30 m of this longship, it is evident that flexibility was an important principle in the concept of this ship type, and that all elements had been carefully selected and optimised in order to achieve maximum lightness and suppleness without the loss of strength. This principle had its advantages when handling the ship at sea and on the shore, but it might also have led to leaks in positions where individual elements could wear against each other as the ship flexed in the waves. However, the use of pliable treenails of willow and the slenderness of the floor and side timbers amidships seems to have minimised this abrasive tendency in Skuldelev 2.

*Repairs*

The post-deposition damage to the ship caused the plank edges with rivet holes to be worn away, especially in the midship area. This fact deprives us of the possibility of studying the nail-hole pattern of these areas as clues to identifying repairs to the planking.

There is, however, one very prominent repair feature in this ship, observed already in 1957: the doubling of the first strake on one or both sides over most of the length of the ship, to be traced even outside the areas of preserved planking. The indications for this feature are the holes for spikes in some of the floor timbers at the upper edge of the repair-plank which can be followed intermittently from 13F to 14A.

Here the original planks from the construction phase had evidently been worn down so much that it was necessary to fit a new plank. This was done by cutting down the lower edge of the original plank with an adze to a wedge-shaped cross-section so as to provide space for a new plank that could fit into the rabbet in the keel and be riveted along the middle of the old plank. In the overlap between


*Fig. 49. Skuldelev 2. The contact area of the repair plank on the outside of the original plank for strake 1S around frame 0 display a coarse axe- or adze-finish.*

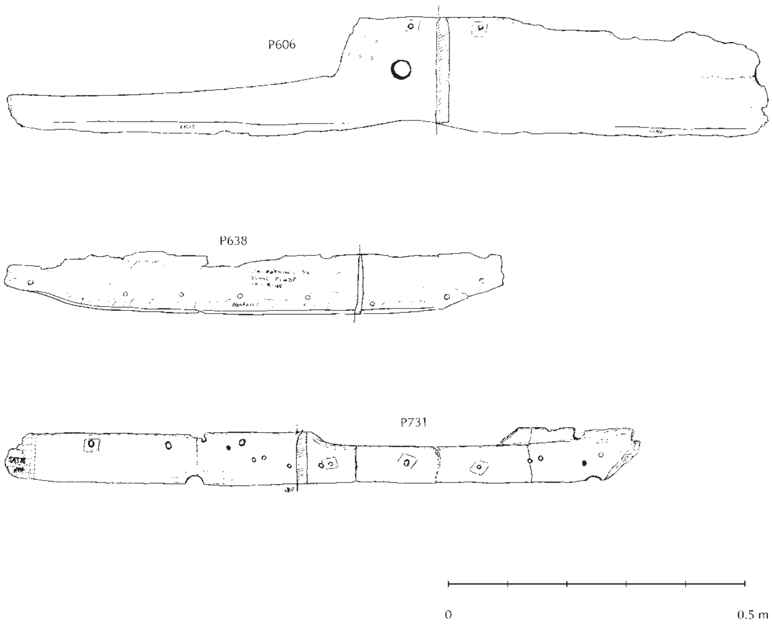



*Fig. 50. Skuldelev 2. Plank fragments with traces of repairs and repair patches. Scale 1:10*

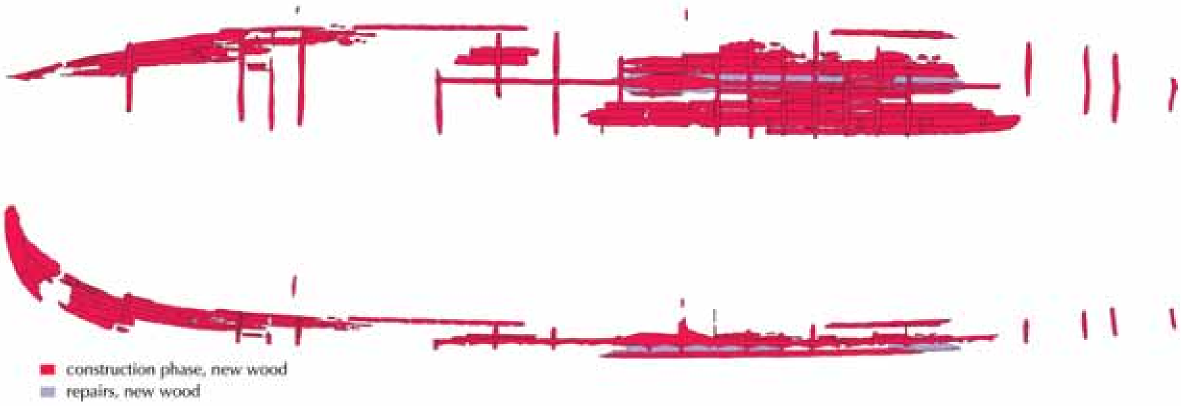



*Fig. 51. Skuldelev 2. The character of the materials used for the construction and repair of the ship.*

the two planks, considerable quantities of wool soaked in tar were placed as caulking to ensure that the plank overlap was watertight in spite of the relatively coarse finish of the contact surfaces of the two planks (Fig. 49).

Further repairs can be traced as extra rivets, plugged holes, and repair patches. Such elements were found along the upper edge of strake 5S at 1.7A, around 0 and at 9.5F, and of strake 6S between frames 6F and 7F (cf Fig. 16). Even among the planks found loose, there are indications of repairs (Fig. 50). On plank fragment P731, the upper edge has been cut down and the presence of several extra holes for rivets and spikes indicate that a repair was carried out here. Traces of treenail holes indicate that the plank fragment is from the lower part of the hull of the ship. Additionally, P638 is a repair patch of wedge-shaped cross-section that has several holes and imprints of spikes and rivets. On the plank fragment P606, a weak point at the edge of the plank, caused by a knot, was covered over by a patch spiked onto the outside of the plank. It is unusual to find such a feature in a radially split oak plank, as the knot here is oriented in the same plane as the plank and thus would tend to weaken the plank drastically. This plank fragment has two ordinary holes for the treenails attaching the floor timbers and therefore it is probably a part of the original planking from the bottom section of the ship. This implies that not all materials used in the construction of the ship were of the highest quality.

In the larger, coherent sections of the planking, where entire lengths of planking might have been renewed, it would have been possible to trace possible repairs by other means. Indications of such would have been plank-scarfs opening forward at the forward end and anomalies in the pattern of fastenings for the floor timbers. Such indications, however, have not been found. Therefore the plank scarfs found are likely to represent the pattern at the time of construction.

For the dendroanalysis (see Section 5 of this chapter), dendro-samples have been taken from the repair planks in strake 1S and 1B. The analysis of these and the other samples taken from the planks of Skuldelev 2 indicates that plank P517, which was found loose, is also a repair plank. Thus there are several indications of repairs, some presumably made during the construction of the ship to remedy defects in the planks, while others were made at later stages during the active life of the ship (Fig. 51).

### *Wear and other traces from the active phase*

The many repair patches in the planking and the major repairs to the first strake, bear witness to the long, active life which Skuldelev 2 had had before it was taken out of active service and used in the second phase of the barrier. Apart from the repairs, there is not much evidence on the preserved parts to document traces of wear or other details from the active phase of the ship. This is mainly because of the damage the ship suffered when it was partially scrapped and from the biological and mechanical degradation after scuttling.

The repair planks in the first strake are in a better preserved state than are the other planks of the hull's bottom (cf Fig. 16), indicating that this repair was carried out at a time when the ship was relatively old, and not long before the ship was scuttled. There are, however, traces of wear on

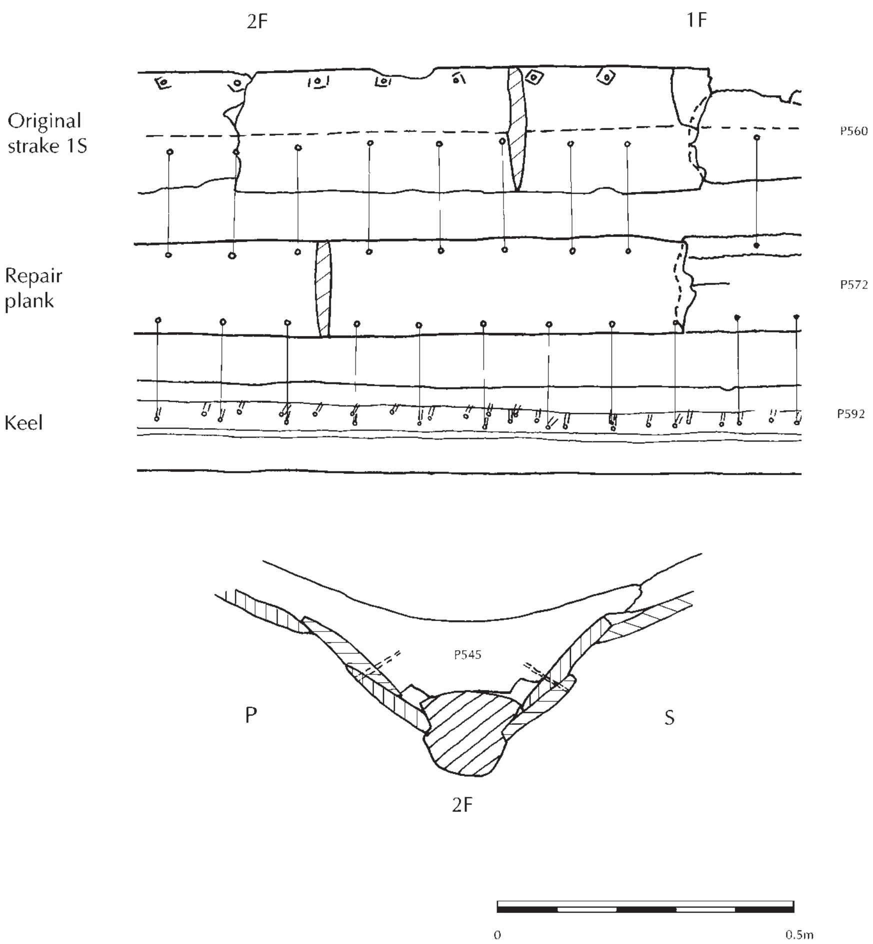



*Fig. 52. Skuldelev 2. Keel and strake 1S between frames 1F and 2F. The planks are seen from the inside. The upper edge of the original plank has imprints of the roves of the rivets for strake 2S, whereas the lower edge has been cut off to a wedge-shaped cross-section to provide space for the repair plank to reach the rabbet in the keel. The upper edge of the repair plank was riveted to the middle of the original plank and spiked into the keel and floor-timbers. The spikes to the keel from the original plank had been extracted and the spikes for the new plank driven in are seen on the recording of the keel. The many spike-holes in the keel between 1F and 2F indicate that there had been a previous repair to strake 1S at this point. After the repair plank shown here was mounted, the outside of the planks was further worn down as visible on the cross section of the original plank between the lands for the planks above and below. Retraced from the original 1:1 recordings, and cross section of keel and first strakes at frame station 2F. Scale 1:10.*

the outside of the original garboard plank, e.g. at strake 1S between 1F and 2F (Fig. 52), which can only have been caused by mechanical or biological deterioration after the repair plank was inserted. This feature indicates that some years had passed after the repair was made and before the ship was definitively taken out of active use.

*The scuttling and subsequent disintegration*

This subject has been extensively mentioned in the description above as a basis for understanding the distribution pattern of the various loose parts of the ship. In sum, there is evidence enough to show that the ship was scuttled with a moderate load of stones, primarily amidships and aft, on top of the ships which formed the main part of the first phase of the barrier, Skuldelev 1 and 3. The total absence of all the upper parts, except a side frame evidently split with an axe, is a strong indication that these parts of the ship were scrapped and pieces removed for re-use at an early stage. The forward part of the ship on top of Skuldelev 3 disintegrated and disappeared at an early stage as well, leaving only some of the floor timbers behind.

The bottom part amidships and aft as well as the after stem were held in position beneath the stones. Most of these stones were probably brought along in the ship while others may have been added to stabilise the barrier. As Skuldelev 2 was not built with a flat bottom but had a relatively sharp bottom profile, the weight of the stones caused the bottom of the structure to collapse, pressing the keel into the ship and flattening out the planking. In this process the floor timbers amidships almost all broke in two or three pieces, releasing the knees holding the keelson in position.

Even after these drastic permutations, however, the hull's situation was still not stable. The planks were partly wedged in between the stones in Skuldelev 1 below and those of Skuldelev 2 itself, with large areas exposed to bacterial and mechanical erosion. In addition, the keelson and parts of the framing system partially projected from the heap of stones. In this position some of the individual parts of the structure started to chafe against each other, and treenails expanded their holes in the planks. This was due to the rocking movements of the various parts after scuttling, when the planks were only partially supported in between the stones, and the rivets were rusting away. Some of the planks could also be moved individually by the current and waves over the barrier. As a contrast to this pattern, the port planking and after stem were held down firmly by the stone load against the relatively smooth seabed north of Skuldelev 1.

What happened next was clearly an effect of ice drift during a winter soon after the scuttling took place. The after stem with some of the multiple hooding end planks still in position, as well as the keelson and several of the floor timbers, knees, etc., were torn away from their positions in the ship and pushed down over the western edge of the barrier into the deep pit there. Other parts of the ship were frozen into the ice and transported further away from the barrier in this way, as demonstrated by the small section of the ship recorded as 'Wreck N' and located ca 300 m away from the site of deposition. At this stage, the iron fastenings were still strong enough to hold the stem and the multiple hooding end planks together, but on the other hand the various parts of the ship had been submerged long enough to become waterlogged so that they did not float away when the ice melted.

After these drastic events within the first few years after the scuttling of Skuldelev 2, the remains slowly became covered by sand and shells. These sediments included musselshells from the local biotope as well as sand carried along by the current and caught among the stones. Parts of the ship that were not effectively covered or which were later exposed, continued to be biologically and mechanically eroded. The northern end of the keel, which was worn off to a pointed end, deteriorated in this way.

*Table 12. Skuldelev 2. Dendro-dated samples of planks from the construction phase.*

| D2-no. | strake/position | average width of last 30 years | last annual ring dated AD | number of years missing to 1042 | approx. lacking plank-width to 1042 |
|---|---|---|---|---|---|
| 13 | 6B/13.5A | 1.55 mm | 1023 | 19 | 29 mm |
| 14 | 7B/ | 1.26 mm | 1019 | 23 | 29 mm |
| 16 | Stray find | 1.52 mm | 1017 | 25 | 38 mm |
| 20 | 4S/1.2F | 1.09 mm | 1015 | 27 | 29 mm |
| 9 | 2B/20.2A | 1.89 mm | 1000 | 42 | 79 mm |
| 8 | Stray find | 0.65 mm | 973 | 69 | 45 mm |
| 12 | 6B/15.7A | 3.18 mm | 963 | 79 | 251 mm |
| 19 | Stray find | 0.93 mm | 954 | 88 | 82 mm |
| 15 | Stray find | 0.90 mm | 931 | 111 | 100 mm |
| 17 | Stray find | 1.46 mm | 920 | 122 | 178 mm |
| 18 | Stray find | 1.31 mm | 880 | 162 | 212 mm |

## 5.2.5 Dating

The details of the dendroanalyses carried out on samples from Skuldelev 2 are given in Chapter 3.3. Twenty-four samples, all of *Quercus sp.*, oak, were extracted from Skuldelev 2 for dendrochronological study. All the samples are cross-sections which were taken by sawing through the parts selected for examination. Chiefly, samples were chosen from the parts of the wreck which could provide information regarding the date of the ship's construction. In addition, a number of samples were chosen with a view to dating the repair/s which, on archaeological grounds, could be identified in the wreck (cf Section 4 of this chapter). For more details on the position of the samples in the ship, see Table 12. One of the samples extracted came from a floor timber found out of context (D2-21). This proved to contain so few annual rings that it was not suitable for dendrochronological analysis, and thus is not included in this study.

*Construction phase*

Of the remaining 23 samples, 18 come from the ship's construction phase. Fourteen samples are from planks, of which six are definitely from the wreck, while eight were taken from stray planks which all belong in the context of 'Wreck 2', though their exact position in the ship is not known. In addition, two samples were sawn from hooding end planks from the stern of the ship.

One sample was taken amidships from the ship's keel, and finally, the ship's keelson was sawn to extract a sample. The sample (D2-4) from the keelson is especially important, as it turned out that it contains all the tree-rings from the pith to the last formed ring of the tree from which the keelson was made. This means that it would be possible to identify the tree's felling date to within months.

None of the other samples that came from the construction phase had sapwood preserved; it had either been worked away during the building of the ship or else lost in the course of the ca 900 years the wreck had laid on the bottom of Roskilde Fjord.

The curves from eleven samples from the planks, representing nine trees in all, cross-match and can be averaged to a mean curve of 246 years. The averaged curve cross-dates with master chronologies from Ireland and England and covers the period AD 778-1023. The best *t*-value is achieved with references from Dublin and Waterford in Ireland (Fig. 53). In estimating the felling date for the trees from which these samples come, Irish sapwood data was utilised[12] and showed that the trees used for the ship's planks were felled after AD 1039.

The curve which was produced by measuring the annual rings of the sample from the keelson contains in all 103 complete tree-rings in all, of which 24 are sapwood rings (cf Fig. 12 in Chapter 4). This curve also cross-dates with master chronologies from Ireland and England and with the aforementioned mean curve and covers the period between AD 939-1041. In all, there are 104 tree-rings identified in the sample. Tree-ring no. 104 was the last one formed during the tree's lifetime, and is called the bark ring. Therefore, the total number of tree-rings in the sapwood is 25, which falls well within the 95% confidence limits for the number of rings of sapwood in trees which grow in Ireland. In this case, the bark ring is not completely formed, which indicates that the tree from which the sample comes was felled early in the growing season, May to June of the year 1042.[13]

*Repairs*

Samples were extracted from five repair planks of the ship. All the samples came from the first strake of the port and starboard side, forward in the ship. One, D2-23, has the remains of sapwood preserved - though not the bark ring - which makes it possible to estimate the approximate felling date for the tree from which these samples come.

The tree-ring curves from four samples taken from the repairs cross-match, and in comparing the curves, it can be concluded that the four planks from which the samples are extracted probably came from one and the same tree. The curves are thus averaged to one curve of 205 years, which

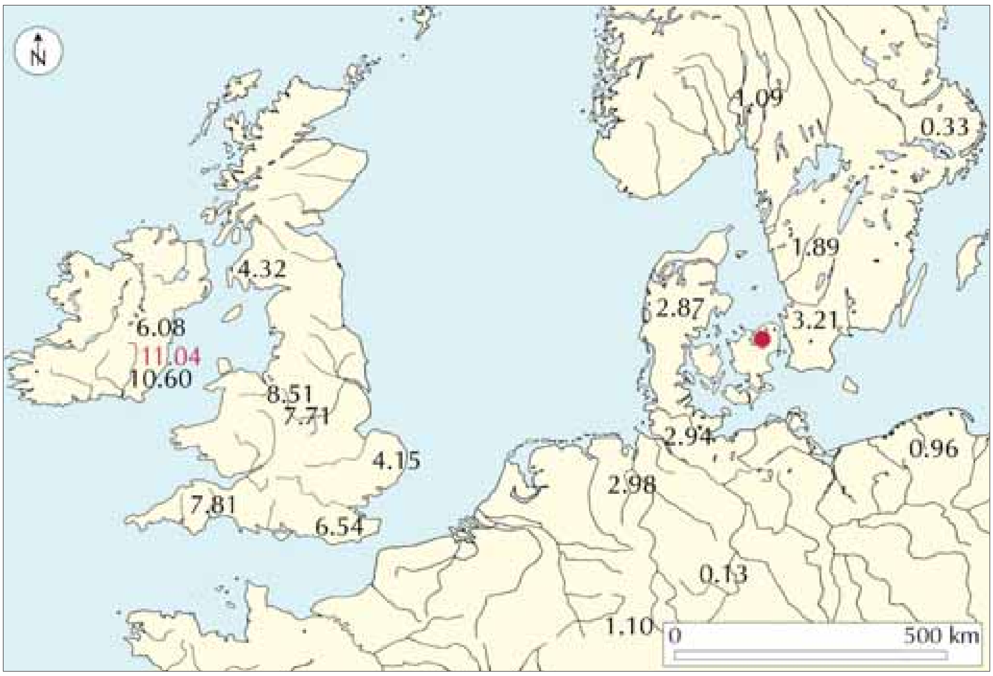



*Fig. 53. Skuldelev 2. t-value map, construction phase.*

12. Baillie 1995: 23
13. Baillie 1982: 46-51; Bonde 1999

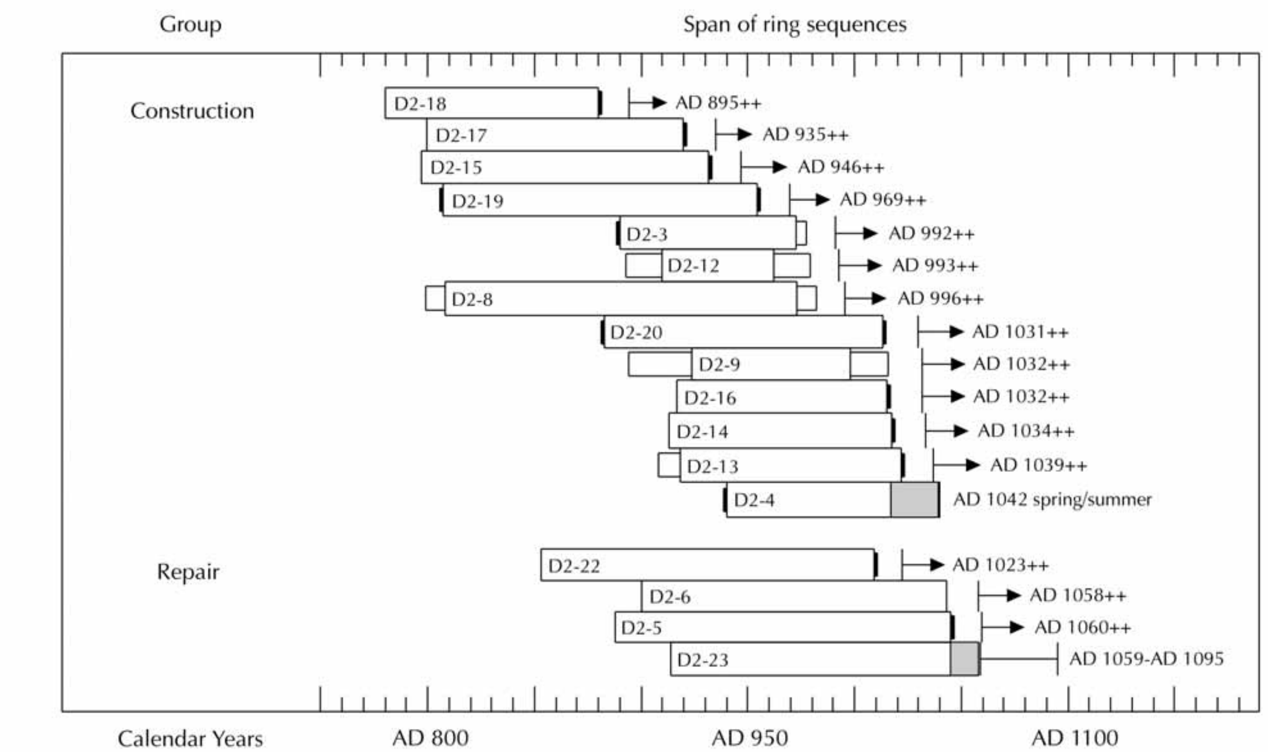
represents one tree where twelve of the tree-rings are of sapwood. The curve cross-dates with master chronologies from England and Ireland and covers the period AD 853-1057.

From the *t*-values that result from the comparison of these dates, however, it is not possible to specifically identify the area where the tree grew. This is perhaps due to the fact that the curve represents values from only one tree, in contrast to the mean curve discussed above, which has better replication, as it is calculated on the basis of nine different trees. By also using Irish sapwood data in this case, - since the area of origin cannot be exactly determined - a maximum felling date range for the tree of AD 1059-1095 is produced. Therefore, it was within this date range that the repair was carried out, probably in the early part of the period, the 1060s. This is because the repair planks are likely to have been taken from a relatively young tree.

*Conclusions*

On the basis of the dendrochronological study (Fig. 54), Skuldelev 2 was built of oak timber that was felled in AD 1042 somewhere in the coastal region of south-east Ireland, most likely in the Dublin area. It is furthermore probable that the ship was built in the area where the trees grew, and that these were felled and used directly for the construction without seasoning or previous use for other purposes. Approximately 25 years later the ship was repaired, probably in the 1060s, with planks from a tree that had grown somewhere near the coast of the Irish Sea, in either Ireland, Wales, or England.

*Fig. 54. Skuldelev 2. Dendrochronological dating, absolute dates. Sapwood statistics 95% confidence.*



### 5.2.6 General conclusion and parallels

The primary evidence, presented above, has made it possible to reach conclusions about the nature of Skuldelev 2 in its active period before the scuttling. All major questions regarding ship-type, size, date, and origin have been answered within narrow limits, even though many details of the upper part of the hull and the rigging remain unknown. These questions cannot be answered without taking account of information from other sources.

Here the preceding sections of this chapter are summarised and compared to relevant evidence from similar ships of the tenth to twelfth centuries, which in turn serves as the basis for the presentation, in Volume II, of a hypothetical reconstruction of Skuldelev 2 as a functional longship.

*Summary of the Skuldelev 2 evidence*

In 1042, or soon thereafter, the ship now known as Skuldelev 2 was built in eastern Ireland, probably in the Dublin area, from local resources of oak and with a few elements of willow. It was a proper longship, ca 30 m long and equipped to take ca 65 warriors across the open sea under oars and sail. We cannot know who had the ship built, but it must have been a person who had the building resources and ability to man the ship appropriately for personal transport, mercenary activities, or proper warfare.

The ship was built by highly-qualified craftsmen who worked within the Nordic shipbuilding tradition. Except for the width of the floor timbers amidships, all the recorded elements of the construction, and the techniques applied, follow the standards known from contemporary ships built within Scandinavia,[14] as well as from ships' parts excavated in Dublin.[15]

Practically all the construction materials were of a high quality, specially selected for their purpose and processed with an intimate knowledge to give the elements of the ship maximum strength and dimensional stability in a supple structure with minimum weight. At the same time, aesthetics played a role in the construction process. This was reflected in Skuldelev 2 by the intricate details of keelson knees and side timbers, but no doubt to an even higher degree by the lines, decoration and colours of the now-lost parts of the ship. These criteria were standard, common for all warship or personnel-transport vessels of the period known from Scandinavia, and to some degree also for ships of other types. It is possible, however, to distinguish between various levels of quality between the ships by comparing the materials, size of the planks, and the decorative finishes.

When compared with the Hedeby 1 longship and the Skuldelev 5 ship, Skuldelev 2 is of a higher quality than that of Skuldelev 5, but below that of Hedeby 1.[16] In Hedeby 1, the planks of the ship in the preserved bottom section are of the highest quality: radially-split oak, some of which are over 10 m in length and up to 37 cm broad. All the plank-scarfs in this ship were carefully cut as tongue-scarfs and decorated with clear-cut mouldings along all edges as were all other parts of the ship. Although there are slight traces of sapwood on some of the planks, the materials and the craftsmanship found in Hedeby 1 have been characterised as being of a superior, royal standard.[17] Skuldelev 2 falls short of this level of craftsmanship, however, as its planks do not exceed 6.2 m in length and 26 cm in width (within the preserved parts), and some planks are of secondary quality, and normal, short scarfs were utilised.

The standard of materials for the planking of the Skuldelev 2 longship matches that of the bottom planking in Skuldelev 5, but in the latter ship, the upper planks as well as possibly one of the floor timbers were reused materials of a mixed, and in some cases secondary, standard. The extant remains of Skuldelev 2 give no indication of short-cuts, such as the use of inferior or recycled materials in the ship (Fig. 51). However, the shipbuilders evidently did not have access to large trees for the planking such as those used in the construction of Hedeby 1, and they sometimes had to accept planks with moderate defects, possibly to be used in places less exposed to stresses and strains. Therefore, the quality of the craftsmanship and materials of the Skuldelev 2 longship, measured on a scale of superior to inferior, deserve a classification in the middle.

Skuldelev 2 evidently had a long working life in the Irish Sea region, beginning, probably 1042/43, and lasting until the ship arrived in Denmark. This fact is clearly demonstrated by the many repairs to the planking and the traces of wear on the outer side of the bottom planking. According to the dendroanalysis, the major repairs to the first strakes were carried out with planks from a tree felled in the Irish Sea area, probably in the 1060s, 20-25 years after the launching of the ship. Before that time, however, other repairs had already been undertaken, as evidenced by additional nail holes in the keel and planking. Even after the repairs in the 1060s, the ship remained in active service for some years, as demonstrated by the fact that the bottom planks saw further erosion on the outside even after this repair had taken place (cf Fig. 52).

The history of this longship is therefore most likely to be linked to the history of the region around the Irish Sea, concentrated, perhaps, around the Dublin area during the period from 1042/43 to the later part of the 1060s. At the end of that phase the ship was sailed to Roskilde. Here it was chosen to be used in the second phase of the barrier in *Peberrenden*, probably in the 1070s (cf Chapter 6.5). In Chapter 6.4 the individual history of Skuldelev 2 is discussed in relation to the historical background in Ireland, England, and Denmark in this period.

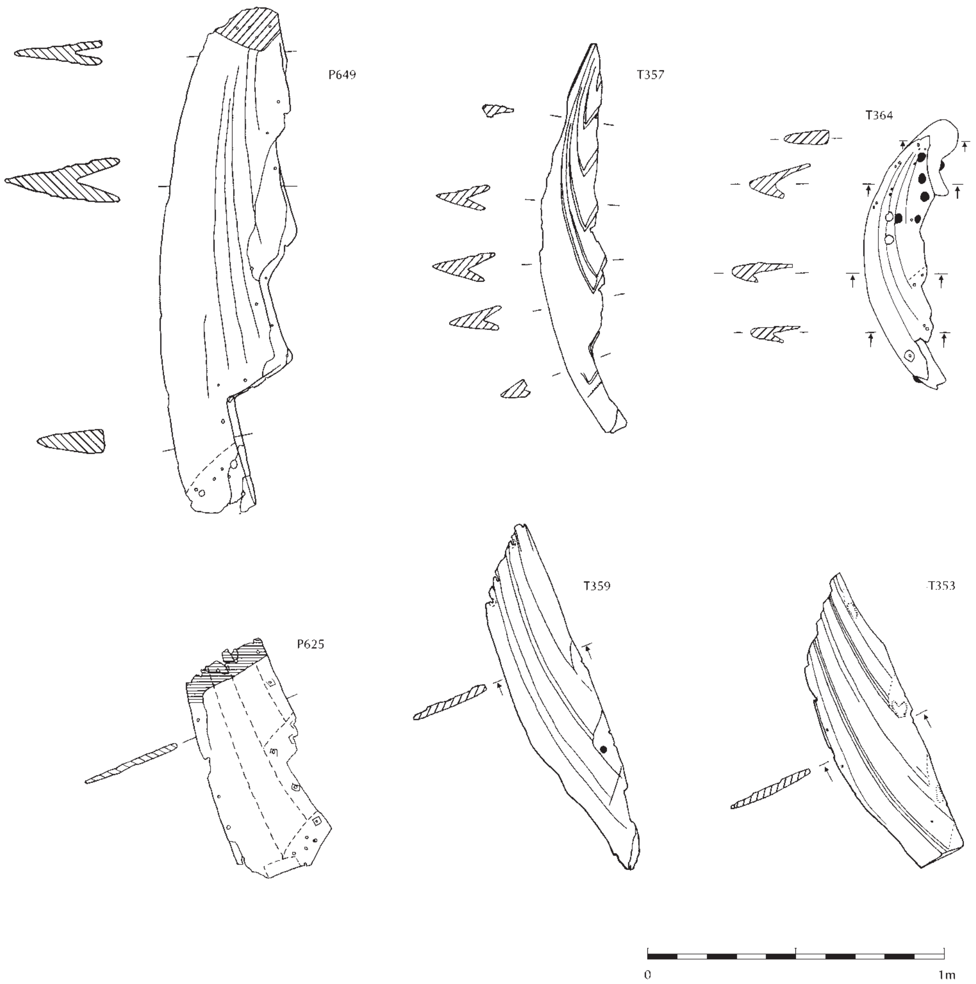



*Fig. 55. Stems and multiple end planks from 11th-12th century Dublin shown at scale 1:20, shown together with the corresponding elements from Skuldelev 2. T357 and T364 are stems from Fishamble Street; T353 and T359 are multiple end planks from John's Lane. After McGrail 1993.*

*Parallels in Irish and English ship-finds*

The ships' parts found at the excavations in medieval Dublin[18] are obviously to be taken as a starting-point in the search for parallels to Skuldelev 2. Sean McGrail has analysed the Dublin timbers in order to determine whether the parent boats and ships of these timbers were constructed in the mainstream of Viking/Norse tradition or whether they instead represent a regional variant.[19] These timbers are reused elements from vessels dating to the tenth to thirteenth centuries and ranging in size from small boats to large ships, none of which are represented by more than a few elements or panels of planking. Those elements which have undergone dendroanalysis all seem to have been built from trees that grew in the local Dublin area. By carefully checking all details of selection and conversion of timber, joints, fastenings, framing patterns, building sequence, tool marks and decorative mouldings, repairs, propulsion, and steering, McGrail concludes that up to the mid-twelfth century, the overwhelming evidence is that Dublin ships and boats belonged in the mainstream of the Viking tradition. At the same time, he concludes that the Dublin timbers demonstrate no evidence for rowing in large ships, and

14. Crumlin-Pedersen 1997a, Chapter 9.1
15. McGrail 1993
16. Crumlin-Pedersen 2002
17. Crumlin-Pedersen 1997a: 93
18. McGrail 1993
19. McGrail 1993: 83

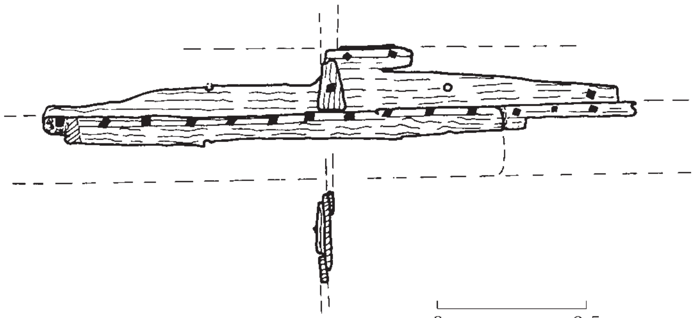
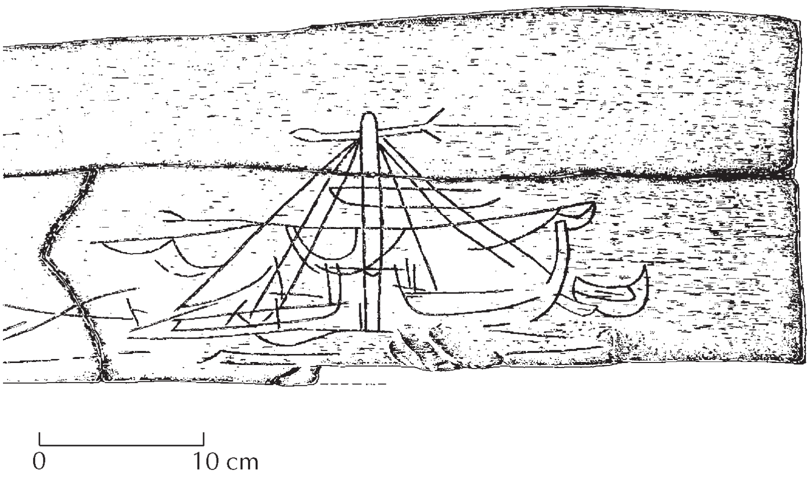
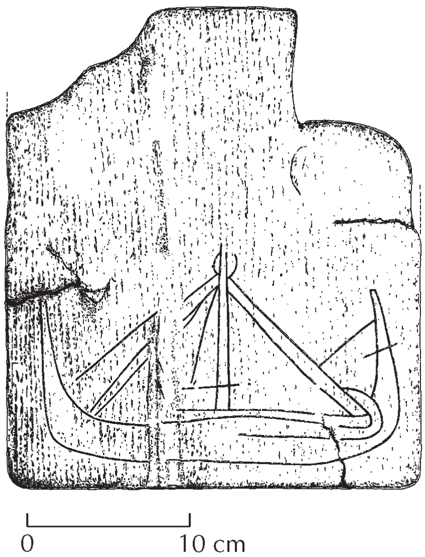



*Fig. 56. Viking-style planking with moulded edges, slender side-timber and square-shank rivets from Vintners Place, London. After Goodburn 1994.*

*Fig. 57. Graffiti showing ships of longship character, found in 11th-century layers in Winetavern Street, Dublin. After Christensen 1988.*



that their form seems more appropriate to cargo vessels than to a galley-like vessel such as Skuldelev 2.[20]

There are a number of constructional features in Skuldelev 2 that have clear parallels with certain Dublin timbers. This is the case, for example, with the stem of multiple plank ends in Skuldelev 2. These plank ends have close parallels in finds of the eleventh-twelfth centuries from Fishamble Street and John's Lane (Fig. 55), but also in the stems in Skuldelev 3 and 5, constructed in Denmark.

Striking, however, is the fact that none of the floor timbers among those from Dublin are similar to those amidships in Skuldelev 2, which are broad and low, arched in cross-section over the second to fifth strakes, and have a 'butterfly shape' when seen from above. As mentioned above, these broad floor timbers were first suggested to be a possible diagnostic feature of Norse shipbuilding in the British Isles. This is evidently not the case as a general statement, although it may be relevant for warships built there, in contrast to the cargo vessels which seem to be the only types represented in the Dublin floor timbers.

The Viking-Age boat-graves from Scotland and the Isle of Man[21] do not supply information on traditions for building longships around the Irish Sea in the eleventh century, as the boats in the graves are generally too early in date, too small, and too poorly preserved.

From England, various ships and ships' parts from the tenth-twelfth centuries, found in the Thames river valley at the Graveney marshes and along the waterfront of London, have been analysed and published.[22] These seem primarily to reflect Anglo-Saxon traditions for building local boats and cargo vessels, although there are fragmentary indications of vessels of Scandinavian and Frisian origin. Thus there are no guidelines in these finds to identify the features specific for the construction of Anglo-Saxon longships, except possibly some general characteristics of details of their clinker-planking.

One small panel of oak planking, reused in an eleventh-century revetment at Vintners Place, London,[23] may elucidate such details. The panel (Fig. 56) consists of parts of three strakes with moulded edges, with treenail holes spaced ca 80 cm apart, and with a fragment of a slender side timber similar to the ones in Skuldelev 2 and Hedeby 1 in position. These features indicate that the panel comes from a ship of the longship type with a frame distance of 80 cm. The rivets are recorded as having square shanks which, at this date, may indicate an English origin of the ship.[24]

*The iconography of eleventh-century warships in the west*

As Skuldelev 2 is so far the only sufficiently preserved example of an eleventh-century longship built within Britain and Ireland to be archaeologically recorded and thoroughly analysed, only iconographic and written sources can provide further information on this subject. These sources will not be fully exploited here, except for a few iconographic examples which appears to have been the product of first-hand observation of ships of this category. Direct observation by the artist is not always the case in such media as miniatures or other illustrations where ships are depicted within a framework of iconographic conventions and symbolic motifs.[25]

At the Dublin excavations, graffiti with ship motifs were identified on three planks, two of which came from eleventh-century layers at Winetavern Street. These probably depict longships, in contrast to a third ship depiction from Christchurch Place that shows a deeper and more blunt ship.[26] The two longships do not display any great detail, but in both cases they seem to be the product of the leisure-activity of an eye-witness, not restrained by artistic conventions and external motifs (Fig. 57). Both graffitied ships have relatively long and low hulls that end in high rising stems. The masts are shown but no oars or oar-ports. It is of interest to note that the upper edges of the ships' sides are either continuous from the stems to amidships or rise to a higher level towards the middle of the ship, as shown in the larger of the two illustrations. This feature may represent a tent raised over the midship length of the ship, to be used while the vessel was at anchor.

Another iconographic source of considerable relevance to this study is the Bayeux Tapestry, designed by an English artist. The tapestry reflects a Norman perspective of the events of 1066 and was made a few years later.[27] It is contemporary with Skuldelev 2 and depicts Norman as well as English warships in considerable detail. The tools and techniques applied in constructing and handling the ships as shown on the tapestry have been analysed and found to be very realistic by the experimental archaeological activities with the Skuldelev ship reconstructions.[28] Therefore, the ships on the tapestry should not be ignored as evidence of those that took part in the events leading up to the invasion in 1066. The question posed by David Wilson as to whether the artist had actually ever seen a ship of *any* type, is therefore to be considered purely rhetorical.[29]

Due reference must be made, however, to the artist's iconographic conventions that, for example, depict people oversized in relation to buildings and ships. The size of these ships cannot be determined by simple comparison with the size of the warriors or by their number. André W. Sleeswyk, in doing so, suggested a length of only 10-12 m for Harold's ship,[30] which must be considered a highly unrealistic size for a vessel used by the Earl of Wessex and his men for a voyage across the Channel. This suggested length would be little more than that of the ship's boat seen towed behind Harold's ship on the tapestry (Fig. 58),

20. McGrail 1993: 98
21. Müller-Wille 1970: 180-181
22. Fenwick ed. 1978; Marsden 1994 & 1996; Goodburn 1994
23. Goodburn 1994: 100-101
24. Cf Bill 1994: 59
25. Cf Varenius 1992
26. Christensen 1988
27. Wilson 1985: 212; Gameson (ed.) 1997
28. Crumlin-Pedersen 1986; described in detail in Volume II
29. Wilson 1985: 226
30. Sleeswyk 1981


*Fig. 58. Harold Godwinson's ship shown on the Bayeux Tapestry at various stages of his voyage to and from Normandy.*


*Fig. 59. Norman ships crossing the Channel in 1066. Figs 58 and 59 printed by special permission of the City of Bayeux.*

whereas his own vessel would most likely be a proper English longship.

Harold's ship is depicted several times on the tapestry with a variable number of strakes, oarports, and shields, and with differences in the colouring of hull and sail and in the decorations at the top of the stem. Although this might indicate that he had more than one ship for the mission, it is more likely that the artist simply wanted to create lively scenes and avoid simple repetitions. The artist felt free to introduce variants, as long as these appeared as realistic possibilities or meaningful simplifications by contemporary observers.

The depiction of sails on the tapestry is a good example of such a process of simplification. The first time a sail is shown (cf Fig. 58), it is presented in its full width at its top as well as at its lower edge. This would be too dominant an element in the composition, however, if the sails were shown in this way in all ships. Therefore, the other sails are only shown in full width at the yard at the top, whereas the lower part of the sail gradually narrows down to a single rope, symbolically held in the hand of the helmsman (Fig. 59). In practice, ships of this size would always have the sheet of the sail belayed aft at a cleat or on one of the beams. *In principle*, however, it would be the helmsman who was in control of the handling of the sail - which is exactly the message conveyed by the images of the ships on the tapestry.

Harold's English longship differ from the Norman ships in one characteristic feature. Harold's ship is consistently shown in its five representations to have a discontinuous

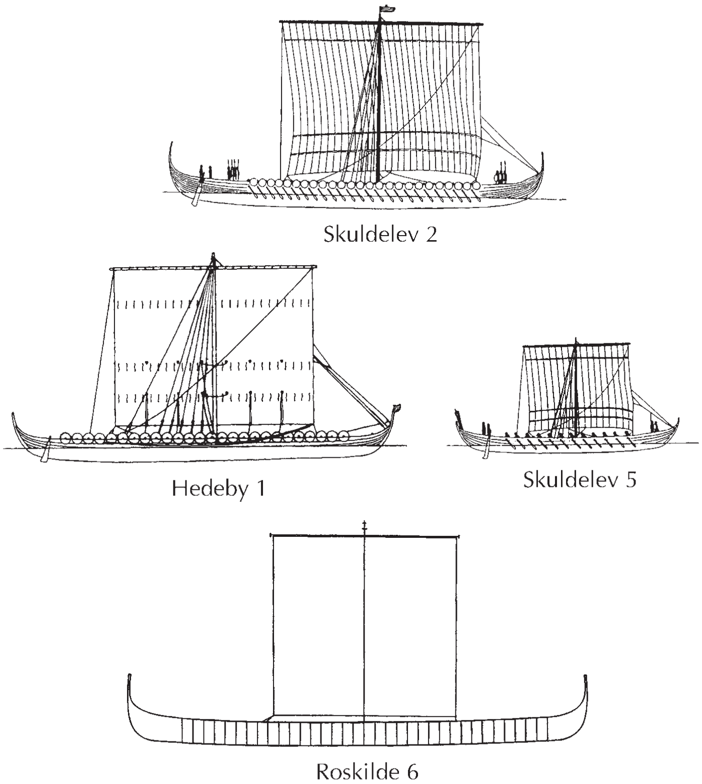



*Fig. 60. Hypothetical reconstructions of longships dated 975-1050. Scale. 1:160. After Bill* et al. *2000.*

sheerstrake with higher sides fore and aft and a lower area amidships in contrast to all the Norman ships. This difference is to be taken as a diagnostic feature for the longships of the two opponents, and possibly even for longships in general from England and Normandy. In the tapestry, one ship, identified as English in the Latin text, does not have this broken sheerstrake line. It is the ship bringing the news to Normandy that Harold had been crowned king after the death of King Edward. Considering that King Edward died in January 1066, this feature may indicate the use outside the normal sailing season of a smaller messenger ship rather than a ship of the longship class.

The study of the ships in the Bayeux Tapestry thus indicates that English longships of the eleventh century were characterised by their broken sheerline amidships in contrast to the longships from Normandy and, as we have seen above in the graffiti from Dublin, those from Ireland. Thus there would be no reason on the basis of this evidence to reconstruct Skuldelev 2 with a broken sheerline amidships.

*Longships found in Scandinavia*

The Viking/Norse tradition of longships combining their oars and sail for propulsion had a long afterlife in the Irish Sea and along the Scottish coast, as it is demonstrated by the construction of galleys known from medieval and later grave-slabs and historical records.[31] Here, however, the focus will be shifted to the Viking homelands for evidence of longships of the tenth to twelfth centuries.

The ninth-century Viking ships of the type known from the Norwegian finds from Oseberg, Gokstad, and Tune,[32] were not proper longships in the sense that they were much higher and broader in relation to their length (L/B = 4.2-4.7) than those from the tenth and eleventh centuries known today from southern Scandinavia (L/B = 7.3-13.1). This has been explained as the result of a differentiation of Scandinavian ships during the tenth century from a multipurpose ship-type to types specialised for warfare and cargo transport, respectively (Fig. 60).[33]

Ships from the tenth and eleventh centuries of a longship character with a length over 15 m and a L/B relationship over six are known from several sites. In addition to the two warships in the Skuldelev find, similar ships have been found in burial mounds at Ladby[34] in Fyn and at Hedeby[35] on the Schlei, in the harbours of Hedeby[36] (Hedeby 1) and Roskilde[37] (Roskilde 6), and from the barrier at Fotevik[38] in Skåne (Fotevik 3 and 5). Parts of such ships have also been found at Hadsund, Hasnæs, Vorså, Aarhus Bugt and Schleswig along the eastern coast of Jutland.[39]

These finds are all of a fragmentary character, with Skuldelev 2 and 5 as the best preserved among them. The Hedeby 1 and Roskilde 6 ships are preserved well enough and have substantial parts of the planking and timbers to allow the reconstruction of their approximate original dimensions and the principal features of their constructional layout. The ships from the burial mounds at Ladby and Hedeby represent entirely different conditions of preservation, as all wood had rotted away, leaving behind only the imprint in the ground with the rivets and nails. On the basis of the original recording of the rivets, and of new supplementary evidence from the Skuldelev 5 ship, it has been possible, nevertheless, to draw up a reconstruction of the Ladby ship.[40] The remaining finds mentioned above are too fragmentary to allow a reconstruction of the parent ships, but they nevertheless contribute additional evidence about aspects of the construction of these ships.

31. Rixon 1998
32. Nicolaysen 1882; Shetelig 1917; Brøgger *et al.* 1917
33. Crumlin-Pedersen 1999
34. Thorvildsen 1957, Sørensen 2001
35. Müller-Wille 1976; Wamers 1994
36. Crumlin-Pedersen 1997a
37. Bill *et al.* 2000
38. Crumlin-Pedersen 1984
39. Crumlin-Pedersen 1960, 1966, 1972, 1973
40. Bischoff & Jensen 2001

*Pictorial evidence of longships from Scandinavia*

The hypothetical reconstruction of Skuldelev 2 described in Volume II is based on the primary evidence from the wreck itself, supplemented by information derived from the finds mentioned above. For the character of the ship above the waterline and its rigging, however, not much information is provided by these remains. Therefore it may be worthwhile once more to study tenth- to twelfth-century pictorial evidence, specifically from Scandinavia, that is related to this ship-type.

The Gotland ornamented stones display a considerable number of ships, ranging from large rowing boats on the earliest stones to fully manned sailing ships on the latest ones. The dating of the stones, however, is uncertain, as diagnostic finds or inscriptions are generally not found together with these. Therefore Sune Lindqvist and Erik Nylén[41] could only arrange the stones in roughly dated groups of which the latest has a time-range from 700 to 1100, making it impossible to distinguish between early-Viking and late-Viking ships as is necessary for this survey. More recent studies by Björn Varenius and Lisbeth Imer have narrowed down the time-frame for some of the groups, however.[42] An analogous group of ship depictions is found on stones with runic inscriptions. In general these can be dated more precisely on the basis of studies of the inscriptions.

Out of the seven or eight ships that are depicted on such stones found within Viking-Age Denmark, the rune stone from Tullstorp in Scania is a major example[43] (Fig. 61). Its inscription: "Kleppe and Åse set up this *kuml* (monument) in memory of Ulv" is simple, yet datable to ca AD 1000. The ship, together with a splendid beast and two wolf's heads, is an element in a composition reflecting aspects of pre-Christian mythology. Here, as on other rune stones and the Gotland stones, there is never any direct connection to be found between the inscription and the pictures.[44] The interpretation of these scenes is the subject of a lively debate,[45] as the ship may be seen in several different roles: as the magic ship *Skíðblaðnír* of the god *Freyr*, as the ship *Naglfar* of the *Ragnarök* myth, as the boat from which the god *Thor* fished for the World Serpent, or as a means of transport for the deceased to the next world. In the case of the Tullstorp stone, the combination of the ship and the beast makes a good case for the *Ragnarök* myth of the end of the world, involving the wolf *Fenrir* and the ship *Naglfar*.

The ship on the Tullstorp stone, therefore, does not represent the ship of Ulv, for whom the stone was erected, if he ever had a ship himself. It was a symbol related to another world, an icon for a myth which may have been composed centuries earlier and have little bearing on the actual character of contemporary longships. The Tullstorp ship has ram-like projections at both ends, and a similar profile is seen on several other rune stones, Gotland stones, and coins from the early ninth century. These features probably are reminiscent of an early stage in the transition of Scandinavian ships from rowing vessels to sailing ships before the beginning of the Viking Age.[46] No stems of this character have been found in Scandinavia, neither among the few pre-Viking finds, nor among the numerous Viking-Age stems found with a ship or as loose elements. This does not, however, preclude the possibility that ships were built this way for a period, possibly in the seventh and eighth centuries, and that these ships played an active, formative role in the myths at that time. Even many of the rigging details that can be seen on several of the Gotland stones appear to represent early stages in the adaptation of sailing

*Fig. 61. The runic stone from Tullstorp, Skåne/Scania. Dated to ca AD 1000 by its inscription.*

41. Lindqvist 1941-42; Nylén 1978
42. Varenius 1992; Imer (forthcoming)
43. Danmarks Runeindskrifter no. 271; Moltke 1985: 249
44. Moltke 1985: 252
45. Cf the articles in Crumlin-Pedersen & Thye (eds) 1995
46. Crumlin-Pedersen 1997b
47. Blindheim 1985: 13-16
48. Roussell 1954
49. Herteig 1969: 88; Hougen 1974; Le Bon 2001; Spurkland 2001
50. Hallberg 1978; Malmros 1986

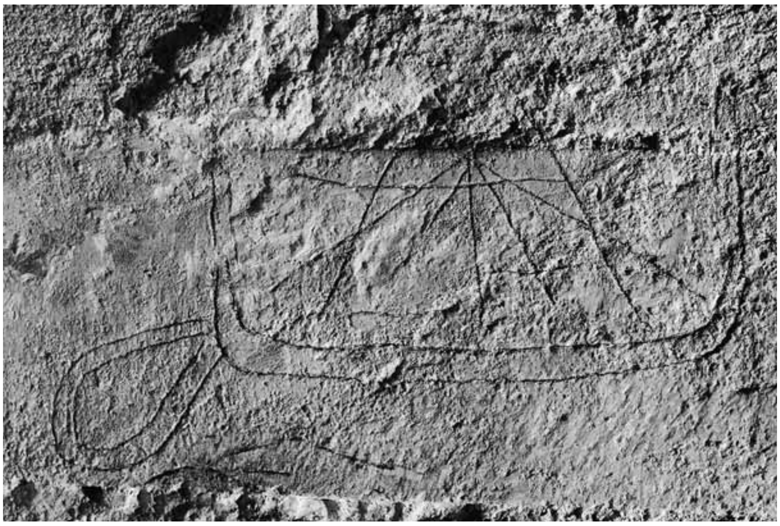


*Fig. 62. Graffito of longship of the 12th century from Horbelev Church, Falster, Denmark.*

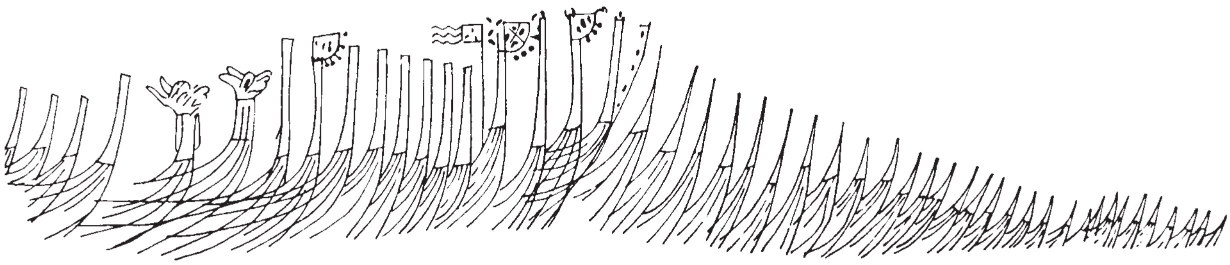
technique to the ships of the North, rather than the fully developed and highly functional rigs of the late Viking Age, reflected in the details of Skuldelev 1 and 3.

In order to identify ships' pictures of a similar eye-witness character as those from Dublin, more informal graffiti must be examined. Such sketches cut into wood or scraped into plaster were probably very commonly made by craftsmen building early churches.[47] These men evidently had experience with ships and they may have used the sketches as a display of their artistic talent. Among the graffiti of this character, a few from twelfth- and thirteenth-century Norwegian and Danish churches depict longships. The late twelfth-century Romanesque churches at Eggerslevmagle and Horbelev in Denmark, have renderings of longships cut into the building stones or in the plaster in places only accessible to the craftsmen who built the church.[48] The Horbelev image displays in its own clumsy way the long and low hull of a longship with high stems, a few lines for mast and rig and an exaggerated side-rudder aft (Fig. 62).

The last example to be mentioned here is a stick from Bergen in Norway dated to the early fourteenth century by the fire layers.[49] The stick is carved with runes and four ships on one side, and on the other side it depicts an entire fleet of ships in a casual but artistic way (Fig. 63). On the one side of the stick, a total of 44 stems are lined up as a similar number of ships of the *leidang* fleet might have appeared when assembled in Bergen harbour. The other side shows a complete ship with oarports, side-rudder and figureheads of exaggerated size, as well as three isolated stems and a runic inscription, *hér ferr hafdjarfr*, "here sails the sea-brave one," or, alternatively, "here sails the valiant master of the waves."

Among the 44 stems there are two with figureheads, three with 'weather-vanes' in the stem, one of these even with a standard, thirteen with high stems ending bluntly and the remainder with pointed stems as known from Skuldelev 3. It is unlikely that we will ever find a more pertinent visual impression of a traditional Norse fleet comprised of longships similar to Skuldelev 2. The image has a quality that matches the best of the skaldic verses describing similar fleets in words that are worthy to praise kings.[50]

*Fig. 63. Renderings of ships and runes on a stick found in 13th-century layers in Bergen, Norway.*



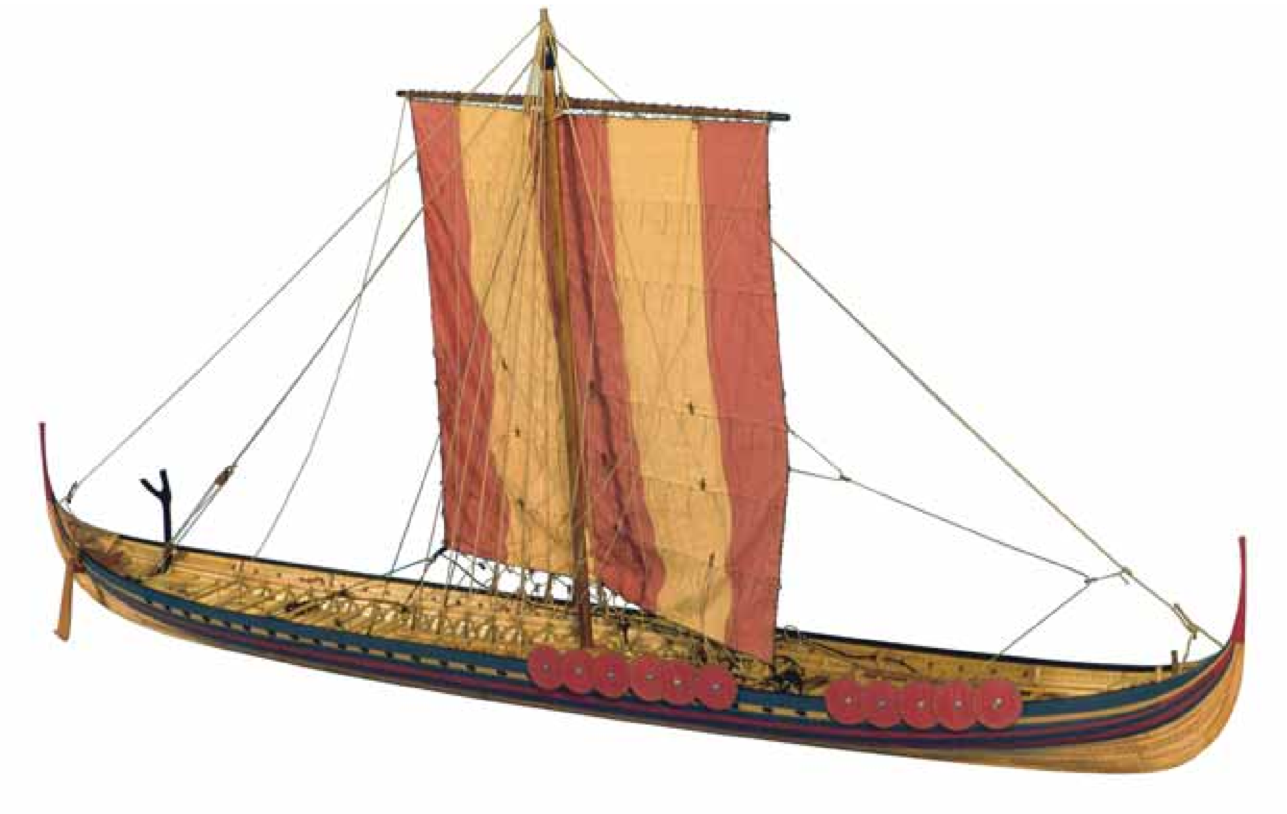


*Fig. 64. A model of the Skuldelev 2 longship as it may have looked in ca 1050. 1:10 scale model made by Morten Grønbech, with the rigging reconstructed by Erik Andersen and Vibeke Bischoff.*