Archaeonautica

Shallow-water craft from medieval Denmark

The identification of a specialized regional ship type

Jan Bill

Résumé

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De récentes fouilles ont permis de connaître un type spécial de navire conçu pour le cabotage en eaux peu profondes dans le sud-est du pays. Ces découvertes nous éclairent sur la manière dont les eaux intérieures étaient utilisées, sur le type de transport et nous permettent de mieux comprendre quelles forces régissaient l'économie et la société du Moyen Âge.

Cet exposé rappelle brièvement les évolutions du paysage urbain danois en 1000-1500 en termes d'accessibilité par navire. Il démontre la présence dans le sud-est du Danemark, d'un type de navire adapté à des eaux peu profondes et précise en quoi cela modifie notre compréhension de l'économie médiévale. Enfin, il tend à déterminer pour cette même période, l'existence dans l'ensemble du pays d'autres navires d'un type comparable.

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INTRODUCTION

It has been claimed that local seafaring in the sense of domestic transportation is and was an important part of the foundation for international trade and therefore of interest for the students of History[1]. While this is obviously true, it is but one aspect of the small craft navigation we observe so abundantly during the Middle Ages. Domestic or regional transportation was equally vital to the interior functions of any country or landscape of which water bodies formed a significant part. So political power was dependent on communication, in many cases inevitably seaborne, and on economic resources which had to be moved to be explored. Denmark, with its many sounds and islands, is an obvious example of this. During the Middle Ages, political power here came increasingly to rest on money, a development which by necessity must indicate that a growing part of the agricultural production was turned into currency through trade[2]. Transport, and thus seafaring, was a part of this conversion process and thus the small scale seafaring was also a part of international trade. As the major foreign consumers of Danish agricultural products were found nearby, in Northern Germany and the Netherlands, an important part of the Danish import and export trades took place on very small vessels[3]. Some of those evidently also served the important

1. F. HOCKER. Lelystad beurtschip. 1991. p. 89.

2. B. POULSEN. Kingdoms. 1995.

3. C. WEIBULL. Lübecks sjöfart. 1966.

function of carrying royal messengers to and fro while others probably had other specific functions: the annual herring fishery undoubtedly being an important one.

The humble *skute* and other modest vessels plying the narrow and mostly sheltered waters dividing Denmark from Germany, Sweden, Norway and the Netherlands, Denmark may thus have played a far more important role in medieval and early modern society than their appearance seems to indicate. But in opposition to the large seafaring that had its offset in the highest political and economical strata, small seafaring set out from the much less highlighted, lower levels in society. The study of small scale seafaring is thus the study of vital interests of the medieval state at work in the very foundation of society. But, this appealing research perspective has its difficulties too: small wrecks are much more anonymous than large ones, in the sense that the potential group of owners, as well as potential uses, are much larger and less distinct. The study of small scale seafaring prompts us to discuss the *where* and the *who* of seafaring much more intensively in order to answer the *why*. The purpose of this article is to help facilitate that discussion.

NATURAL SCIENCE AND THE ESTABLISHING OF A SHIP'S PROVENANCE

First it should be said, that the provenance of a ship is here regarded as the place from which it was operated, not where it was built (its origin) or where it was occasionally found (its provenance as an archaeological artefact). Thus the provenance can be one or more places throughout its lifetime, or the provenance might be an area rather than a location, for example, if a vessel was engaged in tramp trade. The provenance is thus a highly difficult concept, but as it defines one central archaeological parameter – what society was the vessel used by – it is indispensable and it is normally addressed along with a functional explanation in any interpretation of an archaeological ship find. Two methods from natural science are commonly taken into use in order to decide the provenance: dendroprovenancing and pollen analysis. Partly their success is based on the fact that most wrecks yield materials for one or both of these analyses.

Dendroprovenancing is a very efficient way of establishing the origin of wood. A splendid example of the potential of this method is the investigation of the longship *Skuldelev 2*, which was, after a long life of service, deliberately sunk as part of a seaway blockade in the Roskilde fiord in Denmark. The analysis showed that the vessel originally had been built in Dublin in or around AD 1060[4]. In most cases, however, the answers obtained from dendroprovenancing are much less distinct. One reason is that most master curves, against which the dendroprovenancing is done still covers fairly large areas. While this situation will improve over time, another obstacle is that some areas probably will prove to have too large a natural variance in the growth pattern of tree rings to allow the establishing of regional master curves. Still it has not, for example, been possible to establish regional curves for southeastern Denmark. Another factor of importance when discussing provenance from data like this is the growing timber trade and crafts specialization throughout the High and Late Middle Ages, even very precise information on the location, where the oaks used in a specific ship grew, might be immaterial if we want to know where the vessel was used. In some cases, later repairs, alterations or wooden objects in the cargo can provide useful dendrochronological information on the ship's area of operation, but the accuracy of this information in terms of provenance of the ship has to be considered carefully.

The study of large and small fossils, that is, pollen analysis along with determination of wood and plant species found either in the ship's construction or in the cargo, might sometimes contribute to fairly exact determinations of the origin or operating area of a vessel. The newly excavated wreck *Sørenga 2* from Oslo, Norway, illustrates this. The ship was almost exclusively built of oak, which is not common in Norwegian shipbuilding and suggests that the vessel was built elsewhere. The dendro analyses, which established a felling date to around AD 1355, pointed toward an area of origin in the South-Western Scania or further to the east as far as Småland/Öland. Through pollen analyses of the moss luting, it was demonstrated that this probably originated from the Danish islands or the Southern shore of the Baltic. Considering all this evidence it seems most likely that the vessel was built in South-Western Scania, a more specific origin than the one given by dendroprovenancing alone[5]. However, this result derives from the ability to combine pollen analysis with dendrochronology, and from the small intersection between an eastern provenance of the dendro-sampled wood and a western provenance of the pollen-sampled luting. In the majority of cases, and especially if concerning the provenance rather than the origin of the ship, such efficient combinations would be difficult to obtain as they

4. N. BONDE, O. CRUMLIN-PEDERSEN, Dating the Longship, 1990, p. 3-6.

5. K. PAASCHE, J. RYTTER, *Innberetning Sørenga Delprosjekt*, 1995, p. 153f with references to pollen analysis.

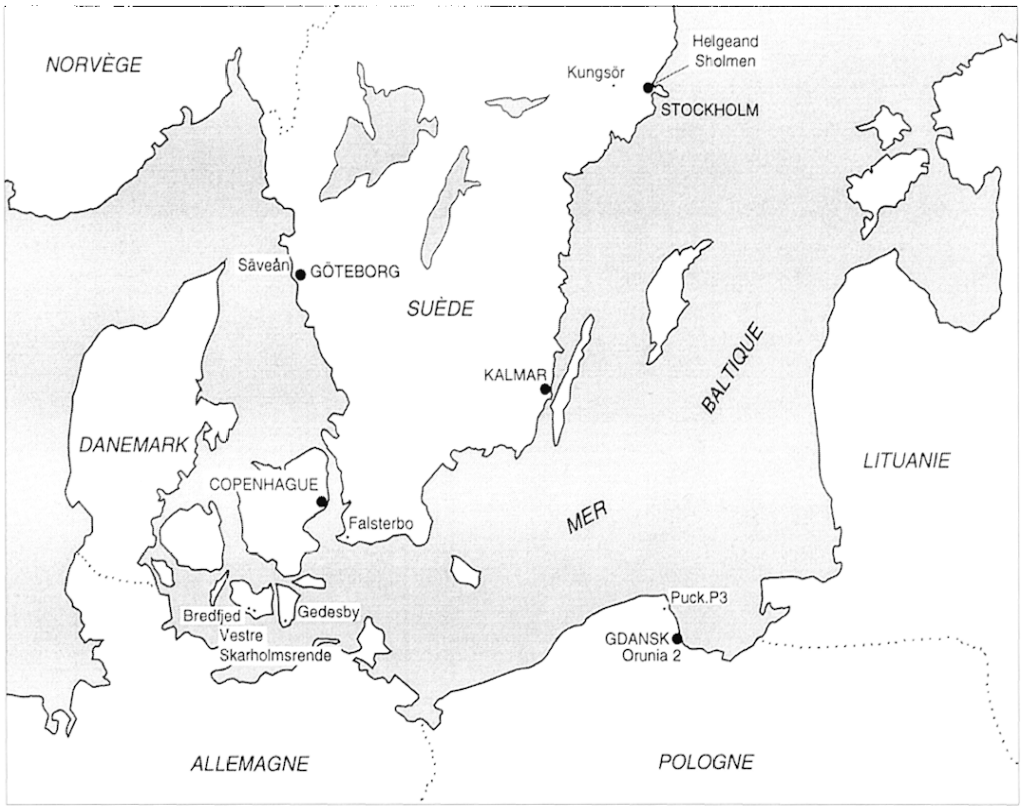

Fig. 1: *Distribution map. (Drawing M. Rival, CNRS-Centre Camille Jullian).*
Carte de répartition des sites. (Dessin M. Rival, CNRS-Centre Camille Jullian).

demand the pollen and the wood actually to be locked together in a perfectly temporary context. Pollen analysis alone, or along with macro fossil studies, usually gives only quite vague information about origin and/or provenance, compared to the standard necessary for the study of small scale seafaring.

Depending on the actual finds in a shipwreck, other methods from natural science might be put to use. Stones, bricks or sand from ballast or cargo can be traced geologically, or the trace element contents of metals can be studied. Given that the relationship between the objects found and the ship is representative of the vessels' operating area, such analysis can be extremely helpful in this respect. But they do in general suffer from the same limitations as those mentioned above.

REGIONAL SHIP TYPES: A QUESTION OF IDENTIFICATION

An alternative method to decide the provenance of a ship find and one, which avoids the pitfalls of timber trade and specialized shipbuilding centers is to establish it as a representative of *a regional ship type*. Basically, the existence of such ship types can be claimed in two ways. One is purely statistical: if an overwhelming proportion of a specific type of wreck is found in a specific area, and rarely outside, it should be regarded as regional to this area. This method is normally not applicable because of the small number of finds. The second is based on a functional interpretation of a vessel type, which links it to specific conditions of a given area and/or trade. Even this method requires a certain amount of statistical probability, but obviously not as much as a purely statistical approach does. For example, when a few late 15th century wrecks found in the southern end of the Zuiderzee show a hull-form and constructional features that point toward a strong concern for keeping total width within certain limits, it seems reasonable to link those finds with the existence of locks and canal systems, the *binnenweg*, on the southern fringe of the Zuiderzee[6]. Those finds can thus be interpreted in a more specific way than if regarded simply as Zuiderzee or Dutch vessels.

6. F. HOCKER, Lelystad beurtschip, 1991, p. 147.

These methods have their pitfalls however, the most obvious one being insufficient statistical foundations. Archaeological distribution patterns are strongly influenced by the amount of archaeological and other types of earth work carried out in the areas in question. This is true for the archaeology of medieval ships too, as the bulk of data on those finds are derived from land excavations. Reclamation of coastal areas, paired with archaeological legislation and interest, is the main spur for growth in this field, and neither has been evenly spread throughout Northern Europe. Especially seen in the more detailed perspective of regional seafaring, the white spots on the distribution maps over the Baltic and North Sea countries are many, and few areas actually show a density of finds comparable to that of the Zuiderzee. Fortunately the area covered by medieval Denmark does, and it is the material from here, from two different, reclaimed areas, that will be discussed below (fig. 1).

THREE SHIP FINDS FROM SOUTHEASTERN DENMARK

In 1989, a well-preserved medieval ship was found during dredging of the ditches in a reclaimed fiord, Bøtø Nor, on the southern part of the Danish island Falster south of the Sound. The wreck, named *Gedesby* after a nearby village, was excavated and raised for conservation and exhibition in 1990 (fig. 2). By then, it could be established that it had once been a small (approximately 13 m long) and very beamy cargo-carrier (fig. 3), whose last cargo had been living cattle, which had embarked from somewhere in the southwestern Baltic on a late summer's day[7]. Also, it could be demonstrated that it had earlier been carrying limestone from quarries further north in the Sound, at Stevns. The wreck failed to give any dendrochronological dating, but four C14 datings placed its construction and operation to the late thirteenth century. Most astonishing was the very heavy timber used for the lower portion of the stem: a large knee-shaped timber, with a horizontal leg of 1,5 m and transforming into a 0,5 m deep, slightly curved stempost (fig. 4). The sides of the stempost were smooth and parallel, without any rebates for the hood ends. While common in cog-type vessels, the find was somewhat surprising when found in a fully clinker-built hull, especially with such gross dimensions. Another remarkable

Fig. 2: *The Gedesby ship from around AD 1280 under excavation in 1990. The ship, which had settled in silt layers and been rapidly covered with sand, was found with its shrouds in place and with evidence of having carried living cattle only days before it sank. It does shows signs of wear, particularly along the underside of the stem, keel and stern, but not of excessive repairs. (Photo Institute of Maritime Archaeology, Roskilde).*
L'épave de Gedesby (c. AD 1280) en cours de fouille en 1990. Le navire, situé dans des sédiments de vase, a été rapidement recouvert par du sable. Les haubans étaient conservés. Il est vraisemblable que le bâtiment avait transporté du bétail peu de temps avant son naufrage. Il présentait par ailleurs des traces d'usure sur l'étrave, la quille et l'étambot, mais ne semblait pas avoir donné lieu à des réparations importantes. (Cliché Institute of Maritime Archaeology, Roskilde).

feature of the stem was a large, circular hole, cut through the stempost just ahead of the planking and so far down that it would undoubtedly be below sea level during navigation. No immediate explanation could be found for this hole, although it was obvious that it would be useful for pulling the vessel ashore, or in other situations where large dragging forces would be conveyed into the hull.

The find initiated a search in the archives and literature for parallel examples. On the photos from a 1937 excavation on the nearby island Lolland, one was found: In another reclaimed area, the Rødby fiord, a farmer had struck wood when ploughing, and the excavation had revealed the approximately 11 m long wreck of a clinker-built vessel, with protruding beams and a stem, unmistakably of the same design as the I ship's. The keel of this find, however, implied a younger age: it did not have the T-shaped cross-section which was found in Gedesby, but was simply a rectangular, rebated and well-worn timber. The *Vestre Skarholmsrende* ship, named after the former channel in which it was found, had not been lifted after excavation, but left in place (fig. 5).

7. J. Bill, Gedesbyskibet, 1991; D. Robinson, B. Aaby, Pollen and plant, 1994.

Fig. 3: *The Gedesby ship as a replica, Agnethe, built by Middelaldercentret at Nykøbing-Falster in cooperation with the Centre for Maritime Archaeology at the National Museum of Denmark. Although Nordic in building style, the ship shows close resemblance to contemporary cogs and is one of many signs of the close connections in the southwestern Baltic during the High and Late Middle Ages. (Photo Viking Ship Museum, Roskilde).*
La réplique du voilier de Gedesby, nomméeAgnethe, a été construite par le Middelaldercentret à Nykøbing-Falster en collaboration avec le Centre for Maritime Archaeology (National Museum of Denmark). Bien que construit selon la tradition nordique, le bâtiment présente des similitudes avec les cogues et constitue l'un des nombreux exemples d'influences techniques avec l'espace de la Baltique du sud-ouest au cours du Haut et du Bas Moyen Âge. (Cliché Viking Ship Museum, Roskilde).

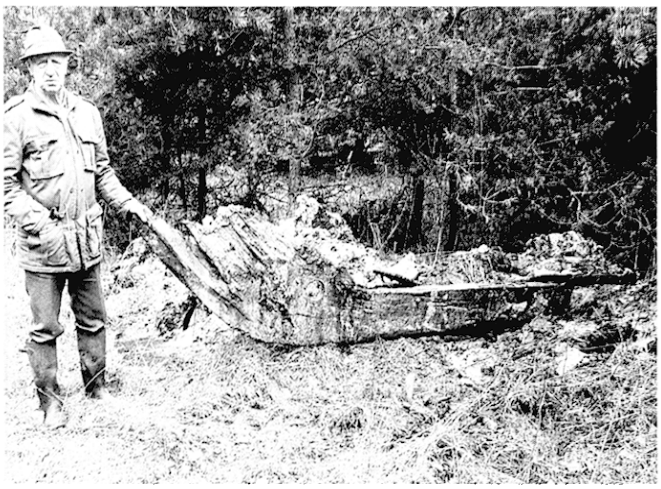

Fig. 4: *The impressive stem hook from the Gedesby ship. In spite of some damages, caused by the construction and dredging of the ditch, the wreck is one of the best preserved known from the Middle Ages. The unusual configuration of the stem initiated the research laid forward in this article. (Photo Falsters Minder, Nykobing Falster).*
La courbe impressionnante de l'étrave du navire de Gedesby. Malgré les dommages provoqués par la réalisation et le dragage du fossé, l'épave est l'une des mieux préservées du Moyen Âge. La forme inhabituelle de l'étrave est à l'origine de la recherche faisant l'objet de cet article. (Cliché Falsters Minder, Nykobing Falster).

A trial excavation in 1994 proved it to have rotted away almost completely, but enough luting was collected to allow one C14 dating, giving the result AD 1300.

Another promising find was done in the report from a partial excavation of a clinker-built wreck in 1967 at Bredfjed, also in the former Rødby Fiord. Although only the stern and part of the stem had been excavated, two now well known features were present: the very large dimension of the stempost on an only 12-13 m long vessel, and the very large hole cut through the stem at a low altitude. The records from the excavation pointed toward a very recent date for this wreck, due to the fact that all the strakes were made from sawn

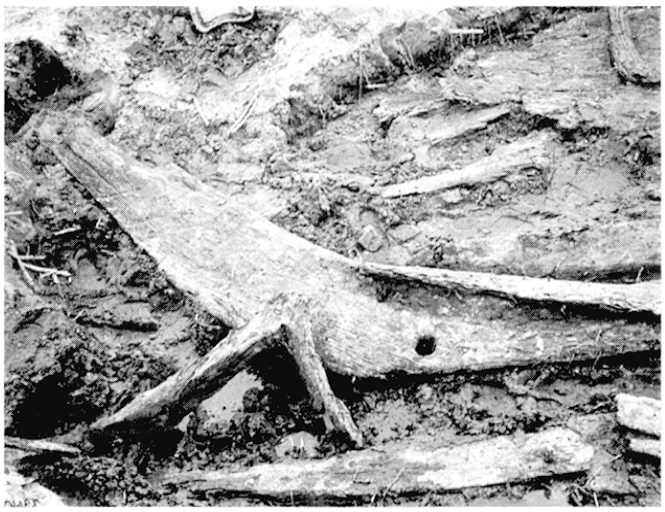

Fig. 5: *The stem of the Vestre Skarholmsrende ship during excavation in 1937. The wreck has unfortunately decomposed by now, excluding the possibility of dendro analyses. The C14 dating points toward a construction date of around AD 1300, although typological considerations suggest a later date. (Photo Danish National Museum).*
L'étrave de l'épave de Vestre Skarholmsrende en cours de fouille en 1937. L'épave n'est malheureusement pas conservée, interdisant toute étude dendrochronologique. Les datations par le carbone 14 situent l'épave vers les années AD 1300, bien que les critères typologiques suggèrent une datation plus tardive. (Cliché Danish National Museum).

planks. As this wreck was likely still to be in existence, a total excavation was planned and carried out in November 1993 (fig. 6). The wreck, of which the bottom and the bilges were preserved, proved to carry a massive stem of the type previously found, although the sides had individual rebates for each hood end and the stem-keel scarf was of a more sophisticated type. The date of the ship turned out to be even later than expected, as extensive dendrochronological analyses proved the timbers to be cut and the vessel to be built close to year 1600 AD[8].

The search in literature was less successful than that in the archives. As the distinction between knee-shaped and curved stems, as well as between stems with holes at low levels and stems with holes at higher levels can be nothing but arbitrary, an inclusive research strategy was chosen. All finds of stems found in clinkerbuild vessels from Baltic or Danish waters, which could be dated to between AD 1100-1700, and which were showing holes drilled or cut in the stem perpendicular to the center plane of the ship, were recorded. Those finds, their location, date and the length and beam of their parent vessels are listed in the catalogue in Appendix A. A simple drawing of each stem is shown in the comparison (fig. 7). All together, 17 stems met the requirement of a horizontally cut hole, but only one actually demonstrated both the hooked shape and the stem hole at a low altitude. This find originated from the excavations in the old harbour of Kalmar, southwestern Sweden. Wreck XVIII, an originally 9,5 m long boat, had a stem which was comparable to that of the *Bredfjed* ship even in the manner in which the hood ends were cut into the stem post. This find was stratigraphically dated to the 17th or 18th centuries but, given a certain age of the ship itself, there is nothing preventing the find from being contemporary with the *Bredfjed* ship. A less close parallel, short of the distinct knee-shape and the extreme length of the horizontal leg, is found in the *Helgeandsholmen IV* vessel, a 10,2 m long boat from 1420, excavated in Stockholm[9].

However, a simple, visual comparison of the stems is not an adequate way of estimating their likeness or difference. The proportions of each stem must be considered relative to the overall dimensions of the vessel, in which they have served as a structural and functional member. The working hypothesis for the functional explanation of the three heavy stems from Lolland-Falster is that they provided fastening points for pulling the boats out of the water. Therefore we should compare variables on all the stems relevant to this question in order to see if the three stems are likely to be exceptional in this respect. Two conditions would be of major importance, if the hypothesis is correct: the distribution of the pulling force throughout the stem and further on to the rest of the hull, and the direction of it so that it would lift the foreship rather than help it bury itself in the sea bottom. While the latter concern unambiguously would speak for a placement of the hole as low as possible, the question of distributing the forces evenly demands more elaborate consideration, including the actual shape of the stem. As no other structural parts of the ships than the planking, the keel and possibly a stem top would be attached to the stem piece in the type of Baltic, clinker-built vessels discussed here, the only points of transition for the pulling forces from the stem to the hull would be the fasteners keeping those parts together. The need to distribute large forces from the stem throughout the hull would thus encourage an increase of the number of fasteners connecting the stem to the hull. Just shortening the distance between the fasteners cannot be

8. T. Bartholin, *Dendrokronologisk*, 1997.

9. B. Varenius, Båterna, 1990.

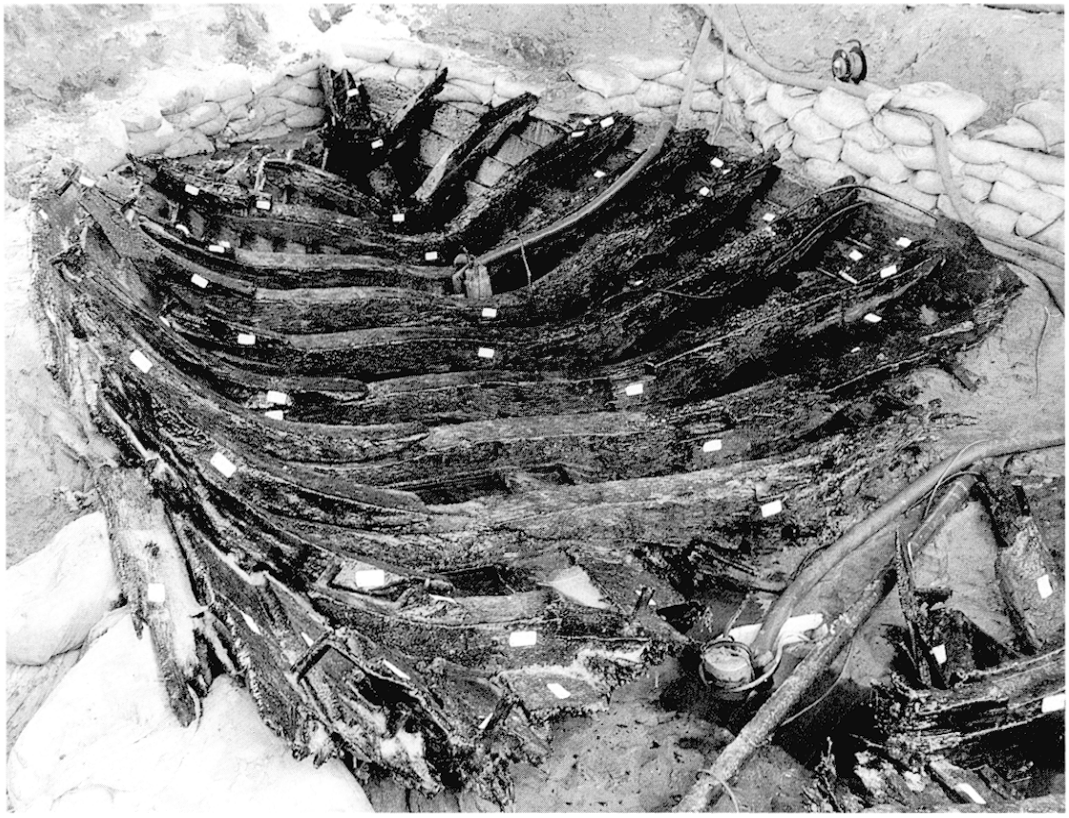

Fig. 6: *The Bredfjed ship under excavation in 1993, view toward the stem. In spite of being a more heavily built vessel and having a fuller hull shape, the Bredfjed ship shares important characteristics with other ship finds from southeastern Denmark. (Photo Centre for Maritime Archaeology, Roskilde).*
L'épave de Bredfjed en cours de fouille en 1993, vue vers l'étrave. En dépit de sa lourde structure et de ses formes pleines, l'étrave possède de nombreuses similitudes avec des épaves du sud-est du Danemark. (Cliché Centre for Maritime Archaeology, Roskilde).

done under a certain limit, as the forces would not be distributed to a larger part of the structure, but would be only more evenly transferred within the same area. Increasing the rising length of the stem would be possible, but has serious implications for the whole hull structure: either the hull would have to be made higher, allowing more strakes to be fastened to the stem, or the stem would have to be made more raking, thus changing the navigational characteristics of the vessel.

A less dramatic choice in terms of derived consequences would be to move the scarf between stem and keel further down the keel, allowing for more plank fastenings along the underside of the first strake to ally with the stem. Pulling forces from the stem would then be transferred via the nails in a direction more or less parallel with the grain in the garbord, exactly the direction in which it would be strongest. Also the choice of a hooked, or knee-shaped stem piece for a curved one would increase the number of such fasteners, improving the vessel's ability to withstand the stress of being pulled along the stem.

The above discussion makes clear that a possible habit of pulling the ships out of the water using the holes in the stem should lead to specific, constructional demands, ever more emphasized with the growing weight of the vessel. It also made clear that we might be able to see the adaptation to such a habit reflected in a prolonging of the horizontal part of the stems, as well as a low placement of the hole. Both features should be seen as relative to the size of the vessel. In figure 8, the length of the horizontal arm is shown together with the reconstructed length of the vessels. The length of the horizontal arm is defined as the distance from the middle of the keel/stem scarf to the point where the fiber direction of the planks, defined as parallel to the underside of the planks, is cut off in an angle exceeding 15°. When compared in this

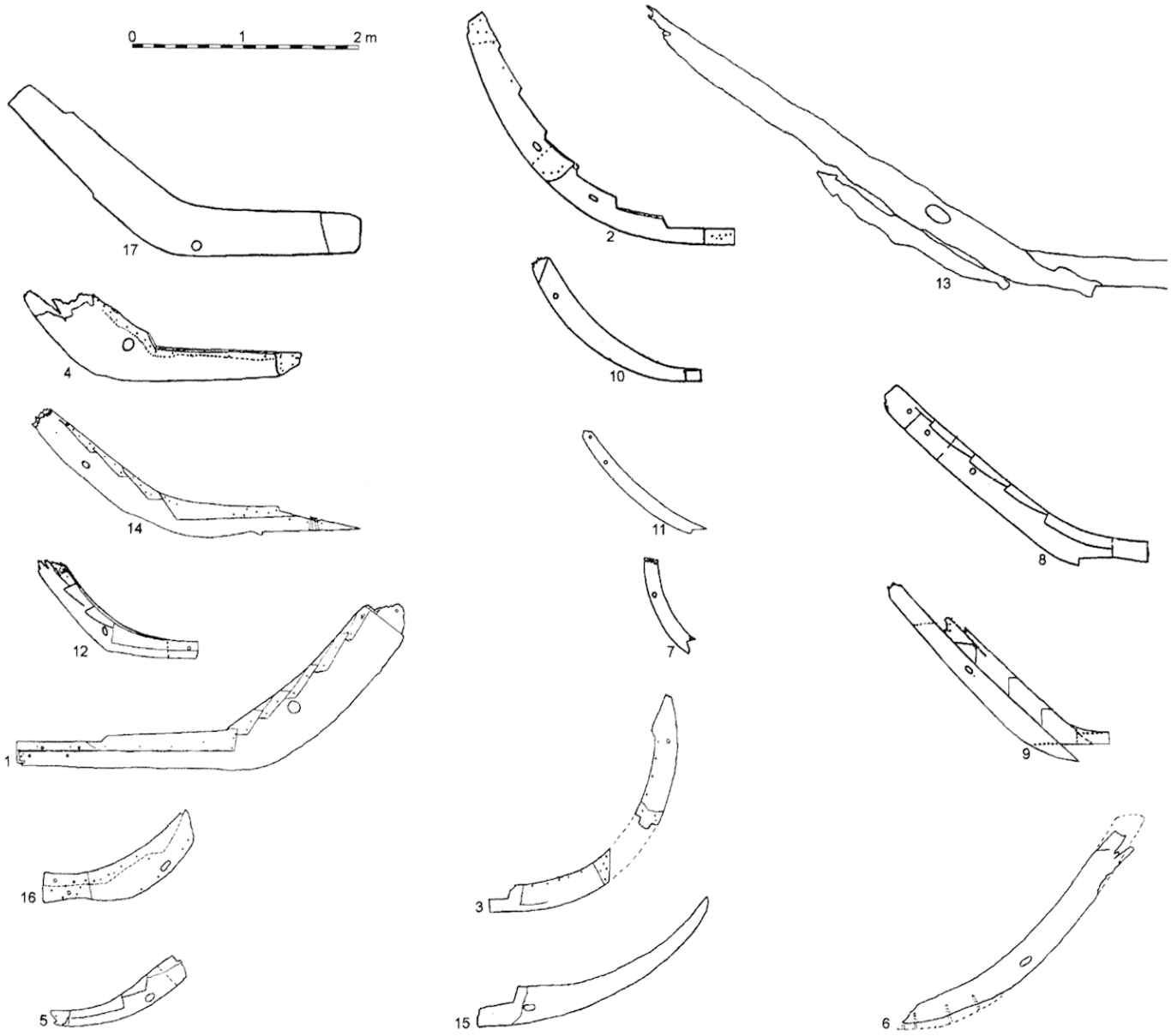

Fig. 7: *Stems with stem holes, found in wrecks in Danish or Baltic waters dating from AD 1100-1700. The stems are all shown to the same scale, but accuracy might vary depending on quality of sources. (References can be found in Appendix A).*
Étraves avec des « trous », découvertes au Danemark ou en mer Baltique et datant des années AD 1100-1700. Les étraves sont toutes figurées à la même échelle, mais la précision du dessin varie selon la qualité des sources utilisées (les références sont citées dans l'annexe A).

manner, the stems from Lolland-Falster clearly distinguish themselves from the rest of the group, which has, in general, a length-of-arm to length-of-vessel ratio of 1: 14 or less. The ratios obtained by the three suspectedly specialized vessels range between 1: 10.7 and 1: 8.2. The *Falsterbo* has a fairly high ratio too, 1: 12.5. It is worth noticing that with Åkerlund's original reconstruction this ratio would have been 1: 13.5 (see catalogue). The stem from *Kalmar XVIII*, visually very similar to the Lolland-Falster stems, has a ratio of 1: 14.6.

The picture is more confusing, when we look at the distance of the hole above the underside of the keel, again relative to the length of the vessel (fig. 9). The three ship finds from southeastern Denmark cluster quite close, again toge-

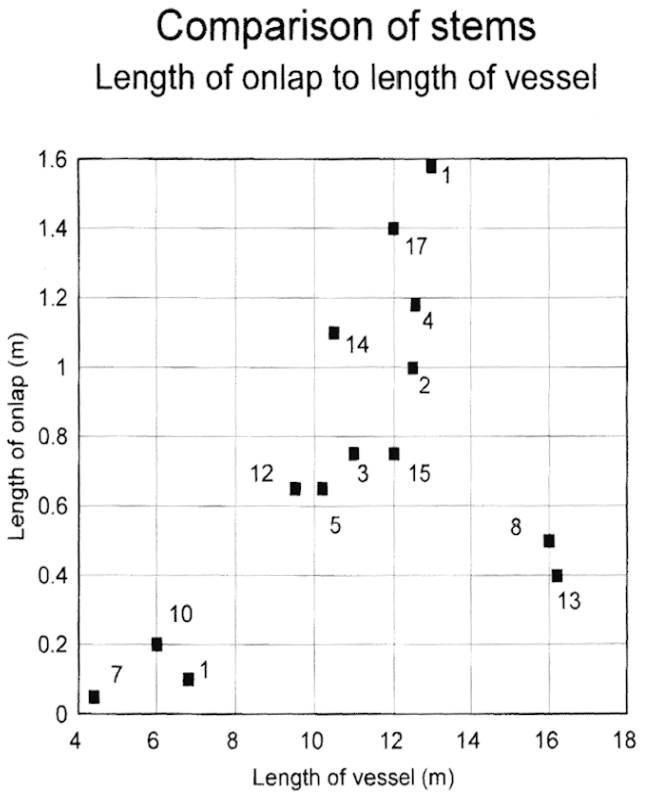

Fig. 8: *Comparison of the vessels with regard to the length of the horizontal arm of the stem and the overall length of the reconstructed vessel as reconstructed.*
Comparaison entre la longueur de la branche horizontale de l'étrave et la longueur hors tout restituée des épaves.

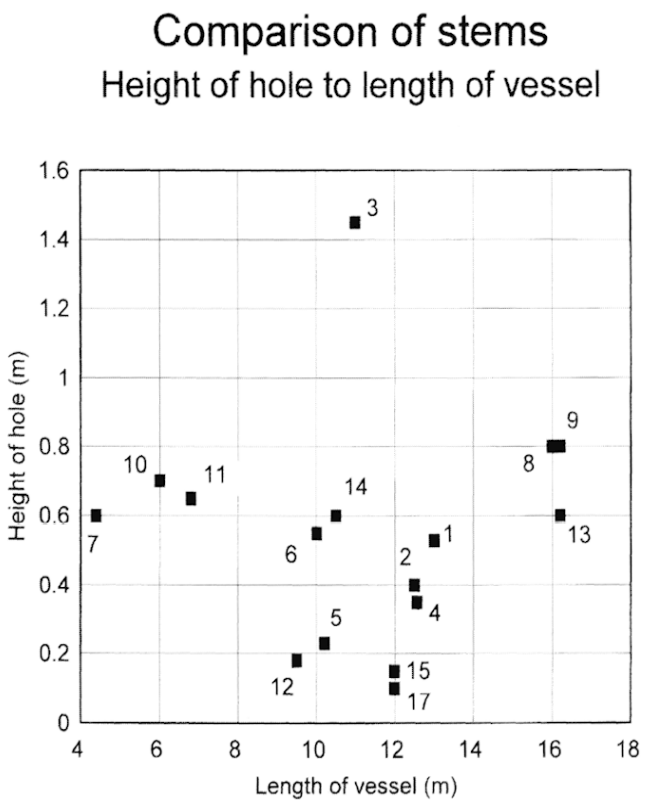

Fig. 9: *Comparison of the vessels with regard to the hight of the stem hole above the underside of the keel and the overall length of the reconstructed vessel.*
Comparaison entre la hauteur du « trou » d'étrave au dessus de la quille et la longueur hors tout restituée des épaves.

ther with the *Falsterbo* ship. However, other vessels seem to have the same feature to a similar or even greater extent. This goes for *Kalmar XVIII*, *Helgeandsholmen IV*, *Puck P3* and the *Kungsör* find. This representation thus underlines the similarity between the Lolland-Falster finds and *Kalmar XVIII* along with *Helgeandsholmen IV*, while the two others mentioned are obviously constructed from a different concept. Both have strongly raking stems, and might thus represent another way to achieve the same qualities, as discussed above.

Considered together, the two figures show an interesting pattern. The three finds of boats less than eight meters long obviously had their stems and stem holes designed as a result of other demands than did the larger vessels. Their pull strength, expressed through the relative length of the horizontal part of the stem, is very low, and the stem holes are situated very high, again relative to the size of the vessel. This is not surprising, as those small vessels could easily be pulled ashore without the aid of ropes and the holes thus were for other uses. Some stems in the group of 8-12 m vessels do show features which might imply that the boats were built to be pulled ashore by the help of ropes fastened in the stem. However, it is in the group of 12-14 m vessels that these features are very marked, while they are less obvious or even missing in the stems of the three larger vessels (around 16 m). It thus seems that the features observed actually reflects a need to pull the large boats/small ships ashore or over the ground, and that the three vessels from Lolland-Falster represent the largest size of vessels where this could be done on the basis of a specific type of stem construction with the ability to distribute the pulling forces directly to a large portion of the clinker hull. The dramatic increase in the relative

length of the horizontal arm of the stem, which can be observed in those three vessels compared to the smaller ones, reflects the fact that weigth grows steeper than length with increasing ship size.

On the basis of the above analyses, is there reason to believe that the three finds from Lolland-Falster actually represent a local ship-type? The answer is yes. That the interpretation of the holes in the lower part of the stem is correct is strongly indicated by the significant, relative increase in the length of the horizontal arm in the largest and most full-bodied of the ships. And the three ship finds from Lolland-Falster are the largest of their kind, especially if the chronological dimension is considered too, as *Falsterbo* and *Puck P3* both are likely to be significantly older. When considered, the material – which also includes *ex silentio* the more than twenty finds of ships *without* stem holes from the same area and period – seems to suggest that the *Gedesby*, the *Bredfjed* and the *Vestre Skarholmsrende* ships were adapted to a behavior that otherwise was only exhibited with smaller vessels. Why?

COASTAL MORPHOLOGY AND TRANSPORT PATTERNS IN THE SOUTHWESTERN BALTIC

The second step in order to designate the three finds as a regional ship type is to connect their specialized features with conditions specific to the proposed region of origin. As has already been noted, all the three finds were made in former, now reclaimed fiords. What has not been stated is, that these two fiords, the Bøtø Nor and the Rødby Fiord, were almost

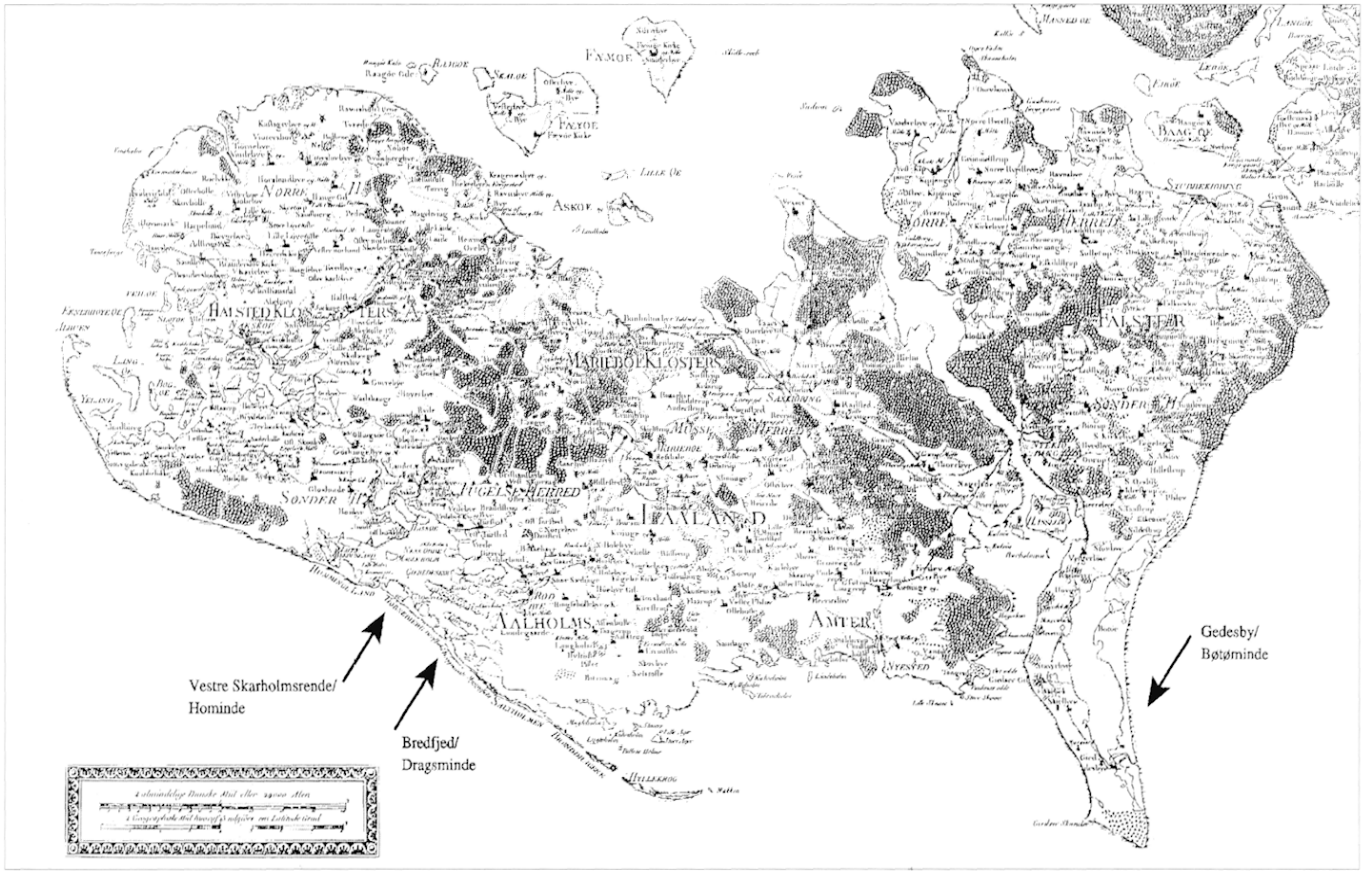

Fig. 10: *The southern parts of Lolland-Falster shown on a map published by The Royal Danish Society of Science in 1776. The positions of the three ship finds are marked along with the names of the navigational channels in or near which they were found. Although the bar islands certainly must have increased in size between the Middle Ages and the time of the production of the map, there is no doubt that at the time of the wrecks, the fiords were in large part cut off from the sea. One evidence for this fact is that some of the bar islands are mentioned in medieval sources.*

Le littoral sud de l'île de Lolland-Falster figuré sur une carte publiée en 1776 par The Royal Danish Society of Science. La localisation des trois épaves est signalée ainsi que les noms des chenaux dans, ou près desquels, elles ont été découvertes. Bien que les hauts-fonds de sable ont dû s'étendre entre le Moyen Âge et la période de réalisation de la carte, il ne fait aucun doute qu'à l'époque des épaves, les fjords étaient partiellement séparés de la mer. Une preuve en est la mention de certains hauts-fonds formant des îles dans les sources médiévales.

totally separated from the sea by sand bars and from the time of the Middle Ages, had only a few, narrow outlets through those bars (fig. 10). All the three wrecks were found in or close to such outlets.

Sand bars are an ever-present obstacle of navigation into the Danish fiords, but the almost total absence of tidal conditions in the southeastern part of the country and the resulting dependence on wind-accumulated changes in sea level in order to keep the channels into the fiords navigable, make the problem more severe in this area, especially on exposed coasts. The fact that both Falster and Lolland are fairly small islands without large watercourses emptying into the fiords adds to the problem and distinguishes the conditions from those found on the southern, equally sandy shores of the Baltic. Thus, from a navigational viewpoint, the Bøtø Nor and the Rødby Fiord were very poor harbours, where the ships would regularly be met with obstacles in the form of shallow waters and ever-shifting sand bars right on the exposed coastline toward the Baltic. But, supposing ships could overcome these obstacles, these harbours had an advantage: they were the ports closest to the European mainland, and therefore the harbours from which you had the most predictable and fastest transportation toward the south. So, the travel route between the Danish capitals Roskilde and Copenhagen to the Hanseatic towns of Lübeck and Rostock or even further south passed one of these harbours. Even travelers from Scania chose this route, as did for example two clerics who embarked from Gedser in September 1523 while on their journey from Lund to the Pope in Rome[10]. However, the maritime history of Gedesby, as recorded in the written sources, goes back much further.

In the « Main Chapter » of the land register of Danish king Valdemar II, compiled in approximately 1230 AD, two maritime dues are mentioned for the village and royal estate Gedesby: one on fishery, and one on seafaring. They amounted to 10 marks of silver each, a significant sum at that time. The due on seafaring is unique in the register and, together with the size of the fees, it indicates maritime trades as an unusually important part of the small society's economy. The presence of the royal estate might be significant. While it was obviously necessary for military reasons, it also provided the king with the necessary local power to ensure that his messengers would obtain a passage at demand. In 1551, we know that Gedesby had the obligation to transport the king and his men to Germany when necessary, and that it also had the privilege of being the only village on southern Falster,

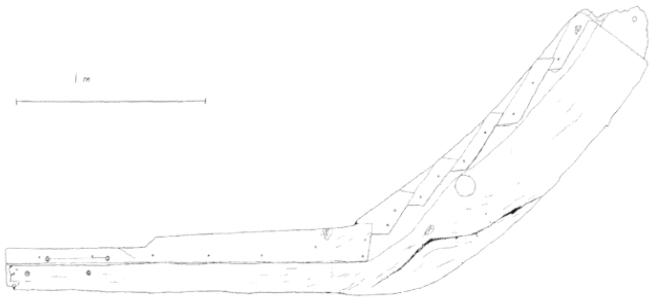

Fig. 11: *The stem of the Bredfjed ship. In terms of distributing pulling forces, this is the most efficient one found in this survey. It is interesting to note that other design features add to this quality. The top corners of the hood ends are secured in rabbets, allowing each strake to contribute significantly to the rigidity of the stem post. However, the stem solution was seemingly inadequate in the Bredfjed ship. The two lowest strakes in the starboard side were severely damaged at the join between stem and keel, and the crack visible on the stem just at the end of the keel-stem scarf suggests that this damage was caused by forces conveyed into the stem. (Drawing by Otto Uldum Christensen and Dorthe Christensen).*
L'étrave de l'épave de Bredfjed. En termes de répartition des efforts mécaniques, c'est l'exemple le plus significatif cité dans cette étude. Il est intéressant de noter que d'autres caractéristiques participent à sa qualité. Les coins supérieurs des abouts sont assemblés dans la râblure, conduisant à ce que chaque bordage contribue d'une façon significative à la rigidité de l'étrave. Cependant, cette solution paraît avoir été inadéquate. Les deux bordages inférieurs de l'épave de Bredfjed étaient très endommagés au niveau de l'écart entre l'étrave et la quille, et la fissure visible à l'extrémité de l'écart entre l'étrave et la quille suggère que cette dégradation résulte des efforts transmis à travers l'étrave. (Dessin Otto Uldum Christensen and Dorthe Christensen).

which could legally earn money from ferrying and cargo transport overseas. But the price for this privilege was high: the village had to have, at any time, four good ferries, each of them large enough to carry twelve large horses, to be used by demand of the king or his officials. The function of the village harbour is further illuminated, as a general permission was given to the inhabitants of Falster, before 1587, to use the harbour of Bøtøminde (Gedesby) for export of vegetables, poultry and lambs.

The situation at Rødby was very similar. The king owned a large part of the farms in the village already in the 13th century, and his possession there grew throughout the Middle Ages. As early as 1456, the inhabitants were granted their first privileges to trade on Germany. Those were specifically given to ease the burden of transporting the king's messengers on the same route, and they marked the beginning of a very slow development toward full town rights, which were not granted until 1682. A temporary zenith was reached in

10. P. INGESMAN, *Ærkedegnens*, 1995.

1555, when the village was given monopoly of export of cattle from Zealand and Lolland-Falster. Although this situation only lasted for a short period, it illustrates the importance of this particular line of communication for the king.

The transport geography of the region thus certainly gives the « raison d'être » for the seafaring from southern Lolland-Falster, while the coastal morphology explains the configuration of the vessels in the area. With this background, there seems to be little reason to doubt that the three ship finds are actually representatives of a regional ship type, specialized for the use of the poor harbours of Bøtø and Rødby fiords. It does not necessarily mean that they were built or operated from there, they could be from Northern Germany, but specialized for the trade with those destinations. The conclusion has some highly interesting implications. What tools were actually used to pull these heavy vessels into the sheltered lagoons, which provisioned them and what social organization was established to ensure that men and equipment were at hand when necessary? And what can we learn by studying the development of a specific ship type, put to a specific, known use through more than three centuries? These are not questions to be answered here, but only through the definition of a regionally specialized ship type is it possible to pose them.

ACKNOWLEDGMENTS

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APPENDIX A

The catalogue contains the basic information on the ship finds discussed above. It gives the state of preservation for each find, along with the reconstructed dimensions of the ship, the main features of the stem, and the height of the stem hole along with the length of the horizontal onlap. The height of the stem hole is defined as the vertical height of the center of the hole above the point where the rise of the stem begins. The length of the horizontal onlap is defined as the distance from the middle of the stem-keel scarf forward to the point where the underside of the first strake ends or exceeds an angle of 15°. Calibrations of radiocarbon dates are done according to Stuiver and Pearson 1993, and with the Calib 3.0.3 C from the University of Washington.

CATALOGUE

1. Bredfjed, Denmark

Excavated in 1993 in the reclaimed Rødby Fjord on Lolland, Denmark. The bottom section of the hull, including the lower parts of both stem and stern, was preserved. A preliminary estimate of the dimensions is: length 13 m, beam 4,7 m. The depth of the hull is likely to exceed 1,5 m. The ship is dated by dendrochronology to AD 1600 ±5.

A round hole, 0,10 m wide, is cut through the stem level with the third strake. Its height is 0,53 m. The horizontal onlap is 1,58 m (fig. 11).

Literature: Bill 1994.

2. Falsterbo, Sweden

Excavated in 1932 on the seashore south of Falsterbo. The wreck was found broken up and distributed over a large area. Approximately 25 % of the vessel was preserved. The ship has been reconstructed with a rounded stern and steep sides by Åkerlund. This gives a length of 13,5 m, a beam of 4,5 m and a depth of 2,7 m, and 15 strakes. The frames were situated with circa 0,5 m distance. However, this author is more inclined to reconstruct the vessel with a straight stern post, thus interpreting a separate, 2 m long aft part of the keel as the foremost part of a stern knee. Also, the sides might have been more raking than assumed by Åkerlund, as the preserved frame timbers lack signs of a strong curvature for the bilge. From this reconstruction the main dimensions would be 12,5 m in length, 4.5-5.0 m in beam and a depth probably not exceeding 2 m.

Dating: The wreck was found in clay and sand beneath undisturbed medieval layers with coins from the beginning of the 14th century, and repairs in the vessel show it to be old when lost. One C14 test gives a date of AD 1220 (St-204, ±1 std. dev.: 1085-1280). Åkerlund dates the find typologically to the 11th-12th century, and Ellmers dates it to between AD 1000-1250. Due to features such as the short distance between the frames along with the lack of decorations typical of earlier ships, the date of construction is more likely to be around AD 1200 or later. The ship is therefore most likely to be from the period 1200-1300.

Two pieces of stem timbers were found, forming the lower section of the stem. All joints in the stem, including one for a missing top section, were vertical diagonal scarfs. The stem is triangular in section, and there are no rebates for the hood ends which are fastened with spikes. Two oval holes penetrate the stem, one cut level with the hood end of the second strake, and one cut level with that of the fourth strake. The height of the lower hole is 0,4 m. The horizontal onlap is 1,0 m.

Literature: Åkerlund 1952; Ellmers 1972, p. 316f. For dating of constructional features, compare with Bill 1995.

3. Gdansk-Orunia 2, Poland

Excavated in 1933-34 outside Gdansk. Keel, frames, parts of the stem and approximately 30 % of the planking were preserved. The rowed cargo boat has been reconstructed with the following dimensions: length 11,0 m, beam 2,27 m, depth of hull to underside of keel 0,87 m. Dating is uncertain, but the possibilities of a side rudder and a distance of 0,8 m between the frames suggest a date no younger than the early 13th century, perhaps earlier.

The stem was made of three pieces, of which only the lowest and the top ones were found. They were joined with vertical, diagonal scarfs. A round hole, only a few centimeters in diameter, is drilled through the stem near the top end, at 1,45 m height (according to reconstruction). The horizontal onlap is approximately 0,75 m.

Literature: Lienau 1934.

4. Gedesby, Denmark

Excavated in 1990 in the reclaimed fiord Bøtø Nor on Falster, Denmark. The vessel was preserved to approximately 90 %. Its dimensions have been reconstructed to: length 12,57 m, beam 5,15 m, depth 1,6 m. Dated by four C14-datings, here given as calibrated dates, ±1 stand. dev.: K-5749: Oak, residual age min. 36 years: AD 1220-1285. K-5750: Oak, residual age min. 128 years: AD 1035-1165. K-5751: Animal hair from luting: AD 1265-1300. K-5752: Bast from rope: AD 1245-1290. The most likely interpretation of the dates is that the ship was built and used during the last quarter of the 13th century, but there is a sligth chance (approx. 3 %) that it is actually from the first quarter of the 14th century. The datings are published in *Arkæologiske udgravninger i Danmark*, 1991.

The preserved, lower part of the stem is a solid knee, joined to the keel by a vertical, diagonal scarf. A 0,08 m large, circular hole is cut through the stem level with the garbord strake, at a height of 0,35 m. The horizontal onlap is 1,18 m.

Literature: Crumlin-Pedersen 1989; Bill 1990.

5. Helgeandsholmen IV, Sweden

Excavated 1980 in Stockholm. A well preserved, 10,2 m long vessel with a beam of approximately 2,75 m. It had 9-10 strakes and is dated to approximately AD 1410 by dendrochronology.

The stem is of an unpronounced knee-shape, fastened with a vertical diagonal scarf to the keel. An oval hole is cut through it level with the garbord strake, at a height of approximately 0,23 m. The horizontal onlap is 0,65 m.

Literature: Varenius 1990.

6. Helgeandsholmen X, Sweden

Excavated 1980 in Stockholm. The stem was part of a fairly well-preserved vessel which has later been reconstructed in detail. The overall length is approximately 10 m, the beam approximately 2.75 and the depth approximately 1,2 m. The vessel is dated to after AD 1320 by dendrochronology, and was found in layers from the 15th-16th century.

The stem is slightly curved and fastened to the keel by a false keel, running below the horizontal diagonal scarf between keel and stem and 0,9 m up on the fore edge of the stem, to which it is fastened with three large nails. No onlap can therefore be calculated. An oval hole is cut through the stem piece at a height of 0,55 m.

Literature: Varenius 1990.

7. Kalmar III, Sweden

Excavated in 1932-34 in Slottsfjärden, Kalmar, Sweden. The find yielded an almost intact small boat with four strakes, 4,40 m long and 1,53 m in beam; depth 0,6 m. Mainly on stratigraphical evidence, the find is dated to the High Middle Ages or later, but not later than the 16th century. The constructional features of the boat make it unlikely to be older than approximately 1200.

The stem was some what more curved than the stern, and both had a hole near to the top end, the one in the stem being at a height of approximately 0,6 m. The horizontal onlap is 0,05 m.

Literature: Åkerlund 1951, p. 51-60. For dating of constructional features, compare with Bill 1995.

8. Kalmar IV, Sweden

Excavated in 1932-34 in Slottsfjärden, Kalmar, Sweden. Port side of the vessel was well preserved, partially to the uppermost, fifteenth strake. The total length of the vessel was approximately 16 m, the beam 4.0-4,10 m, and the depth, from the underside of the keel, approximately 2,0 m. The find is dated by the excavator to the 15th century for typological and stratigraphic reasons.

The stem is hooked, with an almost straight raising leg and an only 0,4 m long, horizontal leg. It is raking strongly forward. The flat scarf connecting stem and keel was reinforced with a chuck on the underside. A series of holes had been drilled through the stem, the largest and lowest of them being approximately 0,05 m across and situated at a heigth of 0,8 m. The horizontal onlap is 0,5 m.

Literature: Åkerlund 1951, p. 61-67.

9. Kalmar V, Sweden

Excavated in 1932-34 in Slottsfjärden, Kalmar, Sweden, where it was found partly underlying the 1571 castle wall. The port side of the vessel was well preserved, partially up to the uppermost, seventeenth strake. The ship had been lost through fire on very shallow water. The total length of the vessel was approximately 16,2 m, the beam 5,6 m and the depth amidship, from the underside of the keel, approximately 2,7 m. From the stratigraphic evidence as well as evidence of the ship being lost through battle, Åkerlund dates the loss of the ship to the first quarter of the 16th century.

The stem was made up of an inner timber, to which the hood ends were fastened. This was hooked with a slightly curved, raising leg and an only 0,4 m long, horizontal leg which was joined with the inner keel in a vertical, diagonal scarf. The inner stem was only fastened by spikes to the outer stem, a straight oak timber connected with a flat, vertical scarf to the outer keel. On the inside, the connection between keel and stem was improved with a vertical knee. An oval hole was cut through the outer stem, at a height of approximately 0,8 m. No vertical onlap can be calculated due to construction.

Literature: Åkerlund 1951, p. 68-80.

10. Kalmar VII, Sweden

Excavated in 1932-34 in Slottsfjärden, Kalmar, Sweden. The originally approximately 6 m long and 2 m wide boat was fairly well preserved apart from its upper strakes. It probably had seven strakes, and the depth has been reconstructed to about 1 m. The vessel is loosely dated on stratigraphic reasons to the 16th century.

The stem is made from a smoothly curved timber, fastened with a vertical, diagonal scar to the keel. There are no rebates for the hood ends, but a stemtop has been attached through a flat vertical scarf. A hole, approximately 0,02 m in diameter, is drilled through the stem at a heigth of 0,7 m. The vertical onlap is approximately 0,2 m.

Literature: Åkerlund 1951, p. 83-85.

11. Kalmar VIII, Sweden

Excavated in 1932-34 in Slottsfjärden, Kalmar, Sweden. The boat was burned, and only the bottom was preserved, along with the stem. The size of the vessel has been reconstructed as: length 6,8 m,

beam 2.3 m, depth 0.65 m. The wreck is dated on stratigraphical and typological evidence to around AD 1600.

The well-preserved stem is joggled over the end of the keel. Two holes are drilled through the timber near the top end, the lowest of them being 0.65 m above the underside of the keel. The horizontal onlap is 0.1 m.

Literature: Åkerlund 1951, p. 84-85.

12. Kalmar XVIII, Sweden

Excavated in 1932-34 in Slottsfjärden, Kalmar, Sweden. Preserved was the bottom part of a vessel, originally approximately 9.5 m long and with at least nine strakes. The beam can only be roughly estimated to 3-3.5 m, the depth to 1.2 m. The vessel is dated by its high stratigraphic position in the sediments of the harbour, which fell out of common use shortly after 1647. Åkerlund has suggested a date to the late 17th or even the 18th century.

The stem is hooked, with a 0.7 m long, vertical leg and a slightly curved, raising leg with rabbets cut for each hood end individually. It is fastened to the keel with a vertical, diagonal scarf, secured with a wooden nail. A large oval hole is cut through the stem level with the hood end of the first strake, at a height of 0.18 m. The horizontal onlap is 0.65 m.

Literature: Åkerlund 1951, p. 111-112.

13. Käringön, Sweden

Found 1936 during harbour construction work. Only fragments of stem, keel and planks were recovered. The keel showed a mortise for the sternpost, and thus the size of the vessel can be roughly calculated to 10.5 m. Stratigraphical evidence points toward a date before 1740, while four dendrochronological datings of samples without sapwood shows the youngest year-ring to be formed in 1611, 1639, 1670 and 1684 respectively. The vessel has thus been constructed probably not earlier than 1700.

The stem is knee-shaped and joined to the keel with a horizontal hook scarf. It has a sligthly oval hole cut through it at a heigth of 0.6 m. The horizontal onlap is 1.1 m.

Literature: Hasslöf 1937. Dendrochronological datings by Alf Bråthen, by courtesy of Göteborgs Stadsmuseum. Drawing by courtesy of Göteborgs Stadsmuseum.

14. Kungsör, Sweden

Found 1954 in the river Arbogaån at Kungsör, and examined on land in 1982. The keel, as well as parts of the stem and stern timbers, were preserved along with a few planks and 15 floor timbers. It had a minimum of 11 strakes and had two clamps for a mast step one quarter from the forward end of the keel. The size of the ship has been reconstructed as 16.2 m in length, 5.2 m in beam and a depth midship of a minimum 1.3 m. The dating is given by one C14 date of luting (animal hair and tar): AD 1635 (St. 8124, ±1 std. dev.: 1470-1665).

The main timber of the stem is one straight piece, preserved to a length of 4.57 m. It is heavily raking forward (30°) and fastened to the keel with a hook scarf. A forefoot was mounted on the stem. An oval hole, approximately 0.10 x 0.20 m, was found cut through the main stem timber close to its inward side, on a height of 0.6 m and level with the first strake. The horizontal onlap is 0.4 m.

Literature: Fredberg and Mäkela 1982; Fredberg 1983.

15. Puck P-3, Poland

Excavated in 1990 in the Puck Bay northeast of Gdansk. The fore end of the vessel was well preserved, with eight strakes in each side, while the aft was missing. No dimensions have been published, but from the excavation plan a rough estimate can be made, indicating a total length of not less than 12 m, and a beam of approximately 3 m. The vessel was quite flat-bottomed and thus the depth of the hull probably did not exceed 1.5 m. Dating: 11th century AD or later, on stratigraphical evidence older than AD 1248.

The stem is strongly raking and smoothly curved. It is triangular in cross section and apart from the first strake, the hood ends have been secured via wings, intermediate pieces taking up several strakes. The stem was fastened to the keel with a vertical, diagonal scarf. An oval hole penetrates the stem level with the hood end of the first strake, at a height of about 0.15 m. The horizontal onlap is approximately 0.75 m.

Literature: Litwin 1995, drawing from Indruszewski 1996.

16. Säveån, Sweden

Found in 1971 in the river Säveån in Nya Lödöse, Göteborg town. The stem was probably part of a vessel found 1.5 m deep in the clay covering the bottom of the river. Remains of old harbour constructions were found nearby. No excavation was carried out, and only some frames, beams and plank fragments were salvaged along with the stem and part of a keel. The find may contain remains of more than one vessel. Nothing can be said about the size of the vessel from which the stem originates. The dating is indicated to be around AD 1700, according to one uncalibrated radiocarbon date from 1972 (St. 3857, Laboratoriet för radioaktiv datering, Stockholm).

The stem is an unpronounced knee-shape and had been fastened to the keel with a flat scarf. An oval hole, 0.11 x 0.04 m, is cut level with the garbord strake, near the fore edge of the stem and at a height of approximately 0.3 m. The horizontal onlap is 0.4 m.

Drawing by courtesy of Göteborgs Stadsmuseum.

17. Vestre Skarholmsrende, Denmark

Excavated in 1937 in the reclaimed Rødby Fjord at Lolland, Denmark. The lower portion of the vessel was well preserved, but documentation is scarce. The vessel appears to have been approximately 12 m long and fairly flat-bottomed, with a beam of at least

5 m. The depth can be reconstructed to not less than 1,5 m. One radiocarbon dating on animal hair from the luting gives a calibrated date of AD 1300 (K-6416, ±1 std. dev. 1285-1385). Also typologically the vessel seems to date between the Gedesby and the *Bredfjed* ships. The fully preserved, lower part of the stem is a solid knee, attached to the keel by a vertical, diagonal scarf A 7-8 cm large, circular hole is cut through the stem near to the underside of the horizontal part, at a heigth of 0,1 m. The horizontal onlap is 1,4 m.

Literature: Hansen 1973. The dating will be published in *Arkæologiske udgravninger i Danmark*, 1995.

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