THE MIGRATION PERIOD, SOUTHERN DENMARK AND THE NORTH SEA

A WORKBOOK IN RELATIONSHIP TO THE GREDSTEDBRO FIND

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FOREWORD

In 2006 the Maritime Archaeology Programme started at the Esbjerg campus of the University of Southern Denmark (SDU). The programme is international and introduces postgraduate students with different national and educational backgrounds to the various aspects of the discipline. The programme tries to be practical, but it is not limited to occupational training. Research is central in an academic education, and students are therefore confronted with theoretical approaches as well as with the practicalities of methods, including maritime technology and diving. Besides this, and in view of their prospective careers, the students are introduced to legal issues and management and to the wide variety of dilemma's that occur in every day engagement with heritage.

The intended areas of research of the programme are threefold. Heritage, heritage perception and developments in its management in the maritime zones is one field of inquiry. The way the (maritime) archaeological record comes about is another. What filters apply? What processes influence how archaeological information sources originate? What processes influence their continued presence? What processes influence their discovery and identification? And last, but not least what determines their recognized significance? Maritime heritage seems to display quite a few peculiarities in both fields. The third focus is technological and deals with the construction of watercraft and the implications of that technology for our understanding of past society. Finally, as the programme is based in Esbjerg at the northern end of the Wadden Sea and on the North Sea coast, there is a noted interest in that region. The area has not attracted a lot of maritime archaeological interest so far. This is especially true off-shore. It is understandable in view of the relatively cumbersome working conditions, but experience elsewhere, such as in the western part of the Wadden Sea, shows that overcoming such obstacles can be most rewarding. Dynamic estuaries and subsiding coasts have great potential.

In its first surveys, it is quite logical for the programme to look into the maritime archaeological information that is available for the region. In this way, it was more or less a natural choice to take a remarkable ship-find that was discovered in Gredstedbro –only 15 km South of Esbjerg– as the subject for a student's seminar in their second postgraduate semester. The

present workbook is the result of that effort, in which the find itself, its discovery and interpretation, the presumed cultural background and the environment were addressed. It was an occasion for the students to delve in the archaeological and wider literature and to critically assess the relationship between data and interpretation in a range of relevant disciplines. Exercises in the application of methods and theory to secondary archaeological sources, were also integrated in the course. The main objective of a course seminar is training rather than comprehensive and original new research.

Covering wide ground in a very limited period of time has its limitations. Nevertheless, the course brought this workbook as a consolidated result. Unavoidably it is incomplete and some discussions it reflects have been more exhaustive than others. Discussions on the cultural environment summarize just an eclectic part of the extensive and often contradictory literature, but also introduce a new approach to the definition of cultural relationships. Unavoidably, relevant literature will have gone unnoticed. For instance, the students were limited to the consultation of literature in English, German, Danish and French. Obvious sources in other languages were therefore not taken into consideration and in the languages mentioned the study has not been comprehensive at all. That, as well as obvious weaknesses in analysis means that many questions remain. But other questions and alleys for further research were deliberately formulated. All in all, we thought it worthwhile to present ourselves and the wider community of researchers with the tentative considerations and results. Some of these probably need to be discarded on more detailed scrutiny. Other ideas, however, may guide us further. As such, the workbook is a background document; both for a site-survey to be undertaken as part of the Maritime Archaeology Programme's field school and potentially for the development of more comprehensive research as well. In the meantime it may also be interesting for others to consult.

Thijs J. Maarleveld
Esbjerg, 25th April 2008

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1. INTRODUCTION

Three pieces of timber were found in 1945 in a normalization project of the lower reaches of the Kongeå River in southern Jutland. As later scrutiny has shown the pieces are fragments of a keel, of a stem or a sternpost and of a frame. They date from in between 600 to 800 AD and have entered the archaeological literature as the Gredstedbro Ship (Crumlin-Pedersen 1968; 1997). Archaeological information on ships and boats is better for some periods and regions than for others. In 1991 Klavs Randsborg (1991) produced a graph which shows the distribution of wrecks according to the century to which they are dated, in which he combined information from the (northwestern part of the) Mediterranean and from Danish waters covering the period from 400 BC to 1400 AD. A glimpse at the graph, as rendered here in figure 1, immediately shows how unique a ship find with this approximate date actually is. Even though only a few pieces have been studied, the find is of very great relative importance. Since 1991 the picture has not dramatically changed.

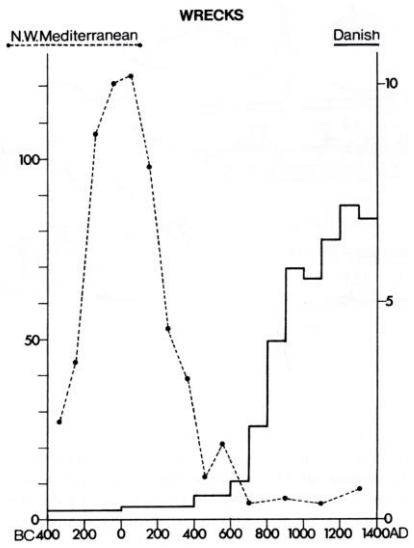


Figure 1. The frequency of archaeological wreck finds. After Randsborg 1991

Unfortunately, the site where the timbers were found and where possibly parts of the boat still remain, is now unknown. In the course of our discussions we addressed this. We also thought, however, that it was essential not only to look into the boat itself but to consider it to the back-ground of its physical and cultural environment. In doing so it would perhaps be possible to understand the whole context in which it was found, or at least to see in which aspects we face uncertainties, contradictions or major gaps in our understanding.

The Gredstedbro ship or boat is dated to a period known for extensive movement of people. Also, it is considered a period of general instability in

northern Europe. On the other hand, other narratives have it that organized trade strongly developed during this period. As a result, the Gredstedbro boat has consistently been associated with this long-distance movement of people or goods, the more so since very few other ship finds from this general period have surfaced so far. It is possible indeed that the ship may have had a role in it. Even though the Gredstedbro ship is dated between 600 and 800 centuries AD, it was deemed crucial to our study to view it in a more extended timeframe, including the early Migration period and the early Viking period. In fact that meant to examine the period from the 5th through 9th centuries AD.

The area of our interest extended outward from the approximate site where the boat was found. The core area for consideration was of course the Kongeå River, its estuary and its hinterland. However, the wider area of the North Sea was also examined. That wider area included the southern North Sea, the Channel, the English east coast, the Danish west coast, Norway and the Skagerrak. These areas were examined in light of being the most obvious overseas contact zones that might be part of a transport and cultural network. That broader context might also inform our understanding of the nature of the Gredstedbro boat and the initial reason that it was built. As in fact it might be a vehicle for trade and transportation of the maritime societies across the North Sea.

After having defined the time frame and the area of study, the discussions and the study started to focus on more specific objectives. These objectives related to the specific physical and cultural environment, as well as to the study of other important ship finds in northern Europe. The discussion of the physical environment evidently had its start in the landscape of the Kongeå area. Besides trying to understand the present and historical landscape, it was tried to understand the role that the physical environment plays in the development of trade. Simultaneously, however, the examination of the estuary helped to develop some thoughts relating to a possible re-location of the boat. The consideration of the cultural environment included discussions about the general historical background of Northern Europe as presently apparent from historical and archaeological discussions. In addressing these issues, we needed to remain at a relatively general level. Even so, there were many interpretations to discuss. However, a distinction was made between discussions on the general situation around the whole North Sea and discussions that specifically looked into the economy of the area.

Besides all this, it was thought to be useful to study other ship finds of the North Sea area of the period. This might prove quite helpful for understanding differences and developments in shipbuilding or shipbuilding traditions, if any, and could also place the Gredstedbro boat among the other ship finds. It must be said at the start that from its first publication, the Gredstedbro ship has been given a key position in the envisaged "evolution" of Nordic shipbuilding. Is there a basis for this, or not?

From all these discussions, other issues arose, such as when the sail was known in the North Sea and when it was used, whether there actually existed different shipbuilding traditions or all ships were more or less part of the same, northern ship-building 'family'. The chapters that follow reflect the steps in thinking and the paths in studying that were followed.

The chapter on the physical environment deals with the landscape and the geology of the Kongeå River, and more specifically with the character of the river in its original state and the influence of human intervention. The estuary and the approaches to the river from the sea are also considered. Moreover, possible landing places and the navigability of the river are factors that are taken into account.

The chapter on the cultural environment deals with the assumed movements of people, the demography of the migrated population and political structures. It also touches upon economic relationships and activities in the North Sea region and the impact of these on the further development of trading settlements and agricultural settlements.

Finally, the last part of this workbook deals with the ship-finds. This section contains some thoughts about the debates relating to the issues of the use of sail in the North Sea and the development of ship-types. It also contains a catalogue of relevant ship finds, describing what is known about them. The catalogue evidently includes the Gredstedbro boat.

I

THE PHYSICAL ENVIRONMENT

2. THE LANDSCAPE

Palaeogeographical reconstruction

While today the Wadden Sea is generally protected from floods through extensive systems of dikes and embankments, the history of natural development in this area is one of constant and often violent change. Anyone who has experienced an autumn storm at the Danish North Sea coast will have seen such changes to the coastline. Add to this the more gradual processes of sedimentation and erosion, which are part of the natural cycles in the Wadden Sea, and one will intuitively sense that this is a landscape where change is constant. As far back as the historical records go, we have lists and accounts of churches and whole parishes that were lost to the sea. A further illustration of this and of research interest in the processes involved is a remarkably early attempt at palaeo-geographical or palaeo-ecological reconstruction for exactly this stretch of coast-line.

In 1652 the cartographer and land surveyor Johann Mejer published an atlas with maps of the duchies of Schleswig and Holstein. One of the maps in the atlas however, did not render a direct representation of the then modern landscape, even though indirectly it was also based on his recent survey. The map in question is entitled "*Map of the old Friesland. Anno 1240*". Drawn to the style of its day it shows a landscape with forests, villages and churches extending far into what is now the Wadden Sea. The sources behind the map are historical records of lost land together with local informants who pointed out the locations of these areas to the cartographer (Danckwerth & Mejer 1652, 93). Clearly visible is also that Mejer has more or less used the tidal flats of his 1652 map, and considered these areas dry land in 1240 (Figure 2). The reconstruction was critically examined by the historian P. Lauridsen well over a century ago. Lauridsen criticized the lists and records behind the map for being historically unfounded. He did so in emotive phrases (Lauridsen 1888). A scientific assessment is given by for instance Gram-Jensen (1991, 15), who commented that the geological evidence clearly indicates that the sunken lands on the 1240-map are purely fictional or mythical. Although a recent attempt to utilize this map in interpreting the medieval landscape has been presented (Newig 2004),

Mejer's map has generally been recognized as a curiosity without much reality behind it. It is interesting for being an early attempt at palaeo-geography. It does stress the necessity of considering changes in the landscape in working with an archaeological site, not least when working in this area.

Figure 2. Mejer's maps of North Friesland. Left 1240, right 1652.

Palaeogeography along the North Sea coast

The reconstruction by Mejer is very exceptional in that it addresses the Danish Wadden Sea and North Sea coast. Apart from the critical assessments of Mejer's map, cited above, no extensive tradition of geographical reconstruction of the Holocene estuaries and coastal zones seems to have developed in Denmark, even though landscape reconstruction has long been recognized as an important condition for archaeological interpretation (e.g. Iversen 1967). The fact that the tidal marsh area is relatively limited in size as compared to the higher Pleistocene grounds may be responsible for this. In Schleswig-Holstein and Niedersachsen there is more attention for this approach than in the Danish Wadden sea area. Diachronic studies of discrete settlement areas (*Siedlungskammer*) along the Wadden Sea, invariably include reconstruction maps (e.g. Behre 1994; Kühn & Müller-Wille 1988; Meier 2001). In the Netherlands, the discipline

of palaeogeographical reconstruction of the younger landscape and its changes through time likewise has a strong tradition where quaternary geology, soil science, historical geography and archaeology interact. The work of Zagwijn (1986), Roeleveld (1974), Berendsen (Berendsen & Stouthamer 2001), Vos (Vos & van Heeringen 1997; Vos & van Kesteren 2000), van der Spek (1994), Schoorl (1973; 1999) and Fokkens (1998) is particularly relevant as a parallel for the area under scrutiny in this study. For a recent overview the reader is referred to the chapter on palaeogeography and landscape genesis in the National Research Agenda for Archaeology (Deeben *et al.* 2005) and a recent consolidation in maps (Vos 2006). It would be useful for the study relating to Gredstedbro if detailed palaeo-geographical research of the area would be undertaken along similar lines. At present no detailed reconstruction maps are available.

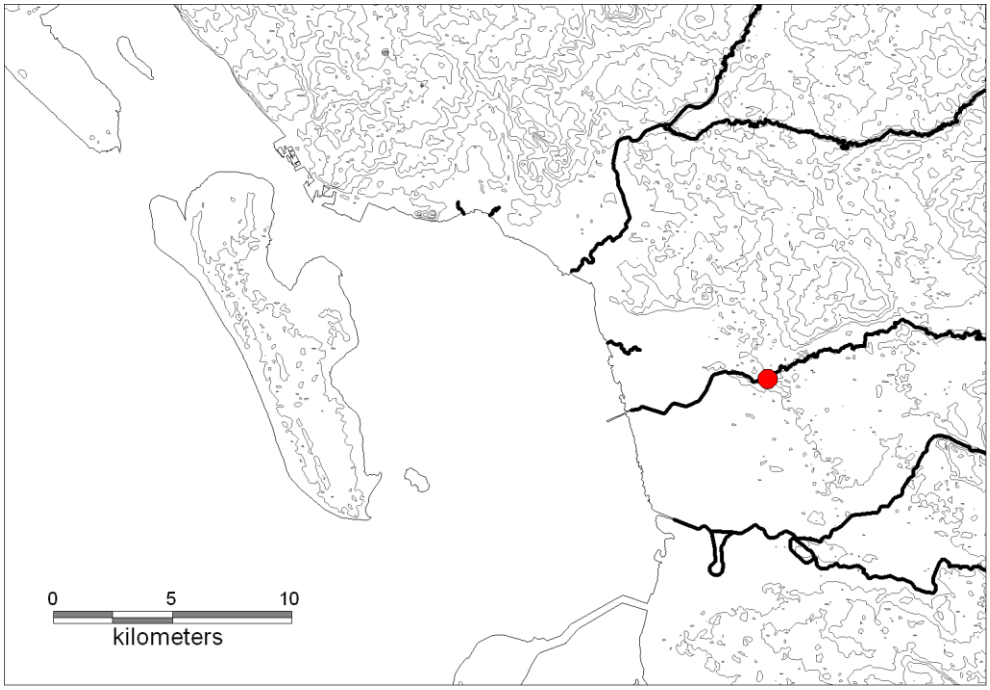


Figure 3. Topography and elevation, shown in 5 m contours. Streams are shown in black. The site is marked with a dot.

The area

The primary focus of interest in this paper is the area around the river Kongeå, where the remains of the Gredstedbro ship were found. In order to shed a light on the physical environment through which the Gredstedbro

ship may or may not have travelled, one must however both look away from the exact find spot and consider a wider area as well as going into the details of the local area of the Kongeå and its hinterland. Some aspects of the physical environment during the 5th-9th centuries are therefore discussed in more general terms relating to e.g. the southern part of the North Sea region, while other aspects are discussed only in relation to the specific Kongeå-area. An overview of the studied area is presented in Figure 3.

Sea level changes and palaeo-coastlines

As presented above attempts to reconstruct the Danish Wadden Sea coastline have been published, but none of these are very useful in describing the coastal environment around the Kongeå during the 5th-9th century. This may however change as the primary purposes of a current research project by Geocenter Danmark are to investigate the formation processes and age of the present day barrier islands Fanø and Mandø situated just west of the Kongeå (Pejrup 2007, 11). Unfortunately the results of this research project have not yet been published. The following descriptions and interpretations must therefore be limited to a general description of physical factors influencing the environment around the Kongeå and Wadden Sea. It will therefore at the most give an intuitive impression of the possible environment in which the Gredstedbro ship functioned.

In areas of predominantly shallow seas and low relief of land such as the studied area, even small changes in sea level have significant impact on the environment. For the period under scrutiny here, the general sea level curve for the southern North Sea indicates episodes of both regression and transgression, although the overall trend of the curve is towards increasingly higher sea levels (Behre 2007, fig. 7). During the period of 350-700 AD (cal) the mean high water level (MHW) was approx. 1.5 m lower than today. Regression was followed by a brief transgression in the period 700-850 AD, during which the sea level rose around 0.5 m, which resulted in a sea level approx. 1 m lower than at present. Towards the end of the studied period a pronounced regression took place around 850-1100 AD. The sea level dropped around 1m to a level of approx. 2 m lower than today. Summing up, it can be concluded that the sea level was at least 1 m lower than at present during the entire duration of the period under study. One can not, however, reconstruct the palaeo-coastline by simply outlining the 1 m

bathymetric curve of the present day Wadden Sea. Such an approach would not be any better than Mejer's method in the seventeenth century. The sea bed in front of the Kongeå estuary is, after all, influenced by both sedimentation and erosion and so is the estuary itself.

Tidal range

Bathymetry and coastline configuration are the most important factors that control or define tidal ranges. During the early Holocene the tidal ranges in the North Sea must have deviated considerably from the tidal ranges of the present day due to the very different configuration of the North Sea at that time. However after approx. 6000 BC (when the Dogger Bank was no longer a land surface and the general layout of the North Sea became more like today) the tidal ranges are not considered to deviate significantly from the tidal ranges of the present (Behre 2007, 84-85). For the purpose of this paper it is therefore assumed, that the tidal ranges during the 5^{th}-9^{th} centuries were somewhat similar to those applying today. However, "somewhat similar" is not precise enough to assess the extent of tidal influence up river or the inward or outward forces exerted by the tides in the shallow waters along the coast.

Currents

Throughout the later part of the Holocene the circulation pattern in the North Sea has been dominated by an anticlockwise movement of water, stimulated by the inflow of Atlantic waters between Scotland and Norway (Hebbeln *et al.* 2006, 988). The circulation pattern of special interest to this paper is the South Jutland Current (SJC), which runs north along the entire west coast of Jutland. The SJC consists of Atlantic waters, which have been modified by the fresh water supply from the numerous rivers that flow into the southern part of the North Sea. The SJC is strengthened by westerly winds and weakened by easterly winds (Hebbeln *et al.* 2006, 988). During sailing and navigation along the west coast of Jutland many sailors have been set off course by this current. The SJC can however also be seen as a travelling companion (at least when travelling northwards) adding to the speed of the vessel.

The Kongeå

Local geology, geomorphology and topography of the Kongeå area

The river Kongeå has its source very close the east coast of Jutland (south of Vamdrup). From there it flows west for 50 km across Jutland towards the Wadden Sea. The river valley of the Kongeå is approximately 1,5 km wide and has been created by meltwater during the last glaciation of Denmark (Weichsel). The Weichselian glaciation never reached the western parts of Jutland. The ice stagnated in the eastern part of Jutland and meltwater flowed towards the west eroding and depositing meltwater sediments along the way. The Kongeå valley is bordered by areas of higher topography, so called *bakkeøer* ("hill islands"). The Danish term *bakkeø* refers specifically to higher areas of glacial sediments that have been deposited during the Saalian glaciation and that presently are placed like an "island" that is surrounded by the alluvial plains of the Weichselian glaciation (Smed 1982; Niebe *et al.* 1990). The *bakkeøer* north and south of Kongeå, rise up to 65-75 m above sea level. Gredstedbro is situated where the river valley widens and gradually changes into marshland. The dikes that exist today along the better part of the marshland along the Wadden Sea coast have not been constructed until long after the studied period of the 5^{th}-9^{th} centuries (Hansen, Nielsen & Rieck 1987, 94). The marsh areas at the estuary of the Kongeå must therefore be envisioned as having been unprotected from the forces of the sea, possibly with several river channels entering the sea. It is not quite clear whether or not barrier islands existed west of the Kongeå estuary during the period of study.

River morphology

The present day Kongeå is a meandering river in which the *thalweg* (deepest part of the channel) migrates back and forth across the channel bottom towards the outer edge of each meander. Approximately halfway between each meander bend a shallow zone (riffle) of the coarsest bed material is maintained (Ritter *et al*. 1995, 215-218). Through time the meanders gradually shift their position by eroding the outer banks of the meander bends and simultaneously depositing sediments on the inside of the bends (Ritter *et al*. 1995, 215-218; Sand-Jensen & Friberg 2000, 14-15). Occasionally meanders are abandoned as the river channel breaks through the river bank, thus creating a short cut. The abandoned meanders are seen

in the river valley as "oxbow" (horse shoe shaped) lakes, until they eventually are filled with sediments and organic material. As a consequence of the development of a meandering river the soil in the river valley of the Kongeå consists of varying layers of fluvial and alluvial sediments, fine-grained organic materials and peat deposits (GEUS 1989).

River gradient

The sea levels of the studied period were at least 1 m lower than the present day sea level. The gradient of the Kongeå in our period of study can therefore not be assumed to be identical to the gradient of the present day Kongeå. Furthermore, the gradient of the Kongeå has not only been influenced by changes in sea level. Human interventions in the river have also changed the river gradient substantially. These human interventions have mostly existed in straightening channels (thus decreasing the length of the river) and in blocking off the river in order to run mills (Volmer *et al*. 2001, 100; Sand-Jensen & Friberg 2000, 16-17). The present day drop of the Kongeå is approximately 30 m along the entire length of the river.

River discharge and depth

Reconstruction of the discharge and water depth of the former Kongeå is not easy. The discharge of the river is dependent on many factors, such as precipitation, catchment area, groundwater level and temperature. Most of these parameters are unknown for the 5^{th}-9^{th} centuries AD.

An approximation of the depth and width of an undisturbed river can however be made on the basis of the size of the catchment area and the substratum of the river (Sand-Jensen & Friberg 2000, 14). As land subsidence of the southern part of Jutland has been relatively uniform within the studied area, the water divides of the catchment area of the Kongeå of the 5^{th}-9^{th} centuries can be assumed to be somewhat similar to the water sheds of today (Gehrels *et al.* 2006, figure 1). Based on these assumptions the estimated width and depth of the downstream part of the Kongeå in the period of 5^{th}-9^{th} century are 10 m and 1½ m respectively.

Approach and navigability of the Kongeå

Approaching the Kongeå estuary from the Wadden Sea may for many reasons have been a tricky business. The relief of the land is not very distinct and cannot be seen very far out at sea. The map of present day topography (presented in figure 3) shows that the 5 m elevation curve is located approximately 5 km inland. Adding the excitement of land approach are the numerous tidal flats and possibly strong tidal currents, sometimes spiced up with strong winds, large waves and a heavy swell.

Once in lee of barrier islands or further upstream the Kongeå, a different way of sailing must be employed, as space is considerably more restricted than along the coast. The Kongeå of the 5^{th}-9^{th} centuries is envisioned to be a meandering river, flowing across the better part of Jutland and ending in a salt marsh estuary. The navigability of this river was largely dependent on the water depth, sedimentation pattern, current and vegetation. Vessels moving down the meandering river would naturally have followed the course of the *thalweg*, where the current was strongest and the water the deepest. Vessels moving upstream a river would have sought the best possible combination of required water depth and least possible current.

The shape of the meander curves would also have influenced the navigability of the Kongeå, as a long ship may have had difficulty passing very sharp curves through which a shorter ship would have passed unimpeded. The question of propulsion up- and down river must also be addressed, i.e. oars or poles, towing or pushing, or any combination of these? Westerly winds are common and may have helped up the river.

As the Kongeå river only cuts through soft sediments and no bedrock is present, the position of possible landing places along the navigable part of the river was controlled only by the height of the river bank and the amount and type of vegetation in the area. However, landing places intended for the practical use of loading and unloading ships were most likely placed close to settlements or in adequate proximity of the land based infrastructural system. A settlement or several settlements certainly existed in Gredstedbro during at least parts of the studied period. It is therefore not unlikely that the Gredstedbro ship was abandoned at or in close proximity of a landing place.

II

THE CULTURAL ENVIRONMENT

3. HISTORICAL OVERVIEW

The early medieval period was a turbulent one for the North Sea area. Following the collapse of Roman rule and hegemony, the area underwent a chaotic period of definition and consolidation of new political, social and economic structures. It was a period of massive movements of people, of *nation building*, piracy and of reorganisation and re-intensification of trade. Alongside these changes Christianity was introduced and spread into the area. As such the period has attracted strong historical attention, stretching back at least to the writings of 8th century Beda. The purpose of this and the following chapter is to present an overview of these events to serve as a historical background for understanding the Gredstedbro ship.

During the Migration period (400-520/530) various Germanic tribes joined together, forming new political communities with polyethnic structures, which were breaking the traditional tribal groups (Hedeager 1992, 281). In this period these politically defined 'kingdoms' also became territorially defined. Most of the Germanic groups migrated on the continent; the Jutes, Angles and the Saxons migrated to England, while apparently Scandinavia was not much affected by immigration. The Danes had come from the northeast much earlier, and became the dominant power in Scandinavia in the following centuries.

The Franks were dominating Western Europe. In the following centuries they came to control the most important communication routes. Among the extensive migrations of people and establishment of polities across Europe in the period, this chapter will focus on those most relevant for the North Sea. England, 'Frisia' and Scandinavia will be dealt with concisely, whereas this chapter will be concluded with short discussions on material culture and on demography.

Germanic tribes in England

The advent of Germanic tribes in England seems not initially to be the result of an invasion as such. Traditionally developments have been described on the basis of two central historical sources: Beda Venerabilis' *Historia*

ecclesiastica gentis Anglorum (I.XV), which was completed around 731, and the late 9th century *Anglo-Saxon Chronicle*. Both texts continue to be important documents for dealing with the early history of the 'Anglo-Saxons', although their actual trustworthiness, and especially that of the *Chronicle*, has been assessed in a steadily more critical way (Yorke 1993).

After the withdrawal of the Romans in the early 5th century, England was vulnerable and exposed to attacks by Picts and Scots. During the mid 5th century the Britons called in Germanic mercenaries to help them defend their land and allowed them to settle in East Anglia. Other groups, who originally had been Germanic *foederati* in the Roman army, had remained on the island as well. During the second half of the 5th century the number of Germanic immigrants increased massively and the number of Anglo-Saxon settlers in eastern and southern England became uncontrollable. The Germanic immigrants successfully fought British overlordship and penetrated further west (Clarke 1985, 40).

A period of peace in the first half of the 6th century resulted in consolidation. The immigrants in the area created political units, kingdoms. They had basically settled in the east Midlands and East Anglia, but the south and west also became anglicized (Higham 2004, 17).

Judging from archaeological find material, the immigrants must mainly have come from the present areas of North Germany, southern Denmark, lower Saxony and the Elbe-Weser region. Cultural affinities to these areas like burial customs can be observed. According to Carver a second wave of immigration from southwest Norway towards East Anglia and Humberside took place in the 6th century (Carver 1990, 117).

The kingdoms of England seem to have kept close relations to the Scandinavian kingdoms during the 5th and 6th centuries. After the Christianization of the island in the beginning of the 7th century, contacts with the Christianized areas on the continent increased. Relations with the Franks intensified, while contacts with Scandinavia decreased. Accordingly, traffic was redirected from the North Sea to the Channel.

During the 7th and 8th centuries trade flourished, due in part or mainly to favourable conditions on the North Sea at that time. Piracy was the only disrupting factor. By the 8th century the four known ports in England that traded with northern France and the Low Countries are Southampton, Ipswich, London and York.

In the early medieval period the system of overlordship had become a common feature in Scandinavia, Francia and the kingdoms of England. It meant that people controlled by the overlord owed him tribute and military aid.

Frisia

The term Frisia is used here in a relatively loose way. In Roman times, Frisians are associated with the eastern and western shores of Lake Flevo or Almere. During the 5th-7th centuries they expanded eastward to the mouth of Weser and westward to the delta of the Rhine, the Meuse and the Schelde.

Until the 6th century some Germanic tribes (Herules, Varnes, Thuringians) who lived in the area of the lower Rhine, were fighting against the expanding Franks. The Frisians were expanding to the west, stopped them and conquered the area. By the end of the 8th century, however, they were dominated by the Franks.

Frisians were reputedly prominent traders, even to the extent that their name became a synonym for an international trader. They were not necessarily Frisians in a more narrow sense (Lebecq 1990, 86). On the contrary they included members of other Germanic tribes, among others also Franks.

The most important 'Frisian' emporium was Dorestad. This town was built around 675, but only developed strongly under Frankish domination at the end of the 8th and beginning of the 9th century. The town also had the most important mint of the Carolingian Empire.

The Frisians presumably had the trade of the North Sea in their hands. Goods from southern Europe that reached Western Europe by way of the rivers were transferred by them to England and to Scandinavia. The Merovingian and the Carolingian empires offered the needed stability for the trade to develop and during these periods trade flourished indeed. Frisians colonies are recorded in York and London (Clarke 1985, 43) and so are Frisian settlers in Hedeby / Haithabu (Ellmers 1990, 92). Haithabu functioned as a transit point for the trade between the North Sea and the Baltic.

The Frisian monopoly ended with the emergence of the Vikings in the 9th century. Vikings ransacked Dorestad in 834 and disrupted trade activities in the North Sea. Nevertheless the Frisian trade continued to flourish now having Tiel and Utrecht as trading centres.

Scandinavia

During the Migration period the present-day Danish area is considered the centre of Scandinavia. Many minor kingdoms were in existence. According to Näsman (2000, 5) several tribal units initially formed a confederation under Danish hegemony which later (in the 6th century) developed into a more coherent kingdom. Its centre was in central Denmark, south Jutland, Funen and Zeeland, its periphery was north Jutland, Scania-Blekinge-Bornholm, south Sweden, and in the Merovingian period perhaps also parts of south Norway. Gudme in the south-eastern part of Funen was a central place and Lundeborg was the trading centre connected to it (Nielsen *et al*. 1994). Northern Scandinavia consolidated its royal system later (Hedeager 1992, 291).

As already mentioned, Scandinavia was not much affected by the migrations. The Danes had already moved from north east during the previous centuries. Only the Jutes seem partly to have left Jutland in the mid 5th century.

In the 7th century the contacts between Scandinavia and the rest of northern Europe reached a high point. Contacts between northern and southern Scandinavia, with the Baltic and with the Anglo-Saxon kingdoms were intensive, but the Frankish littoral area was hostile.

In the 8th century the Franks expanded northward, up to the Elbe and threatened the Danes. This expansion implied ideological and military conflict, also concerning the control of the emporia on the North Sea. A hypothesis of Myhre is that perhaps this situation on the continent led the Norwegians to explore contacts around the northern North Sea (Myhre 2000, 44). In the meantime, the Danes remained the main power of Scandinavia, exercising control over other Scandinavian kings. But in the 9th century they met a decline probably due to internal fights for power. The system of overlordship collapsed (Hedeager 1992, 297). In the 10th century

Harald Gormsson Christianized the Danes and introduced them to the European feudal system.

The Vikings emerged from Scandinavia first as pirates and then as colonizers and merchants. In the beginning they carried out simple raids on monasteries and towns (e.g. Dorestad), causing trade disruption and a new period of turmoil for the North Sea. Vikings were not only raiders but were also hired as mercenaries by the Franks. In that way they contributed to events on the continent. As mercenaries they even fought against other Vikings. This was in complete agreement with the warrior ideology that they continued to adhere to. The cooperation with the Franks results in the formation of 'Northmen's land', Normandy, in the beginning of the 10th century.

Perhaps the first expeditions of the Vikings were engaged in on royal initiative, but later expeditions operated without royal control (Näsman 2000, 6).

In the middle of the 9th century a new phase begins, when the Vikings start to colonize: the Danelaw was established in 881 and York became the capital of their territory in England (Clarke 1985, 45). The northern British islands and part of Scotland were also colonized by the 9th century, while Norwegian Vikings sailed to Shetland, Iceland and Greenland.

Due to the exploits in the North Atlantic Viking shipbuilding techniques are considered to be more elaborate than those of the Anglo-Saxons. They are characterized by clinker built ships propelled by oars and sails.

Complex settlements like Gudme-Lundeborg already existed since the Late Roman Iron Age, but in the 7th century other central market places took their place. Eventually, urbanization properly began during the Viking period. The old central market places were replaced by towns like Hedeby / Haithabu, Ribe, and Aarhus. Ribe was the first proto-town (around 700 AD) (Näsman 2000, 4). During the later part of this period Hedeby and Birka were the main ports of Scandinavia.

Material culture

Objects that are considered common to the Germanic people and that are not the result of trade are found all over northern Europe (Hedeager 1992, 289-292, 294).

During the migration period bracteates were a political medium. They are related to great feasts and to oaths of loyalty. They centre around southern Scandinavia but are distributed from England to Hungary and Ukraine. Other objects/symbols that spread among Germanic peoples outside Scandinavia are bracelets and neck-rings of solid gold, brooches of Scandinavian type and double-edged display swords. In the Merovingian period the ring sword and the parade helmet become the symbol of a warrior aristocracy.

In decorations the development of a symbolic Scandinavian animal art can be observed from the migration period onwards to the Christianization of Scandinavia. The styles spread over the continent and southern England and served as an ethnic and religious symbolic metaphor.

According to Hedeager (1992) these symbols occurred mainly at the borders between two political systems or in periods of political competition. Symbols of power were used in burials when a new elite was being established. Consolidated elites preferred offerings to the gods in the form of hoards.

The cultural affinities among Germanic peoples can also be recognized in other aspects of cultural life like the burial or house building traditions. The ship burials found in England and Holland can for instance be related to the Scandinavian practice.

Demography

In this section some thoughts and archaeological data are presented that relate to the demographic assessment of Anglo-Saxon settlements on the continent and in England during the 4^{th}, 5^{th} and 6^{th} centuries. The archaeological data mainly derives from Anglo-Saxon burials, but also from settlements.

According to the research in Anglo-Saxon cemeteries on the continent it is observed that a drastic reduction in the number of burials happened at two occasions: firstly in the 4th century -around 320 AD- and then during the whole 5th century. Both are interpreted by some scholars as migrations of a part of the population, probably as movements to England. The truth is that the first migration in the 4th century has raised controversy. Willroth, for instance explains the decline as the recruitment of soldiers from the continent to England (Gebühr 1996, 65). Among the recruits were also soldiers from Saxony, who created the first Saxon association in England. However, the population decrease of the 4th century is not compatible with the finds in England, where evidence for foreign massive invasion exists only after 408 (Gebühr 1996, 66-67). In all probability, parts of the Anglo-Saxon population migrated elsewhere in the empire around 320 or were forced to leave their homes - for example because the coastal areas were abandoned.

After 408 and the end of the Roman occupation, a large number of settlers moved into England. This was followed by a wider movement of settlers in the middle of the century. Most of these settlers came from the area of north Elbe, mainly from Angeln and Saxony.

On demographic questions the study of burials is the most illuminating. The composition and content of graves of the 5th century is slightly surprising. While one might expect the majority of the burials in the emigration area to be female and the majority of the burials in the immigration area to be male, the results of excavations do not show this. In the immigration region there are many burials of elderly people while in the emigration area burials of children are prevalent (Gebühr 1996, 75). Obviously the adults that are missing from the latter set of burials had emigrated as young persons, had become old in the immigration area and had in this way influenced the composition of burials in England. Furthermore the increased child mortality on the continent indicates an increase in the population of the area: the higher the birth-rate, the higher the child mortality. The probable increase of the population in the emigration areas could be a factor influencing the population's movement.

According to Gebühr it seems that the settlements in Angeln met a population decrease of about half in the 4th century, whereas in the 5th century the population was reduced to one quarter of the level of the 2nd and

3rd centuries (Gebühr 1996, 81). Pottery finds indicate that the migration process from north Germany to England lasted 2-3 generations, from the first half of the 5th century to the first decades of the 6th (Weber 1996, 208).

The burial finds in the probable immigration region of Spong Hill in East Anglia bear great resemblance to those of Issendorf, in Niedersachsen. During the first half of the 5th century the cemetery of Issendorf is enlarged. It seems that it developed into the central cemetery for many settlements in the area. Perhaps that was partially related to the abandonment of coastal settlements. Perhaps the area around Issendorf became the waiting point for migration to England or perhaps the remaining population gathered in a few central places for political, economical or security reasons.

It is assumed that the population of Issendorf didn't take part in the migration. There was no predominant sex or age in the burials. There is a majority of female burials but the difference is not too great. However, the examples of the middle 5th century show a decrease in the number of adults, which might mean that at least a small part of young adults, left Issendorf (Weber 1996, 209-210).

People from north Germany and southern Denmark migrated in great numbers to England not only because of the needs of manpower for army and workforce at the beginning of the 5th century. The abandonment of coastal settlements in favour of larger central places and an increased preference for drier soils on the continent indicate that other reasons existed as well. Problems relating to nourishment as a result of declining crops due to excessively intensive agriculture, climate change or insecurity due to attack may well have been part of the equation.

The migration of a great part of the population of especially the Angles and Saxons is a fact. But to be sure about the numbers of the migrated population we should await results of more burial-ground investigations and we should have a clearer picture of the areas of immigration.

4. SETTLEMENT AND ECONOMY

During the fifth century, after the fall of the Western Roman Empire the economical frame work continued to function, even though production and craftsmanship declined and even though the market system was becoming inadequate. Trade consisted mainly in regional exchange. The only international trade was the trade in luxury goods. The Germanic people acquired luxuries, metals and weapons from the Romans and their successors and in exchange they gave slaves, furs, honey, beeswax and amber (Näsman 1991, 26). This international long distant trade had a political and social character.

Throughout the 6th century there is continuity in sea traffic from the North Sea to the eastern Mediterranean (mainly luxury items), but according to many trade is reduced after the rise of Islam from the middle of 7th century AD onwards.

During the late Merovingian and the Carolingian period there is prosperity, based in agricultural production (Randsborg 1991, 19f). In this period the market settlements that had previously been used on a seasonal basis take on a more permanent character. Some of these markets are in England like Ipsiwic or Hamvic and on the Continent there are Quentovic, Ribe, Hedeby. Such permanent markets replace the ones of the previous period of which Lundeborg, Sorte Muld and Helgö are Scandinavian examples. The new markets include permanent production and crafts.

Development of central trade-places and emporia

In this section some sites in various regions of the North Sea will be examined. With these settlements as a starting point it will try to examine the imports and the exports of goods from the 5th to 9th centuries.

5th to 7th centuries

During the 5th to 7th centuries there are three important central-trading sites in Scandinavia: Dankirke on the west coast of southern Jutland, Gudme-

Lundeborg on Funen and Helgö in eastern Sweden, which were positioned along sea routes. These central-places not only had a function in trade but also had a political, religious and social function (Näsman 2000, 4). Besides sea transportation, as established from the Roman period onwards, an equally significant land transport network was in place (Näsman 1991, 26). Nevertheless, we will mainly be concerned with sites that are close to the region where the Grestedbro ship was found.

The beach-market on Amrum
On the north-Frisian island of Amrum a possible landing site has been found (Segschneider 2002, 248). This interpretation was made because of the finds in the area (decorated potsherds, bronze brooches, glass beads and 20 glass beaker sherds from the Rhineland, amber and stone-implements and more) and also because of the existence of an occupation layer, of two sunken houses and a four-posted granary. On the basis of the pottery and the glass, the site is dated from 400 to 500 AD.

Associated settlements to Amrum
The settlements of Dankirke and Dejbjerg are related to Amrum. Finds from Dankirke, maybe the predecessor of Ribe, have proven that this location existed from the 2nd century BC to circa 750 AD. Remains of houses attributed to the 5th century AD have been excavated. The excavations show an increase in finds of metal, coins and Frankish glass sherds and glass beads. The find of a small pot in Anglo-Saxon style may suggest contacts with Britain as well. Probably the two settlements were part of the glass-route from the Rhine to Jutland and Norway (Westergo- Elbe-Weser triangle- Eidersted- Dankirke- Dejbjerg- Sejlfod- Norway) (Segschneider 2002, 248-253).

The two settlements Dejbjerg and Dankirke are considered typical for a coastal trade that was dominated by rulers of the region whose power depended on their participation in that trade.

7th to 9th centuries

During the 7th to 9th centuries the Frisians controlled the trade between the Carolingian Empire and the rest of northern Europe. They transferred goods from the Rhineland to England, Scandinavia and the Baltic area. As a result of the developing trade, new *portus* are established all around the North Sea.

Central places like Gudme/Lundeborg lose their importance and are replaced by others. Dorestad on the Rhine was an important trading centre. Other ones are London, Southampton, York and Ipsiwic in the West, , Quentovic, Ribe and Birka in Sweden in the East. These ports, commonly called *wic* or *emporium*, were market-places and centres for international exchange. They were situated on the frontier of a kingdom in coastal or riverine locations that were developed especially during the second half of 7th century AD.

The *emporia* were under the control or influence of kings/rulers. However, from the 8th century onwards, bishops and abbots actively participated in coastal trade and in trade across the Channel. *Wics* or *emporia* had a function as centres of exchange for imports and exports of bulk commodities and were linked to networks of inland markets. Port tolls like the *decima* (10% on the wares) are introduced (Middleton 2005, 319f). In the 8th century also, a process of urbanisation started. The first proto-towns were planned with plots and roads for craftsmen and merchants (Näsman 2000, 4). The emporia were perhaps a determined step towards the urban transformation as it happened in Scandinavia, in England and on the Continent during the late 9th to 10th century (Reynolds 2005, 110). In London and Southampton for instance a distinction occurs between port and town from the 9th century onwards.

Dorestad

Dorestad (Ellmers 1990, 91f) on the Rhine is an interesting case of port development. It started around 625 as a beach market under the protection of a manor house and progressed to a permanent settlement where products were transferred to England and Scandinavia, following a peculiar building pattern ("Einstrassenanlage"). Dorestad and Quentovic were the main Frankish ports providing for contacts with the British Isles in the 7th and 8th centuries.

Ribe

In the settlement of Ribe a large number of artefacts were found that indicate intensive trade activity. The pottery connects Ribe with what we now call Northern France, Germany, Belgium and Holland. Othwer finds worth mentioning are soapstone and different whetstones from Norway, various types of glass beads of Frankish origin and coins struck at Dorestad, from Kent or Mercia, and a mix of Frisian coins that date to the 8th century (Feveile & Jensen 2000, 13-15, 23). Cattle were traded at an early stage.

Limfjord-Sebbersund
The Limfjord was of vital importance for communication across Jutland and for local transportation of commodities. During the Late Germanic Iron Age it was the essential transit point between Western Europe and Scandinavia, even though the archaeological evidence is somewhat scanty. During the Viking period the inlet continued to be an intermediate station for trade between Denmark-England-Scotland-Norway (Birkedahl & Johansen 2000, 25).

At the east end of the Limfjord villages of the Late Iron Age/Viking Age have been found at a distance from the coast. Nevertheless there is a trading centre on the coast, which is called *Sebbersund* and is dated from *c*. 700 to 1000 AD. Goods, as found at that location were mainly imported from England and Norway. In fact it seems that at this trading centre goods were transshipped for further distribution around the eastern Limfjord. In Sebbersund iron, soapstone and slate for whetstones have been found as well as querns. Other finds included the remains of iron knives, the iron of which supposedly comes from Norway. The settlement consisted of 300 sunken houses which might be a sign that it is a seasonal trading centre (Christensen & Johansen 1992).

London, York, Ipswich, Southampton, Sandwich, Chester
The English ports of the 8th century were all under some form of royal patronage (Hodges 1982). In these emporia bulk commodities like fish, wine, woad (a blue dye for woollen cloth) were imported and wool and clothing were probably the exported cargo. Even though the evidence of production is limited at the ports, there is pottery production in Ipswich and metal-working and weaving in London.

Development of rural settlements

During the Early Middle Ages (Iron Age and Viking Age) rural settlements appear in places that are thought to be the best agrarian areas like in valleys and on ridges. From the 6th century onwards farmsteads in Denmark and Norway were abandoned. The settlement pattern was reorganized. This may reflect a new economic organization: centralization of farming and the resultant appearance of control by a landed aristocracy?

In the Danish region two subsequent expansions of rural settlements took place, both in the coastal and the inland area; the first around 200 AD, and the second around 700 AD (Näsman 2000, 3).

From around 700 AD, villages start to be well planned and expanding. The settlements have bigger farmyards, more buildings and houses are constructed in a new fashion. Agrarian production increases as well. The rural surplus has an impact on the central-places, as the elite of the central-places starts to trade the agricultural products.

An example of a well-planned rural settlement of the 8th to 11th centuries that offered agricultural products like meat, butter and wool is Elisenhof in the Eiderstedt peninsula (Kühn & Müller-Wille 1988, 185).

Conclusions

In many respects the situation was unstable during the periods just before and after the collapse of the Western Roman Empire. Various invasions, immigration, emigration, changes in religion and changes in the political structure qualified Northern Europe. Trade never stopped but developed according to the needs of each society. During the Migration Period there were connections between the lands of Scandinavia and Anglo-Saxon England. During the Merovingian period these connections increased. In the Viking Age there were no new contacts in the region, but the traditional trade routes were used more frequently (Näsman 2000, 3f). The goods that were exchanged were more varied; from luxury to agricultural products.

One could say that the changes in both rural and trade settlements that occurred in and after the 7th or 8th centuries meant a real transformation of Scandinavian and English society. Did the new "urban" inhabitants come from the rural settlements to the emporia? And could one suppose control by a landed aristocracy in the case of the expanded farms?

5. TRADE AND CONTACTS ACROSS THE NORTH SEA: AN ANALYTICAL APPROACH

Background

Considering the way in which the Gredstedbro ship is presently interpreted, it would be logical to assume that it was used on the North Sea. It is hard to say whether in practice it has been used for relatively short distances or for long hauls. Given the sea-conditions on the west coast of Jutland, relatively short and longer distances basically put very similar demands on seaworthiness, equipment and crew. Whatever the preference, the concept of always finding shelter after a day-trip is simply inapplicable in this environment, due to the shallow waters and strong currents that are prevalent in these areas: one should be ready to find deeper water to ride out a storm, as the coast is not always approachable. In the period we are concerned with here, the North Sea is part of a much larger network. But how extensive were contacts in reality? How intensive was trafficking around and over the North Sea? How did networks between people and regions come about and develop? How were they maintained? Ship finds are scarce and only give very limited indications. We therefore chose to take a traditional archaeological approach and to look at the distribution of specific artefacts on land in order to see what perspective this may give us on trade and contacts around the North Sea. Does it produce a useful context to the ships of the period and their use?

If artefacts or some of their characteristics are identical or very similar in different regions, then contact is assumed; if many artefacts and features are similar, a high degree of contact is assumed; if there is reason to assume that a specific type originates in a specific area, one can even indicate a direction of movement. Despite apparent weaknesses in such a 'diffusionist' approach, we chose to try it out as an exercise in archaeological reasoning, exploring systematic methods to describe contact as reflected in archaeological material.

However, how is "contact" expressed in material culture? We can map regional differences and similarities on many scales, but not all of them would be relevant to an understanding of cultural contact in which the geographical focus is on the entire North Sea area. For instance, the basic mode of food production is dependent on local ecological conditions. If we register such differences, we would map the ecological setting of societies. That is not the same as contacts between them. Therefore using such data would not further our understanding of the maritime aspect of culture. At the other end of the scale, the similarities between the Anglo-Saxon Sutton Hoo grave and the several Swedish boat graves are relatively straightforward to recognize, and have often been commented upon in the archaeological literature on the period. Despite their importance, this particular similarity could reflect a highly exceptional contact. This contact, moreover, could have been limited to the highest political level. Basically, the similarities could be the result of just one Anglo-Saxon king having visited his peers in Sweden, seen their burials and wanting something similar at home. With regard to cultural interplay it may not necessarily be al that significant to have a single instance of similarity, as it could reflect the actions and thoughts of single individuals, in this case at a very high level of society. In other words, neither the distribution of food production nor the occurrence of contact at a high political level give us a good indication of the intensity of contact and exchange that we are looking for. In other words, we need to define a level of analysis that lies in between production and politics, as it is at that level that we want to describe and analyze the artefacts.

Transport zones of the Early Middle Ages

In trying to find an appropriate level of analysis we looked into the model offered by Westerdahl on traditional transport zones of Europe (Westerdahl 1992; 1994; 1995b). As a means to study ship types, their use and development, the transport zones geographically define maritime 'watersheds' in between which trafficking networks developed into vernacular maritime traditions. As the different zones reflect different waters and different challenges to navigation, the ship building traditions would also develop in different directions.

As a practical application, Westerdahl has developed a "preliminary sketch" of the transport zones of Europe during the Viking Age and High Middle Ages (Westerdahl 1995b), a section of which is shown on Figure 4.

The transport zones directly provide a geographical context to the Gredstedbro ship. A basic idea behind the zones is that contact by ship was regular within them, and that ship types developed to navigate the waters of each zone, while a transition between zones generally also meant a change of vessel. In the model the Gredstedbro ship belongs to zone 6, the "Nordsæ", from the Danish west coast, across the Low Countries to South Eastern England. These areas would form the "inner sea" in which the Gredstedbro ship would have navigated, and if we apply this model we should try to understand the ship from this perspective.

The obvious question is whether and to which extent the zones apply to the Early Middle Ages. Westerdahl himself points out that zones were breached during the Viking Age, and again in the Late Middle Ages, due to changes in ship technology (Westerdahl 1994, 269). In both cases these changes extended the range and the transport capacity of the ships in question.

Legend

1a. The inland zone of subarctic northern Fennoscandia and Russia north of the portages.
1b. The inland zone of central Sweden and Norway
1c. Western Finland
3. "Ostsæ/ Eystrasalt". The maritime transport zone along the Swedish eastern coast by way of Åland to the Finnish Bay
4. The "Beltic" Sea. The southern zone of the Baltic, from the Danish islands and the present-day coasts of Germany, Poland and the Baltic countries up to the Gulf of Riga/Hiumaa.
5. "Westsæ", Kattegat/ Skagerack.
6. "Nordsæ." The zone between southern Jutland and the Rhine and Schelde estuaries, including the river systems up to Switzerland.
7. The North Sea with western Britain and its corridors to west Norway.
8. The northern French rivers systems, the south part of Britain and the south part of the Channel.
9. The Irish Sea.
10a. The Norse utleid corridor to the northern Isles (Scotland), Faroes, Iceland and up to Finnmark in the north.

Figure 4. Traditional transport zones of North-western Europe according to Westerdahl. Redrawn from Westerdahl 1995b, 225.

Being explicitly inspired by Braudel's concept of *la longue durée*, Westerdahl uses a very broad timeframe to illustrate the validity of the zones, from the sacrificial weapons finds and water blockages of the Iron Age in Jutland to the development of the medieval cog, and he finds that the zones have existed as a cultural "*undercurrent*" up to the present days (Westerdahl 1995b, 214). However, the zones are made to reflect the Viking Age and the High Middle Ages, and what was the actual duration of the *longue durée*. Do these zones tell us anything about the Dark Ages, or had *les conjonctures* and contingent *évènements* changed them significantly?

The transport zones are based on a general analysis of ship types, together with an assessment of geography. As has already been put forward, ship types can hardly be used as analytical category for the Early Middle Ages, as the finds are too few. It is not possible to make a study directly parallel to that of Westerdahl, but in stead it is possible to elaborate on the ideas behind them, and thereby develop a picture of transport geography.

If transport zones reflect the "*vernacular, everyday, traditional, material culture, often reflected in other fields than the specifically maritime one*" (Westerdahl 1994, 267), then we must assume that these zones are represented by, and can be seen in the archaeological data. Applying the hypothesis that areas in regular contact would have similar material culture, it should be possible to distinguish zones on the basis of what is found on land. If this is correct, we can define transport zones, not only by the ships, but also by what was transported in them. In other words, if the zones are valid cultural descriptors, they must be reflected in some general degree of similarity in material culture, and the zones must therefore be discernable by analyzing similarity in artefact assemblages across geographical space.

Methods and data

Methods

The problem of assessing similarity is not restricted to maritime archaeology, but is a general and basic operation in many lines of scientific work. As such a vast array of approaches and methods has been developed which are readily available to the researcher. In this work we will explore a quantitative approach, measuring degrees of similarities by using advanced multivariate techniques, and illustrating the results through the use of

Geographical Information Systems (GIS). Two methods are being used, correspondence analysis and a - relatively simple - similarity index.

Correspondence analysis is a method to explore the associations between objects and variables in a contingency table. The result of the analysis is a measure of correspondence, the individual objects and variables being represented as points along a number of principal axes. These axes are ranked in descending order, so that the axis holding the largest representation of variables accounts for most of the variation. In calculating these axes the data matrix is standardized and frequencies are being computed. A Chi-square test is carried out to measure the deviation between observed and expected values - a kind of best-fit measure - in relation to a centroid point (Shennan 1997, 318; Madsen 2005). While the exact numeric positions of objects and variables on each of the principal axes are not really meaningful or easy to interpret in themselves, the result is best interpreted in a so called 'scattergram' in which any two axes may be shown against each other. Due to the ranking of the axes, one would normally work with the first two axes, as these have the best possible representation of the variation in data. The 'scattergrams' must be interpreted in such a way that objects and variables that are close to one another in the scattergram also have a high degree of similarity in the underlying data. In the present study the correspondence analysis was done using the program CAPCA, which is an add-on to Excel, written by Torsten Madsen (Madsen 2005).

While the correspondence analysis is based on calculations across the entire table, the similarity index is based on a pair wise comparison of two objects at the time, calculating their relative similarity on a scale from 0 to 1. There are a number of ways to do this, but in this case we use the Jaccard coefficient, which is suitable for presence/absence data. The comparison between two objects can be explained as a contingency table of presence and absence of a number of variables (artefacts) in two objects (Table 1).

Table 1. Model contingency table for calculating the index.

		Object 2	
		Present	Absent
Object 1	Present	*a*	*b*
	Absent	*C*	*d*

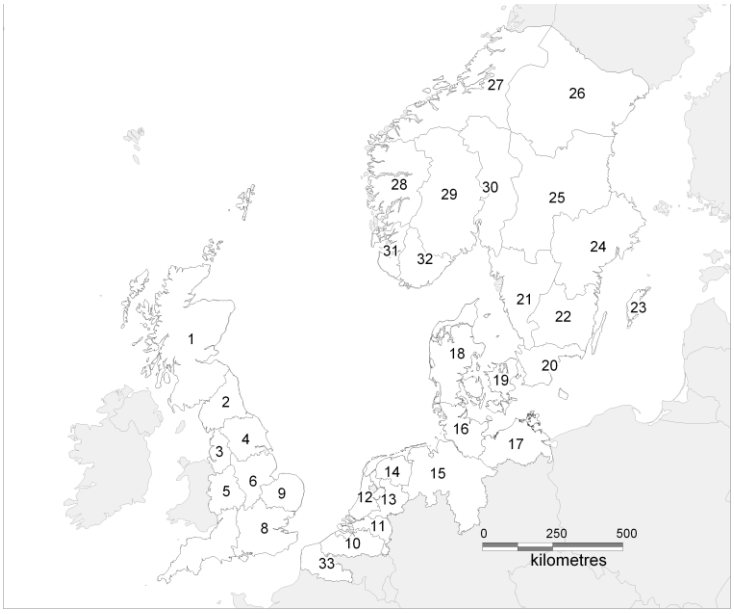
Thus, cell *a* counts the number of instances, where a variable in present in both objects, *b* and *c* count those instances where a variable is present in only one of the two objects, while *d* count the instances where a variable is not present in any of the two objects. The Jaccard coefficient is calculated as:

$$y = \frac{a}{a+b+c}$$

Note that the values in cell *d* are not part of the equation, to omit the effect of negative evidence. The method is known from cluster analysis, where the results are mostly displayed in the form of dendrograms. Although the index of similarity is computationally a much simpler approach than correspondence analysis, it posed more problems, or at least more work, to implement into the present analysis. While there are many readily available tools and add-ons to calculate the index, we wanted the result to be displayed geographically, on a map rather than in a dendrogram, and implemented into our GIS. To solve this problem a macro was written for MapInfo to calculate the similarity index. The macro expresses the pair wise comparison geographically by drawing a line between the two objects compared, and assigning the result of the calculation to this line. The degree of similarity can then be displayed directly on the map.

Regional division

In both quantitative approaches outlined above, individual finds and sites are not the basic units of analysis. In both methods, after all, similarity is expressed through a comparison of variance of data on an aggregate level, which in our case implies a geographical aggregation to regions. To define regions we have used the *Nomenclature of territorial units for statistics* (NUTS) regions developed by EuroStat. Although these regions reflect modern administrative borders, they give a workable spatial resolution for the analysis. Moreover, these units correspond more or less with the regions generally referred to in literature discussing the distribution of archaeological data. As the NUTS regions reflect somewhat different units in different European countries, our chosen regional division combines two levels of NUTS. To facilitate the analyses, Denmark has been subdivided into an Eastern and a Western part, while the Norwegian *fylker* have been added to the map, using some aggregation. All in all 33 individual regions form the basis for the analysis (Figure 5).



Legend

1. Scotland
2. North England
3. North West England
4. Yorkshire and Humberside
5. West Midlands
6. East Midlands
7. South West England
8. South East England
9. East Anglia
10. Vlaams Gewest
11. Zuid-Nederland
12. West-Nederland
13. Oost-Nederland
14. Noord-Nederland
15. Niedersachsen
16. Schleswig-Holstein
17. Mecklenburg-Vorpommern
18. Vestdanmark
19. Østdanmark
20. Sydsverige
21. Västsverige
22. Småland
23. Gotland
24. Östra Mellansverige
25. Norra Mellansverige
26. Mellarsta Norrland
27. Möre og Romsdal
28. Hordaland
29. Buskerud
30. Østfold-Hedmark
31. Rogaland
32. Agder
33. Nord - Pas-de-Calais

Figure 5. The regions used for the analysis. © EuroGeographics for the administrative boundaries.

Artefacts

In order to analyze contacts between the regions so defined, four categories of artefacts have been selected: Pottery, glass, ornaments and coins. These categories are selected to reflect the cultural level that lies in between production and politics as was called for in the discussion above. We assume they are the best available indicators reflecting trade, and its variants, although this is obviously not an unproblematic assumption. Even coins may have been distributed and brought together through other mechanisms than what we would nowadays define as formal trade. This has for instance been discussed by van Regteren Altena & Heidinga (1977). The same applies to other artefacts. Nevertheless, whatever mechanisms of exchange actually underlie artefact distribution, we assume that the distribution in itself is an expression of cross-regional cultural contact.

The four categories of artefacts have subsequently been assessed and mapped to produce a basic table for the two forms of quantitative analysis. All along, it has been evident that a full overview of all finds in the four categories of artefacts would not be attainable. Preparing such an inventory would take far more time than is reasonably availably in the context of a training seminar. Indeed, it would also be difficult within the framework of a relatively large research project. The sheer mass of archaeological data, collected and filed in different ways in different European countries, means that a study with such general aims as the present one cannot dig too deeply into individual sites. A lot of material is probably registered digitally, and could at least potentially be accessed, but even so this is a huge task. We are well aware that this is problematic. We must consider it in the analyses in order to mitigate some effects. Part of the problem, however, cannot be eliminated and needs to be discussed.

The data we processed is taken from published catalogues and review articles. Some of these secondary sources are relatively old. Others may even have been missed altogether. Moreover, the newest finds have been missed anyway. This may seem very problematic. And it would have been if we had chosen to count and use frequencies of sites and artefacts. Such an approach would also have been vulnerable for another reason. One would have to adjust for various find circumstances. A hoard with hundreds of coins would skew the analyses in relationship even to many graves with a single coin in each of them. For both these reasons the distribution of artefacts is registered as presence/absence within a region as previously defined. We do not consider the frequency of occurrences within each region, but just consider whether a certain type of artefact occurs or not. In this way the apparent weaknesses of the database are mitigated. A new find in a region, where finds of the same type have already been registered, does not contribute to the overall picture.

By using this setup, the study is less dependent on the newest finds, and the influence of different forms of deposition is ruled out at the same time. It also means that we cannot measure the strength of a geographical relation through the concentration of certain artefact types in selected regions. The centre of a distribution will not be distinguishable from the outmost periphery. The relative centres and peripheries of different cultural regions will only appear through the combined use of several different artefact types.

The timeframe for the study is the period from the 5th to the 8th centuries. In Denmark –and thus for the Gredstedbro ship– this period would be called 'Germanic Iron Age'. In other regions other names are used for the period, such as 'Migration Period', 'Vendel Period' and 'Merovingian Period'. Nevertheless, from a viewpoint of material culture the period is relatively well-defined in Northern Europe. Obviously, the occurrence of some types of artefacts is not limited to these centuries. Chronological boundaries therefore are not strictly fixed, but are open for discussion in relationship to individual types of artefacts. Another question is whether the Dark Ages can be treated as a coherent period, or whether developments within the period justify a subdivision. Trade connections seem to have changed during the period (e.g. Hodges 1982; Näsman 1991a; see also chapter 4). However, if the hypothesis of defining transport zones is to have any value, we have to assume some structural continuity in the *longue durée*, and hence assume that recognizable patterns exist despite such developments. That is the reason to use a relatively broad chronological framework.

The four main categories of artefacts have been analyzed and mapped by four different students. Their task has been to establish a meaningful typological division of the artefacts, based on the available literature, and to register the distribution of these types across the regions. The typologies evidently reflect the typologies in the literature. However, it has also been important to choose typological divisions at a relatively general level that reflects the problem at hand. The nitty-gritty details of a full typological division, as one would use in a detailed chronological analysis, is not the issue here. In the context of the present study it is considered more relevant to map broad categories of types within each category of artefacts. The following sections reflect these considerations.

Pottery

All along it has been clear that a full assessment of North-West European pottery was impossible. The most important types of pottery have been included in the list and thus included in the distribution map. Simplification and generalization of data is necessary to draw a clearer and more informative picture of the assessed information.

Basically the intention is to create a balanced picture of cultural connections of the whole area in question. Any focus on particular connections between areas is unintended. Classification, distribution and

types of pottery have been chosen from the available literature in a way that was thought to be convenient for a satisfactory result of the work. The following groups were chosen and are briefly discussed below.

Presentation of the pottery

Table 2. Pottery types, their groupings and dating

Type	Sub-types	Dating
British	All	400-
Bar-lip		700-900
Badorf		700-900
Germanic pottery	Buckelurnen, Anglian, Jutish, Saxon	400-650
E-ware		700-800
D-ware		600-700
Red Slip ware		400-600
Slavonic	Sukow, Feldberger, Fresendorf, Menkendorf	600-900
Muschelgrus		650-900
Gray ware	Egg-shaped and Gray ware (round and flat base)	700-900

British

Britain poses an interesting problem regarding the mapping of pottery. It had a substantial domestic production of high quality (weelthrown) pottery – remains of know-how from the Roman period. Domestic pottery production in Britain is a comparatively well-discussed subject. Apparently, it was widely traded between the different areas of Britain. However, (almost) nothing seems to have been taken abroad to the continent during the period in question. In view of this, the types of pottery have been grouped together and will only occur as one category in the dataset, although the different types seem to be innumerable.

E-Ware, D-Ware and Red Slip Ware

A substantial import of pottery to Britain from the Mediterranean, the Iberian Peninsula and Southern France was going on during the Roman period as well as in the course of the migration period (5^{th} – 9^{th} century). This trade is especially in evidence for the western sea lanes between Ireland and Great Britain (including Scotland). Even though it does not

really contribute to the understanding of cross-Channel contacts, these wares and this trade is included here to show the pattern in contacts between West and East Britain, which is slightly different than elsewhere (Crawford 1993, 1995; Wooding 1996)

Muschelgrus

Shell-tempered pottery originating in the Frisian area and widely distributed in Northern Europe.

Slavonic

An overarching term for more or less contemporary or succeeding pottery types. The Slavonic pottery had a continuous stylistic impact on North-East European pottery.

Bar-lip

A type of pottery commonly found in East Britain. It has its origin in South Scandinavia.

Badorf

Frankish pottery of good quality. It's primary use was as containers or as tableware (luxury).

Grey Ware

An overarching term that lumps Late Germanic Iron Age/Viking pottery and the Frisian egg-shaped pot.

Germanic pottery

An overarching term for pottery from the classic migration period in Britain (400-600 AD). It includes material of great similarity on both sides of the Channel (Britain, Jutland and Frisia).

Discussion

Even though it may seem relatively straightforward, the classification of pottery turned out to be a rather complicated matter. Almost every country and research tradition has its own names for different groups or single types of pottery. Besides that, only few authors have compiled and compared distributions of culturally similar pottery comprehensively across present day borders. Depending on the literature assessed, the classifications are changing. In some literature for instance Grauware (Grey Ware) is used as a general overarching term to denominate the domestically produced pottery

from the Late Germanic Iron Age and Viking Age – the globular bowl or "Jutish bowl" with round base as well as pottery-types with flat base, a type primarily found in East Denmark and Sweden (Lüdtke & Schietzel 2001, 23-37). Gray Ware is sometimes divided into sub-groups (e.g. A0, A1, A2 etc.). This classification, however, is hard to match with simple terms like West Danish or East Danish pottery (e.g. Brorsson 2005, 35).

There is evidently inconsistency in the classification of pottery in the literature. Basically it is all a matter of details, accuracy and criteria of division. This, of course, may complicate things further. Which criterion of classification to choose? All of the early domestically produced Viking pottery was handmade, and was round based as well as flat based. However, contemporary early Slavonic pottery was also handmade and had some influence on the East Danish and Swedish domestic pottery production and in fact it is very hard to distinguish it from the East Scandinavian types (Brorsson 2005, 30-37). All of the above mentioned pottery is of somewhat the same quality and same method of manufacture. Furthermore, the egg-shaped (eiförmigen) pot originating from the area between Ribe and the northern part of the Netherlands (the Frisian area) may also be included in the same manufacturing and cultural sphere of handmade pottery. From a point of view of manufacturing, all these types of pottery can be interpreted as belonging to the same group of similar contemporary handmade pottery. The East Danish/Swedish pottery with flat base is hard to distinguish from early Slavonic pottery. Whatever one has tried, there is no clear ethnographic distinction. On account of ethnicity, however, the pottery has been divided into three distinct groups: Slavonic, Swedish/East Danish and Frisian/Saxon/Juttish/Norwegian (Lüdtke & Schietzel 2001, 26, 45-46). On the other hand the population of the whole area, with the exception of the Slavonic areas, is supposed to constitute a more or less homogeneous group with more or less similar language and culture, despite differences in pottery tradition. From this it is obvious that there is some sort of discrepancy in the relation between ethnicity and type of pottery: the groups are not, judged from style or manufacturing processes, clearly distinct from each other. Assumed contacts between different areas expressed by the presence of certain kinds of pottery, e.g. pottery found in Britain but supposed to have its origin in Scandinavia and the Frisian area, are often based on an indeterminate mix of arguments of typology, ethnicity (migration) and trade (trade is supposed to have had a subordinate role in the beginning of our period). This also means that we can not always be certain on the nature of the contacts. The Germanic pottery present in Britain in the 5th to 7th century

(Dunning *et al*. 1959, 49) is a good illustration. This all means that choices had to be made in constructing the database for the present analysis. In the case of the Scandinavian/Slavonic pottery a division has been chosen to be based on ethnicity – all the pottery from the Late Germanic Iron Age/Early Viking period – the Grey Ware – is thus separated from the early Slavonic pottery. This is in line with a long-standing tradition of research, but is perhaps not as straightforward as it seems.

As the main question at issue in this exercise is to sort out connections and the transition of cultural expressions (by different means – not only pottery) between (distant) areas whether this reflects trade, migration or transition of form and style (typology), we –of needs– have chosen a diffusionist approach. In this approach it is necessary to assume that a certain (or similar) type of pottery can have only one, more or less, well defined region of origin. The Bar-lip pottery which is found in Britain, for instance, is supposed to have had its origin in South Scandinavia/ Frisia and was then, by some means, transferred to East Britain by Germanic marauders, by Frisian traders or….? (Dunning *et al*. 1959, 48-49). This kind of Bar-lip pottery found in Britain is normally interpreted as belonging to the "Grey Ware"- category in the literature, even though in concept it may have reached further back in time in other parts of Europe. However, this particular form is used to indicate a strong cultural impact from Scandinavia and Frisia and it has been picked out in order to indicate cross Channel contacts. The Grey Ware is then interpreted as being a strong indicator of close connections between most parts of Scandinavia.

As shown by the example above, no strict and fully consistent typology can be firmly made. Another example of inconsistency in the approach is the apparent connection between Funen (Western Denmark) / Schleswig-Holstein und Hamburg and East Anglia exemplified by finds of period III pottery starting as early as the 4th century and terminating at some point in the 5th century (Jensen 1977, 151-190). Such detailed studies are, however, of little value to this project for two reasons. Firstly, this close study of a specific pottery type found on Funen is only related to a single location in Britain (Caistor-by-Norwich). Secondly, in the period of the 5th to 7th century a range of only slightly different potteries, believed to be of Germanic origin are found in Britain. This pottery can be related to similar finds in Denmark, the Saxon and North Frisian areas (Saxons, Angles and Jutes). A combined assessment through grouping together of (more or less) contemporary pottery on the basis of supposed ethnic relations is necessary

in this case. Too detailed an analysis of relations is not proportionate to the size of the regions. It therefore entails a potential risk of biasing the final results. Even though it is possible, at least to some extend, to point out areas inhabited by either Jutes, Angles or Saxons the division of Britain as chosen for the present analysis is simply too rough (Myres 1986, 105-143). Consequently the only reasonable solution is to group all the (slightly) different pottery types together and to interpret the migration of the various Germanic tribes to Britain as a continuous movement in the time span of the 5th to 7th century.

Pottery from the later part of the period is somewhat easier to handle. Even though pottery is still classified in different ways in the literature, the distribution is apparently caused by commercial trade and it is possible to trace most pottery types back to a specific town or area of production. At some point in the 8th century a more organized trade, probably due to the advent of the organized towns/market places, was taking place between the different areas around the North Sea. The occurrence of pottery in the early towns in the North Sea area has been subject to much more substantial trans-national archaeological investigations than the pottery of the preceding centuries. The occurrence of specialized pottery centres like Badorf and new economic conditions gave pottery a 'renaissance' both as containers and as luxury goods (Roesdahl 1994, 136-148; Liebgott 1989, 293-294).

It has been the intention to compose a balanced picture of the movement of pottery through time in the whole area in question. Local exchange of pottery in adjacent areas which is thought to be of minor importance in the understanding of cultural connections has been left out. This is the case in East and Northern Sweden and on Gotland between which locally produced pottery apparently was exchanged. However, the patterns are not absolutely clear. These potteries have been described and interpreted mainly in a local Swedish context, which makes them rather difficult to compare with the rest of Europe (e.g. Nerman 1975). It seems that the major part of the pottery found on Gotland in the Iron Age was domestically made, although there seem to be some resemblances regarding style and form, with the Germanic pottery category in this paper, for instance the period III pottery previously mentioned. However, such an interpretation does not seem to be corroborated in the accessible literature.

There are areas in which no or only little proof of cultural exchange has been found. In the Norwegian Iron Age there was a substantial self-

sufficiency of pottery. Only a few disputable finds of possible Danish/Frisian origin have been found. Especially East and North Sweden, Scotland and most of Norway, except from the Kaupang area, are short of or totally lack finds of the presented categories (Holand 2001, 43-50).

The classification and division of the pottery in the present contribution work has been decided in each instance by the choice of the author, Tomas A. Hunnicke, who undertook this part of the research. In accordance with the task at hand, the main focus has been to outline trade connections or instances of cultural impact between different ethnic groups and/or different areas continuously through time.

The amount of material, the size of the area and the number of excavations carried out through time in the area are substantial. There have been some additional considerations that led to the present approach. The feasibility of a comparison on a more detailed level, for instance by comparing the amount of pottery in kilograms between different areas or excavations has been considered. But it was dismissed for two reasons. Firstly, some types of pottery, e.g. the Muschelgrus in which the clay is mixed with sea shells, are easily recognized while Grey Ware and early Slavonic (e.g. Sukow) pottery are easily confused (Brorsson 2005, 30). This would without much doubt result in a biased conclusion when counting the different pottery types on a single location. Secondly, some finds of Frankish luxury goods are found in such small quantities, e.g. in Birka, Ribe and Kaupang, that it is not indisputable whether it has ended up there by coincidence or whether it really is a true expression of contacts on a regular basis between areas (Holand 2001, 48). These are the main reasons for choosing a data-structure of presence/absence. This kind of data-structure is suitable for a correspondence analysis.

Glass

Production of glass vessels was a highly specialized craft which was only undertaken in a few areas within or close to the investigated North Sea region, mainly centred in modern-day France, Belgium and Germany (Frankish glass) and some parts of England (Anglo-Saxon glass) (Tait 1991). Besides the production in the North Sea region glass vessels were also produced in numbers in Eastern areas around the Black Sea (Näsman 1984).

The artefacts chosen for this investigation are glass vessels only and not glass beads as these have been produced locally in many places. Because of the very few production areas the occurrence of glass vessels at a site is a good indicator of contact of some kind between an area of glass vessel production and the find area. Specialized glass studies are few and it is hard to assess, how much the integration of more recent finds would change the overall picture.

Glass types

The types of glass vessels in the Frankish (and Anglo-Saxon) repertoire are mostly named according to their shape. For the present analysis five types of glass vessels have been chosen. The vessels have distinct shapes and are only known to have been produced in the Frankish and Anglo-Saxon regions (Tait 1991; Savage 1972).

Table 3. Types of glass vessels and their dating.

Type	Description	Dating (century AD)
Claw beaker	Beaker with claw like projections from the side	$4^{th} – 5^{th}$
Eketorp 2	Green glass with ground rim. Decorated with blobs of coloured glass.	4^{th}-5^{th}
Eketorp 3	Beaker of poor green material. Decorated with cut ovals in open rows.	4^{th}
Eketorp 4	Conical beakers of good quality material. Decorated with long cut and polished ovals.	4^{th}-5^{th}
Eketorp 8a og Eketorp 8b	High (mostly footed) beakers of green glass with spiral trailing around neck and looped trailing on body	$5^{th} – 6^{th}$

The most elaborate of the Frankish and Anglo-Saxon glass types are the so called “claw beakers” with claw-like projections from the side of the glass. This type of vessel is also called “trunk beaker” in the German literature. It originated from Roman glass vessels with dolphins on the sides, but in the Frankish and Anglo-Saxon tradition it was produced in a crude fashion and ultimately the protrusions looked more like claws than dolphins. The claw beakers are not known to have been produced in other areas of Europe or further east.

The distribution of claw beakers presented in this work is based on literature studies and internet search. The most complete distribution of other types of glass vessels of the period was found in Näsman (1984),

which is why they have “Eketorp” type names. Due to the fact that glass vessels are very fragile, only fragments of these vessels have been found at most sites. The collection of data for this assignment is therefore focused on both entire glass vessels and the fragments thereof. Complete glass vessels are primarily found in graves, whereas the fragments of glass vessel are more common in market places and settlements.

Discussion

The lack of distribution maps from more than one source (Näsman 1984), has bearings on the present work. The purpose of Näsman’s work was to establish a comparative basis for interpreting the glass finds on the Eketorp site on Öland in the Baltic Sea, and the types described in his work obviously reflect this. The same goes for the chronology, as most of the glass finds plotted in this work are dated to the 4^{th} and 5^{th} centuries.

As was also the case with the pottery, the use of presence/absence data seems to be the most meaningful approach for the distribution of glass. The reason for this is mainly that the data search is not ‘complete’ and available information may be missing. (Näsman 1984, 26ff).

The distribution maps in Näsman (1984) were scanned as reference for the map. Instead of geo-referencing the distribution maps and thereafter digitizing the ‘dots’, the approximate position of sites from the literature has been plotted as a new table with the regions map (figure 5) as a background reference map. The position of the sites is therefore not very precise, but is considered precise enough for the purpose of this study, namely the absence or presence of a certain glass type in specific regions.

A more thorough literature study is necessary in order to make a complete compilation of finds of glass vessel and glass vessel fragments within the North Sea region.

The absence of glass finds of the known Frankish production area is misleading. It must be assumed that there will be numerous finds of glasses in these areas and that the absence of these in the maps is only a consequence of the lack of literature that was readily accessible from the present investigating students.

Ornaments

In every part of the North Sea region ornaments of bronze, silver and gold are found, and therefore the distribution of particular types would be helpful in describing contacts. Unfortunately - for a study such as this - there is a bewildering range of types and variants in this material, not all of them relevant for the present purpose. A selection and broad classification of types had to be made, and certainly many types are not included in this study.

Types used

The latest available review of the European fibulae is Beck *et al*. (hrsg. 2000), describing in detail the typology of fibulae from the Bronze Age onwards. Unfortunately not all types come with distribution maps, their distribution being described in more general terms with reference to wide areas, typically similar to the regional division we use in this study. From this catalogue the types used in table 3 have been selected. The actual distribution of them has been taken from other sources (Falkus & Gillingham 1981; Näsman 1991a)

Bracteates have been published in detail by Axboe *et al*. (1985-89), and could be mapped from Näsman (1991b).

Table 4. Ornaments used in the study

Type	Description	Dating
Cruciform brooches	The cruciform brooches are a dominant type of the early Scandinavian Late Iron Age, but are also found in England, and more sporadically across the entire area.	375-520
Saucer brooches	Circular brooches with a concave section, found in many variants across the Anglo-Saxon and North German Lowlands.	450-550
Relief brooches	Prestigious silver or gilded brooches. Various types, whose common feature is the relief decoration. The variance lies mainly in the shape of the head plate. Main distribution in Scandinavia.	450-520
Bracteates	Circular pendant in gold, with a one-sided stamp. Main distribution in Scandinavia, mostly in hoards, while finds outside this area are mostly in graves.	400-650

Discussion

The first approach to the subject was the collection of literature and the gathering of relevant data. A great help has been the ‘Reallexikon der

germanischen Altertumskunde, Fibel und Fibeltracht' by de Gruyter, which turned out to be very illuminating to the subject.

With this catalogue the brooch types became accessible but not their exact distribution, as important distribution maps are missing. The catalogue refers most of the times to the general location of the artefacts' findspot, but not precisely, especially with reference to certain areas. General descriptions like south or west Scandinavia are frequent. The attempt to find other sources of distribution maps was not very fruitful. Most of the books about brooches that were browsed in the present context, like Oscar Almgren's '*Fibelformen*' focus on the Roman Period.

According to Näsman the relief brooches are the earliest indication that the coast of Frisia linked South Scandinavia with the British Isles (Näsman 1991a, 34f). Strangely, his map does not mark any finds along the entire Frisian coast. Being very specialized artefacts, ornaments can be important sources for mapping cultural connections, but the problems of retrieving well founded distribution maps did much reduce the usability of them in this study.

Coins

This part focuses mainly on a particular group of coins called *sceattas*. Sceattas are rather small coins (10-12 mm in diameter), typically weighing 1-1.3 grams. They are similar to the Merovingian *denarii* in size and weight (Sutherland 1973, 5). They were made of silver and were struck widely on both sides of the North Sea. In England they are also known as *peningas* (=pennies).

Sceattas were produced in various areas of north-western Europe. In the case of England the first sceattas were issued in the region of Kent and at the Thames estuary. Nevertheless, the 'secondary' sceatta series expanded into many new areas like East Anglia, Eastern Mercia, Northumbria and Wessex. Among the considerable number of sceattas hoarded in the area of Friesland, along the coastal line in between the rivers Schelde and Eider, at Hallum and Franeker, there are also finds in the "productive sites" (Cook and Williams 2006, 152) of Domburg and Dorestad (Sutherland 1979, 110). Also there are examples in Scandinavia.

The authorities behind the minting of sceattas are uncertain. An exception to this rule are the silver coins of York in England, on which the name of king Ældfrith is written and which were also circulated in the area of modern Netherlands and Jutland. Some relatively large issues may suggest the existence of important rulers, and others that are small may imply more local minting. Also, some of the sceattas are decorated with religious motifs, perhaps an indication of production by monasteries or bishops.

The production of sceattas extended through the 7th century AD and into the first half of the 8th century AD. The absolute dating of individual coin types has proven very difficult, although several attempts have been made, and several chronologies have been established (e.g. Blackburn 1984).

Coin-types used

There is a large number of types and motifs on the sceattas, and several systems for classification of them have been used through time. Still a standard reference work, the catalogue for sceattas in British Museum made by Keary (1887) listed 54 different types, later extended to 76 (Hill 1952), and then 109 (Steward 1984). This classification is still routinely referred to as *BMC* types (British Museum Catalogue), followed by a number. Another standard classification into 'series' was developed by Rigold, and series from A to Y has been described (Rigold 1977). The latter system will form an important base in this work, in combination with a classification on main motifs developed by Sutherland (1979). Omitting the rarest types and series, the coins in this study form the main groups shown in Table 4, which will be used in here. Descriptions of the coins are based on Steward (1984) and Pedersen (1997), while datings of the British coins are from Blackburn (1984).

Discussion

The latest catalogue available to this study was Pedersen (1997), who lists all known sites with types, numbers, context and references. Although not updated with the latest finds, the catalogue is still sufficiently new to give an impression of distribution at the regional level we are using here, as it does include the Scandinavian finds that only emerged relatively late. The main problem with this source was that it is written in Danish, and therefore

difficult to use for a non-native reader. Another problem for a spatial analysis was the fact that the catalogue text and the distribution maps in the paper were not linked, so that the distributions of coin types were not immediately apparent. Instead, the geographical locations of place names from the catalogue were found using internet gazetteers, especially www.fallingrain.com/world, to get the latitude and longitude of the locations. The locations could then be marked on a map in MapInfo, and the regions finally be updated. Supporting this work were the slightly older maps published in Steward (1984) and op den Velde *et al*. (1984)

Table 5. Groups of coins used in this study.

Group	**Description, BMC-types**	**Approx. dating (AD)**
Primary series A & B	The primary series A and B have profile busts on the obverse side, and are indirectly derived from late Roman coins. BMC types 2a, 3b, 26 and 27	680-710
Madelinus-Dorestad triens/dinar	Early coin, minted in Dorestad by the moneyer Madelinus, and later widely copied. It has a face in profile on the obverse, and text identifying the coin.	690-700
Porcupine-standard	The obverse side includes a curve surrounded with spines '*like the quills of a porcupine*' (Sutherland 1979, 110f). The motif is probably derived from the profile bust of the primary series. Series E, BMC types 4 and 5.	700-750
Plumed bird	The 'porcupine' motive has developed into a bird-like figure on these coins. Series E, BMC type 6.	700-750
Frisian/continental runic	Two types, the more abundant type 2c with a head in profile. Series D, BMC types 2c and 8.	700-715
Wodan-monster	This type has a face with flaming hair and an animal. Very common type, centred in the Netherlands. Series X, BMC type 31.	710-750
London	The 'London'-types and their derivatives have a profile bust and a man standing with a combination of crosses and branches. Although belonging to the 'London'-series only few of them actually have a clearly readable '*De Lundunia*' inscription, if any at all. All Series L types (BMC 12-20) are included in this group.	730-750
Maastricht type	Have a coarse head and a cruciform interlace. Found mainly on the Continent.	
Merovingian dinarii	The Merovingian dinarii are frequent in hoards, especially in France and the Netherlands.	

The initial purpose of the assignment was to describe more extended groups of coins with their subtypes like the Merovingian tremisses, the Carolingian heavy and light denarii and of course the group of the sceattas, but the work described, and the lack of updated catalogues on other coin types than the sceattas above prohibited this. Also, since distribution maps are often published with another purpose in mind, they are surprisingly difficult to use in an investigation with a different perspective.

Even if the whole procedure in both literature and the MapInfo section as described above was rather discouraging at the beginning, in the final stages (mostly in the technological part), the significance and the help that the MapInfo program offers for the creation of an entire image of the contacts were appreciated as very useful.

The coins especially illuminate the problems of centre and periphery in distributions. The presence of types especially in Scandinavia is dependent on occurrences at single sites, and the presence of these types are thus dependent on the chance discovery of the "right" sites, providing coins in the excavated material.

In spite of the problems, the sceattas are an important coin-type that was widely circulated across the North Sea. The circulation of these sceatta-types that is presented in this work was wide and can show aspects of cross-regional contacts across the North Sea.

Results

It should be clear from the sections above that the collection and classification of data from published work has posed problems to the researchers. The collection of data was dependent on the scientific aims of other researchers, and on the artefacts published in their works. The distributions we have been able to register for this large area is also dependent on depositional traditions, research intensity, publication intensity - and linguistic barriers. As such the selection of data may seem random and too weak for analysis. But as anyone with even a slight idea of statistics will know, randomness is actually the best way to achieve a precise result. Our problem is rather the opposite, that the selection is *biased* in the ways discussed above. Archaeologists often confuse the two words.

Bias is inherent in any archaeological distribution map, and the problems we describe here are thus inherent in any archaeological interpretation based on such maps. Nonetheless they have formed a fundamental tool to archaeological analysis for a century, and experience tells us that we should probably not do away with them altogether (Näsman 1984, 26ff), but that it is a basic prerequisite for any archaeologist to be able to recognize what we can see, and not see, from such a map.

In the current work we apply statistical tools that are best used in an early, exploratory phase of an investigation. The aim at that stage should be to establish a broad overview of the problem and data, and therefore we need not go deep into the details of individual sites and artefacts. Recognizing what an archaeological distribution map is, we can also recognize what type of answer we can possibly get from an analysis of them. As shall be demonstrated below, we have actually been able to extract meaningful results from the statistical analyses of our data.

Correspondence analysis

From the graphical representation of the 1st and the 2nd principal axes (Figure 6) it is clearly shown that some of the regions are positioned far away from the other regions in the diagram. The rest of the regions are positioned comparatively close to the origin (0.0).

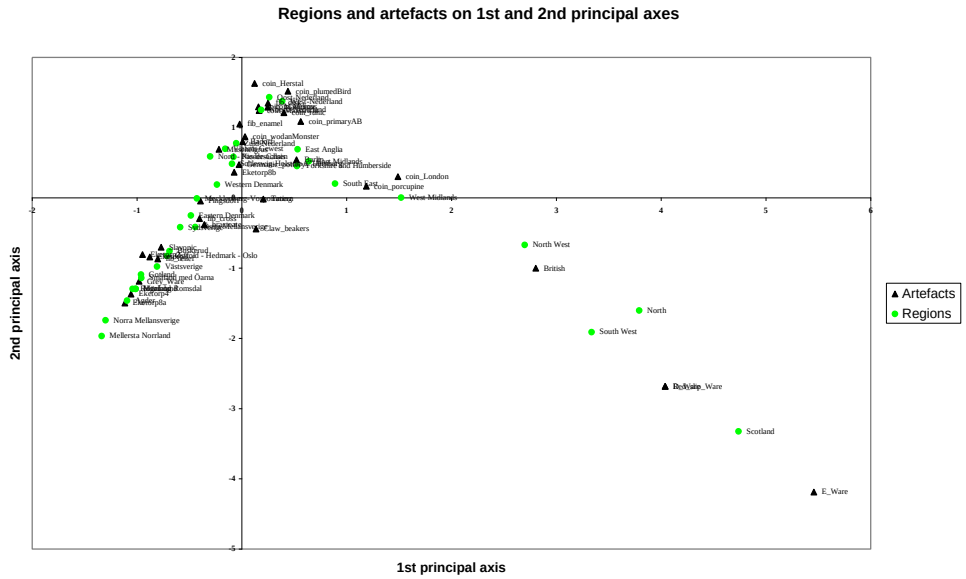


Figure 6. Plot of the two first principal axes of the correspondence analysis.

The most outlying regions are in the British Isles. The western and northern parts differ considerably from all other regions. The other regions can initially be interpreted as falling into three (more or less) distinct groups, interpreted on distance from 0.0 in the coordinate system. The first group is formed by Agder, Rogaland, Hordaland, Möre og Romsdal,

Mellersta Norrland, Norra Mellansverige, Västsverige and Småland med Öarna. The second group consists of East and West Denmark, Sydsverige, Östra Mellansverige, Østfold, Buskerud, Schleswig-Holstein, Mecklenburg-Vorpommern, Niedersachsen, Zuid-Nederland, Vlaams Gewest and Nord - Pas-de-Calais. The last group comprises Noord- and Oost Nederland and the eastern part of Britain from South East to Yorkshire and Humberside.

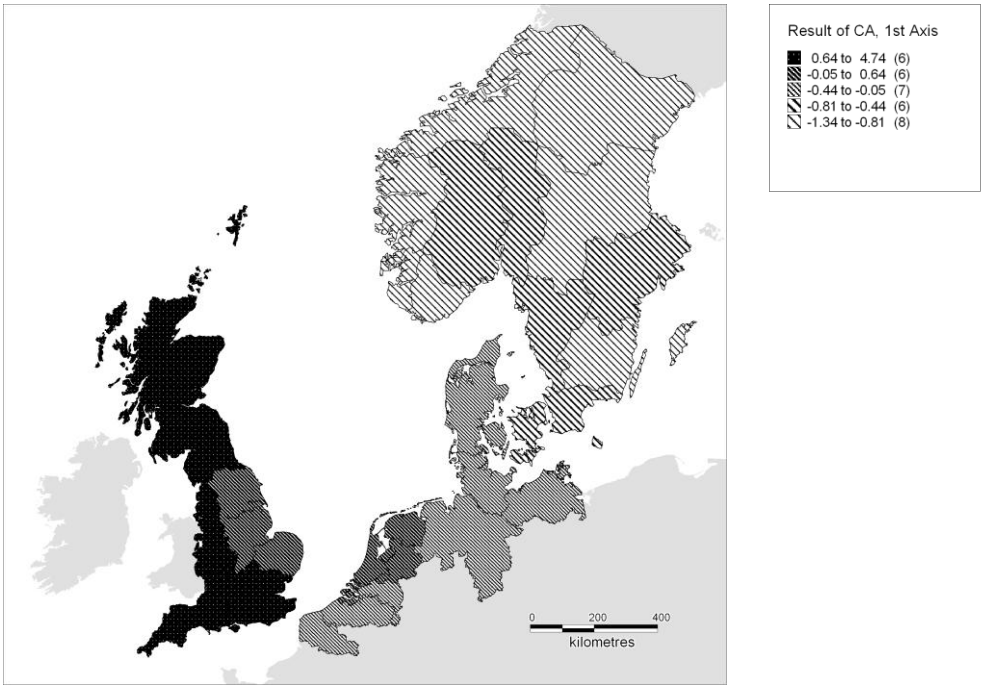


Figure 7. The 1st Axis of the Correspondence Analysis mapped using the 'Equal Ranges' display option of MapInfo.

When making a thematic map from the result of the 1st axis (Figure 7) this looks much like the initial interpretations, although it must be remarked, that the different display options in MapInfo do give somewhat different maps. From the resultant table it can be seen, by use of the "Explanation %" that the first axis only accounts for c. 27 % of the variation. The second axis accounts for c. 19 %. None of the axes has an impressing degree of explanation, indicating that the relations we are attempting to map are very complicated. The result will be discussed below when further analyses have been carried out.

Index of similarity

This analysis creates an index of similarity through pair-wise comparison between regions. The degree of contacts between the different regions is expressed as a number ranging between 0 and 1. Only numbers higher or equal to 0.5 are taken into consideration in this analysis. A value of 0.5 or higher indicates a large degree of similarity. The strength of similarity between the regions is shown in Figure 8. The width of the lines indicates the degree of contact.

Figure 8. The index of similarity. Only relations with an index above 0.50 are shown. The width of the lines reflects the strength of the relation, although all lines shown here reflect a relatively strong relation.

The result from this analysis seems to support the general picture derived from the correspondence analysis, although there are, of course, some differences. What is first worth noting is that there apparently is a comparatively large similarity between neighbouring regions. This pattern is also seen in the correspondence analysis. The pattern of connection may be divided into three groups outside which only few regions show contacts. The groups are: 1) the Scandinavian Peninsula, except South Sweden, 2)

South-East England, The Low Countries, Saxony, Denmark and South Sweden, 3) West Britain (Celtic areas). This is also in some accordance with the results of the correspondence analysis (figures 6 and 7). Both the 1st and the 2nd principal axes suggest such a division. Exceptions are found in the Scandinavian Peninsula in regions where trade centres of the Migration Period are found: Östra Mellansverige, Buskerud and Østfold. West Denmark and South Sweden seem to have been the bridge between the Scandinavian Peninsula and the continent. Gotland, an ancient trade centre of the Baltic Sea, shows surprisingly weak relations to other regions, possibly because we do not map the eastward connections, in which this island was a part. In the pair-wise comparison analysis West Denmark, South Sweden, Niedersachsen and Schleswig-Holstein seem to form an axis of similarity pointing directly to East Anglia. The 2nd axis (Figure 6) of the correspondence analysis may support this. The correspondence analysis shows that the Netherlands except from Zuid-Nederland has a high degree of similarity to the East British areas. However, in Figure 8 this similarity between the continent and East Britain is comparatively reduced although the Netherlands retain a quite strong interrelation. Instead Niedersachsen takes over as a main connection in the pair-wise comparison.

One of the reasons for the differences might be the way the degree of similarity is calculated in the different analyses. The correspondence analysis calculates whole matrices and variables are weighted while the pair-wise comparison is a 1:1 comparison expressed as a percentage of similarity.

Discussion

The assessment of a correspondence analysis is basically visual, using the plot on Figure 6. A plot including both objects and variables gives an indication of interrelation between objects, and with which variables they interact. Judging from the plot of 1st and 2nd axes it appears that the points tend to form an arch. If this is true it indicates that the data, to some degree, is unimodal; forming a continuous gradient of connections. However, there is a break in the gradual relationship between the West British regions and the rest of the regions. A visual interpretation is difficult. Whether we are facing a break in a gradient of points or whether we are looking at clustered data is hard to decide. It might be, and probably is part of both.

Concerning the choices of artefacts and their sub-groups, and those sub-groups which have not been included, this might be a part of the problem. From the distribution maps of ornaments and coins it is obvious that there are strong connections between the East British regions and the continental North Sea regions. Reversely, glass is mostly registered in Scandinavia and only two types are found in the British regions. There is a great variety of pottery covering the whole time span of 5th to 9th century AD. The glass applies to the period of 4th to 6th century AD while the coins cover the period of 7th to 9th century AD. Ornaments were used throughout the period, although the types mapped here are relatively early.

The 5th to the 9th century is a long time span - maybe too long. Contacts between regions through time may change. Strong connections between the East British regions and West Denmark (one region amongst others) are starting in the 4th century and cease at some point in the 6th. From the 6th century a new state of cultural exchange in terms of organized trade and industrial-like production of e.g. pottery occurs. Along with the organized trade, coins come into use. In contradiction to artefacts made locally for personal use and brought into new regions by migrating people the organized trade and export of luxury goods like glass and pottery will be spread out much wider. This may blur the result of the analysis as more regions will contain exported goods of the same kind. It does not necessarily make much sense to compare Buckelurnen of the 4-5th century with Porcupine coins (7-8th century) or the presence of Badorf pottery (8-9th century). Dividing the period (into two) would possibly yield a clearer result.

However, the approach of this analysis is explorative. The variables have been chosen from available published material. The result of the correspondence analysis may be helpful figuring out which variables the objects (regions) share and especially which they are not sharing. From Figure 6 for example it seems that the Porcupine coin is in especially strong relation to the East British regions and much less related to the regions located on the continent. However, Porcupine coins are also found there. And there are more examples of this kind. Local items or find groups of single regions pointing in different directions seem to have substantial influence on the result of the correspondence analysis.

The pair-wise comparison on the other hand behaves more as expected. Connections of some strength between Denmark and the German regions on the one hand and the East British regions on the other are evident.

The artefacts picked out to be included in the analyses cover a period of 400 years. Not all find groups are represented in the whole period. Nonetheless, analyses have been conducted on the whole body of artefacts. Due to changes in relations between regions in course of the 400 years this may cause a mix between items which basically have a different area of origin. An object is either brought into new regions by migration (but it still resembles types found in the homeland) or they are being imported as a result of commercial trade (glass could pose a problem as it is an item of prestige and can not be considered a commercialized product at this early stage). Denmark and the northern parts of Germany have a strong connection with Britain early in the period due to migration, while the Frankish areas and their commercial trade take over in the later part. This is a change of scope through time which may have an influence on the outcome of the analyses. The correspondence analysis seems especially to suffer from this, as no clear picture of similarity emerges (Figure 6). The pair-wise comparison, on the other hand, shows connections of some strength between Denmark and the northern parts of Germany and East Britain (Figure 8). This is in some accordance with the expectations. Furthermore, the Scandinavian Peninsula, the areas around the mouth of the Rhine, and West Britain are forming three different groups. West Denmark and North Germany seem to form a mediating area between the other groupings. The pair-wise comparison seems, in this case, to be a better method for analyzing the data than the correspondence analysis.

It is, of course, an unsound argument to claim that the pair-wise comparison is a better method than the correspondence analysis just because it meets the expectations better. In a deductive analysis, however, we can only try to interpret the results and, on condition that we are actually dealing with the right variables, trust and choose the results that answer our expectations in the best way.

Conclusion

Returning to Westerdahl, and the *longue durée* of the maritime transport zones, how do our results compare to his? First of all one should notice that our results do not relate directly to Westerdahl's, simply because the

regional divisions are not identical. This is especially noticeable for the Danish waters, which Westerdahl has divided into three zones, while we for practical reasons have worked with an East-West division. If we look at the distribution of individual artefacts, however, the tripartite division of Westerdahl can be substantiated, and is certainly meaningful.

Apart from the problem of slightly different regional divisions there seems to be a general resemblance between the two analyses, but also some striking differences.

One result is that Scotland should be part of Westerdahl's zone 9, with Western England and presumably Wales, rather than forming a zone with Eastern England. The areas outside the classical Anglo-Saxon area are clearly more connected to one another than to the rest of the North Sea area.

The most striking result is possibly that the linkages we find in our analysis are almost entirely between neighbouring regions and do not crisscross the open sea, the only possible exception being the link between East Anglia and Jutland, which may be a direct link, but could also be a link through the Netherlands and Saxony.

This, and the historical evidence for the period, means that Westerdahl's zone 10a, *the Norse utleid corridor to the northern Isles (Scotland), Faroes, Iceland and up to Finnmark in the north*, is hardly meaningful, except as a more local zone along the Norwegian coast.

The lack of crossing contacts also means that there is no evidence for Westerdahl's zone 7, *the North Sea with western Britain and its corridors to west Norway*, during the Early Middle Ages, and one could be led to conclude that maritime transport during this period firmly, if not exclusively, followed routes along the coasts. Is it the lack of sails we witness in these artefact distributions? Or is it a *longue durée* preference to cross at the latitude of the Schelde estuary or even more to the South? The assumed absence of sail has been much discussed in Nordic archaeology, but can hardly be taken for granted and certainly not in the southern North Sea.

Our choice of general area makes Denmark a natural centre, as it lies more or less in the geographical middle of a coastally bound network between the regions used in the analysis. As a consequence the present

analysis cannot inform us further on Westerdahl's claim that Denmark was a cultural centre, with a pivotal status between East and West. To assess such a claim we would have to include a much larger area in the study. On the other hand, the central geographical - and geopolitical - position of the Danish area between East and West has been a recurring circumstance throughout history, and as such the interpretation makes some sense. The same claim has been made on other grounds, for instance on the basis of detailed analyses of 6th to 8th century animal art (Højlund Nielsen 1991) and on the basis of more general interpretations of archaeological, historical and literary evidence (Hedeager 1997). It is thus corroborated by other analyses than those of maritime archaeology.

However, although it may be tempting to see the Gredstedbro ship as a tool of centrality, we should not loose sight of the expanding Frankish empire, which must have formed an insuperable centre in Northern Europe (Näsman 1991b). It may have functioned with success on largely land-based lines of communication, but it has certainly thoroughly influenced maritime networks as well.

In conclusion our investigation seems to substantiate, at least to some degree, the delineation of Westerdahl's zone 6, stretching from Western Jutland across the Low Countries to South-East England, as a coherent zone of regular contacts during the Early Middle Ages, and this seems *a priori* to be the cultural and navigational context in which we should expect to understand the Gredstedbro ship.

III

THE SHIP

6. THE GREDSTEDBRO SHIP

The Gredstedbro ship was found in 1945 when a meander or of the Kongeå river was straightened by digging it through. Initially the wooden pieces were interpreted as the remains of a bridge. In 1964 the surviving pieces were reassessed and recognized as the remains of a ship. Subsequently the pieces were sent to the National Museum of Denmark for analysis (Crumlin-Pedersen 1968, 262). Today they are on display in the museum *Ribes Vikinger* in Ribe, less than 10 km south of the original find spot. The archaeological investigations of the site are described in chapter 8, while this chapter will focus on the ship itself.

The timbers

The recovered parts of the ship consist of a piece of the keel, a piece of the stem or stern that features a scarf and parts of a frame.

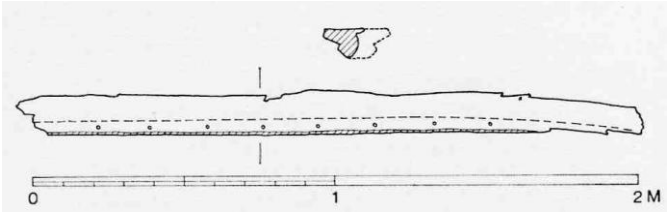


Figure 9. The keel fragment. 1:25. After Crumlin-Pedersen 1968: 263

The keel fragment is 2.03 m in length. It is split lengthwise. Despite this there is no doubt that it has been T-shaped in cross-section. The keel has originally been *c*. 26 cm wide (including the rabbet of *c*. 5 cm on each side) and *c*. 10 cm high. It was a wide and shallow keel with a depth/beam ratio of *c*. 0.39. As the underside of the keel shows traces of heavy wear, which might indicate that the boat has regularly been pulled ashore, the ratio may originally have been slightly different. Traces of eight rivet holes, 1 cm in diameter, are found on the rabbet spaced at intervals of 18.5 – 20.5 cm Crumlin-Pedersen 1968, 263).

The frame fragment gives a solid impression. It is made out of a naturally curved piece of wood. One end is the root end. The dimensions right above the keel are *c*. 26 cm moulded and *c*. 12 cm sided. The preserved length is *c*. 1.8 m. The frame has been composed of (at least) two pieces of which the smaller part(s) have disappeared. The cross-section is tear-drop shaped, with the narrow side facing the strakes. This minimizes the contact between strake and frame, although the feature is most marked towards the bottom of the frame, and hardly noticeable at the top.

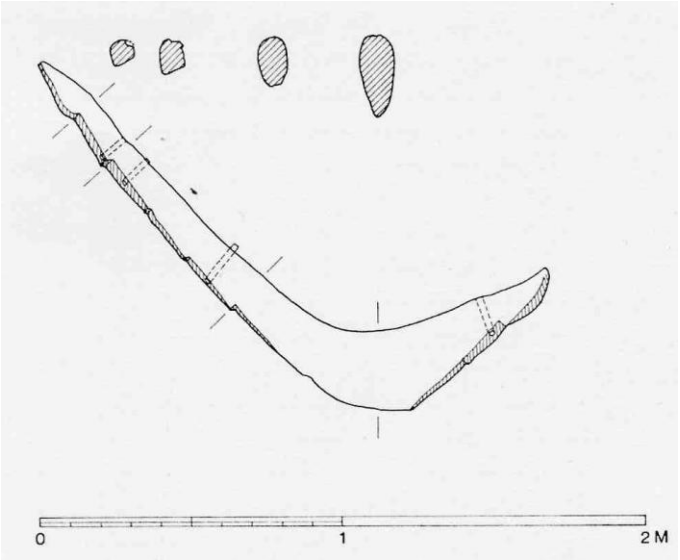


Figure 10. The preserved parts of the frame. 1:25. After Crumlin-Pedersen 1968: 263.

The well preserved side of the frame had notches for seven clinker laid strakes, about 20 cm wide. The strakes have been treenailed to the frame. The pattern is irregular, with only strakes no. 2, 3 and 5 (counting from the top) having been fastened. This irregular arrangement is not exceptional in a shell-first construction. The treenails, still present in the frame, have been wedged on the inside (Crumlin-Pedersen 1968, 262). The notches in the frame have been cut at an angle. This suggests that the frame fitted near one of the ends of a vessel. During an examination of the timbers in the museum in Ribe in 2007, the angle of the top notches was assessed and in the ensuing discussion the distance from this frame to the end of the ship was estimated as in the order of 2 - 2.5 m. As only one side of the frame has

been preserved, the exact width cannot be determined precisely. It is estimated to be about 2.2 - 2.4 m at the top.

The stem/stern fragment is 1.13 m long. At the lower end it features a horizontal scarf. The scarf, that connected the stem or stern to the keel, has a length of c. 26 cm. The fragment has a rabbet on either side. It is carved as a V-shaped groove, c. 4 cm wide, that curves upwards from the top of the scarf. The upper or inner face of the fragment is hollowed in a shallow V-shaped fashion. Along the sides rivet holes are found, just as in the keel fragment. The top of the fragment was broken off. The lower part, the scarf-end, was partly damaged (Crumlin-Pedersen 1968, 262).

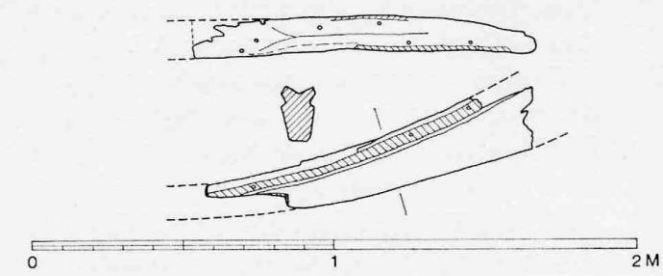


Figure 11. Fragments of the stem/stern post. 1:25. After Crumlin-Pedersen 1968: 263.

Features of the Gredstedbro ship

Although only a few parts of the boat were recovered, the structural features are quite distinctive. As such, the remains give a relatively clear indication of the construction of the ship. It must have been fairly large. The size of the frame and comparison with other finds indicate an overall length of some 20 meters (Crumlin-Pedersen 1968). We know there had originally been at least seven strakes. These had been riveted to the keel and stem/stern, and in all likelihood also to one another. The keel is T-shaped, although relatively flat with the low length/width ratio. The horizontal scarf resembles the arrangement as it is thought to have been in the Sutton Hoo ship and in a way it is like the arrangement in the Nydam boats. The keels of the Viking period Oseberg and Gokstad ships had a much more pronounced T-shaped cross-section and had an increased length/width ratio. Moreover, the stem/keel scarf in these ships is vertical. On the basis of such typological criteria the Gredstedbro ship has been ranked somewhere in-between the Nydam boat of the 4th century AD and the advent of the Viking type ship around 800 AD (Crumlin-Pedersen 1968, 264-266, and Figure 12 here).

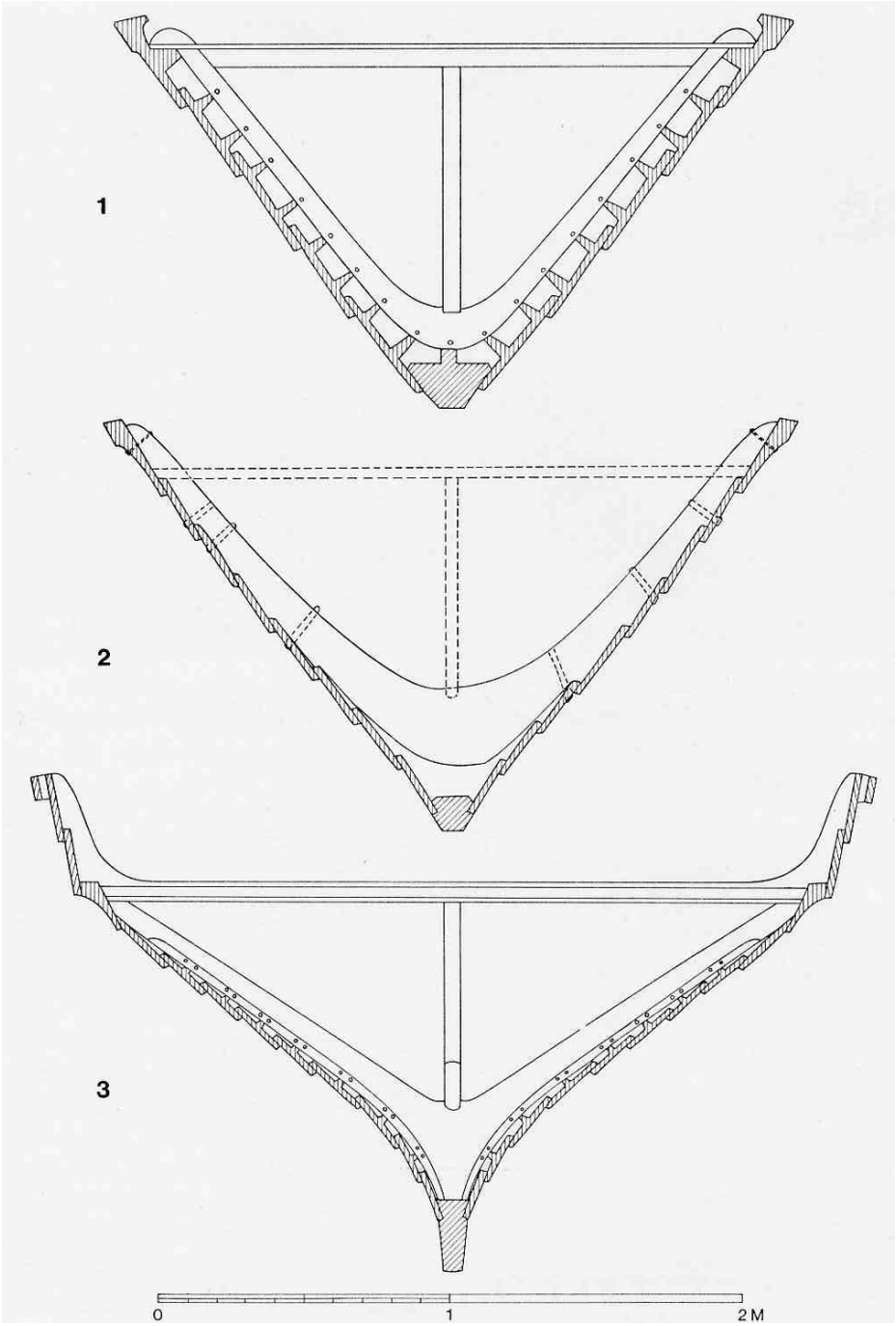


Figure 12. Comparison of the frames from 1. Nydam, 2. Gredstedbro and 3. Oseberg. 1:25. After Crumlin-Pedersen 1968: 266

The Gredstedbro ship is built of oak. Treenails were likewise of oak. In 1966 a radiocarbon date was obtained for a treenail sample. The analysis provides a date of 1400 ± 100 BP (K-1094; Tauber 1968). At the time it was suggested that this gives a calibrated result of 650 (600-690) AD. Present calibration according to Reimer *et al.* 2004, using the OxCal 4.0 calibration program results in a calibrated date interval from 425 - 867 AD (figure 13). Dendrochronological analysis of the keel was undertaken in 1995 by the laboratory in Århus (Wormianum 317). It provides a provisional date of 622 AD, with suggests a felling date after 630. Unfortunately the result is based on just 64 treerings and therefore uncertain. Although both scientific dates are indicative at most, they do not contradict the typological dating.

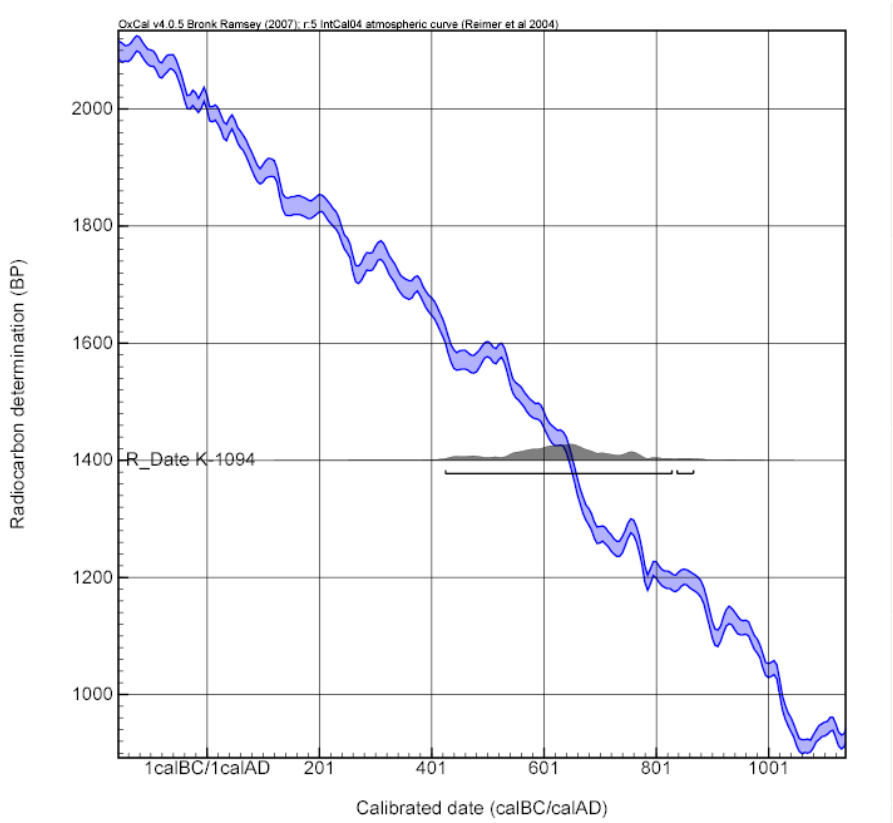


Figure 13. Calibration curve for the Gredstedbro. From OxCalc 4.0.

This does not mean, however, that the typology as such is waterproof. To present the Gredstedbro find in a scheme as shown in Figure 12 is a good illustration of the relative size of the several boat finds depicted. However, the figure must not be interpreted as a typological series *sensu strictu*, with Gredstedbro as an intermediary type between Nydam and Oseberg. A first objection to such a proposition would be the lack of cleats in the fastening of strakes to the Gredstedbro-frame, a feature which is present both in Nydam and in Oseberg. In terms of timber conversion and ship construction this difference must necessarily be considered as rather fundamental.

In the reconstruction of the Gredstedbro cross-section in Figure 12 there is one element that surprised the present study group. It is the addition of an eighth lower strake. Not only would such an arrangement give the garboard a very limited support, but there is no direct evidence for such a board. In fact the angle of the lower part of the frame fits the angle of the keel rabbet relatively well, allowing the frame to rest directly on the keel if the garboard strake would be slightly wider than the other strakes.

Another feature that struck the eye is the difference in sturdiness. When one gives the frames a closer looks, it becomes immediately apparent how coarsely built the Gredstedbro ship is: the frame is very solid by comparison to the other ships with which it is aligned. This might indicate a different general function of the ship. It may also, however, be worth noting that whereas the ships may belong to the same general – North European – boat building tradition, they may have been made to navigate very different waters. In respect of the development of theory on "maritime transport zones", as presented in chapter 5, one can perhaps not expect to be able to draw a linear evolutionary line between ships that were meant to navigate the Inner Danish waters, the South Norwegian fjords and the North Sea respectively. The different geographical circumstances could possibly help to explain why the Gredstedbro ship is so sturdily built, but there could of course also be a social explanation: that it was built, owned and sailed by a differently oriented group of people than the Nydam or Oseberg ships.

Rather than to establish types and 'lineages' of ships on the basis of disparate finds that are spread over a wide area, a potentially wide range of uses and an extended time-frame, a better method might perhaps be to compare the individual technical features of the Gredstedbro ship to other finds we know of, and thus to try and get a better understanding of the

technical context of the find (Maarleveld 1995). This will be the purpose of the following chapter.

7. COMPARISON

Catalogue

For reasons of comparison this catalogue includes a range of ship finds dated to the 5th to 10th century AD. The catalogue is, however, not a comprehensive one that covers all finds of ships of the Migration and early Viking periods that might be considered to be of Scandinavian type. The ships that are included have been selected so as to be limited to the time span in which the Gredstedbro ship is believed to have functioned, and to finds which may inform us on this particular ship. One of the main purposes is to outline the technologies in Scandinavian and Anglo/Saxon shipbuilding of this period. The focus is on the South- and Westward connections across the North Sea. This means a selection of finds from the Norwegian west coast, Jutland, Frisia and Eastern Britain. Finds of the classic Nordic Viking ship (e.g. the Gokstad ship) will be left out as these supposedly relate to a somewhat later period and a better understood building tradition.

The 'evolution' of the Scandinavian ship and especially the problem of propulsion – the introduction of the sail and the date of its first occurrence in Scandinavia – has been the subject of quite some discussion in the literature. The sail has been used in the Mediterranean at least from the Middle Bronze Age (*c*. 1800 BC). If it had not been used before, it was introduced in the southern North Sea region in the 1st centuries BC and AD at the latest, with the advent of the Roman ships in England and along the Rhine. The first Scandinavian evidence of a ship carrying a sail is found on the picture-stone from Tjängvide, Gotland, from around the 7th century AD (McGrail 2001, 112; 212).

Arguments that have been put forward to stress and explain the late introduction of the sail in Scandinavia are elaborate. It is for instance argued that it is related to the general social stage of Scandinavian/Germanic society and the division of the landscape and sites into units suitable for manning a ship, for coastal defence as well as heroic journeys. This has, furthermore, the implication that for reasons of safety and prestige it was important to the local chief or merchant to have many men in his retinue as

well as onboard his ship(s) when travelling (Westerdahl 1995a). It has also been suggested that travelling by ship, in this period, was an opportunistic enterprise that included plunder as well as trade and that an alteration of the basic ship-construction from a rowed personnel carrier vessel to a sail-propelled merchant ship was determined by some kind of royal control of havens and coastal waters that could guarantee their safety. The transition from rowing vessels to the use of sail is suggested to have happened in the period of the 8th to the 10th century AD (McGrail 2001, 212).

This suggested dating of the introduction of the sail in Scandinavia seems to be in agreement with the archaeological finds. Solid evidence for the use of sails is absent and ships that have been found tend to be rowing vessels or to be interpreted as such. It is generally accepted that certain structural features must be present in a ship in order for it to be able to withstand the forces of a sail. One of the main trends that are recognized in the development of ships in the 'North' in between the 4th and the 10th century AD, is the alteration of the keel. The Nydam boat, dated to the 4th century AD, has a flat central bottom plank with a depth/beam ratio of 0.14. Although it is of considerable dimensions, such a keel-plank is considered unsuited for carrying a mast. Anyway, the boat is a rowing crew carrier and has not been fitted with one. The Nydam boat is considered to be the first instance in which the Nordic clinker-tradition can be recognized, a tradition which was to evolve through the following centuries and was to culminate in the Gokstad ship of the early 10th century AD. The steep and pronounced V-shaped cross-section of the hull of the Nydam boat is interpreted as compensation for the absence of an actual keel (Brøgger & Shetelig 1950, 59f). The Sutton Hoo ship of around *c*. 600 AD is seen as the next step in the evolution of the Nordic ship. The keel/bottom plank had a depth/beam ratio of 0.35. No traces of a mast were found. The Sutton Hoo ship has some structural or rather formal resemblances to the Nydam boat (e.g. the length/width ratio) (Brøgger & Shetelig 1950, 60). The Kvalsund II around. 700 AD shows new structural features. The keel is wide on the inside, as a broad plank, but on the outside it extends downward in the middle. In other words, the keel protrudes much more than those we know from earlier times. With this downward extension in the middle the keel has a depth/beam ratio of 1.8. According to the interpretation this facilitated a broader hull-construction and thus increased stability. Furthermore, a specially constructed rib for the attachment of the rudder in the stern at the starboard quarter has been found (Brøgger & Shetelig 1950, 61). These features (pronounced keel and a special "rudder"-rib) have been interpreted

as significant pointers in a directional development toward the fully developed Viking ship.

This is of course a very sketchy presentation of the predominant interpretation of the development of the pre-Viking Nordic ship-tradition. The boats mentioned above and additional ones will be more adequately assessed in the catalogue.

The Sutton Hoo ship

The excavations at Sutton Hoo, in East Anglia in 1939, revealed among others two ship burials of the early 7th century. It is the great ship burial of mound 2 that we are dealing with in this paper. The ship's wood had not survived. What remained were the corroded ironwork and the dark stain and impression of the ship in the sand.

The main characteristics of the construction of the ship as given here were deduced by careful analysis (Green 1988, 58-61; 72). The dimensions would have been a overall length of 27.1 m, a greatest beam of 4.3 m, a depth of hold c. 1.5 m, and a draught of c. 0.6 m. The keel appears to have been a flat plank of the Nydam type, probably rounded on its lower side, giving it a slight external projection.

The ship has been clinker built with nine strakes on each side. The planks had been clenched with iron clenchnails over diamond shaped roves. Each strake consisted of five planks, each butt joined by short clenched nails. According to Green it seems probable that the frames were fastened to cleats like in the Nydam ship. According to Cameron however, they could have been treenailed to the strakes like in the Gredstedbro ship (Cameron 1982). Evans & Bruce-Mitford (1975, 371) likewise advocated a direct connection. The stem and stern posts were joined to the keel with a horizontal scarf joint, reinforced by three additional iron nails, clenched over roves.

There were 26 ribs. But no traces of thwarts were found. The number of rowers is estimated to be forty. 19 tholes were found with long bases of about 1 m. length, thus forming a rail around the gunwale. They were attached to the gunwale by iron spikes. None were found amidships. This can be interpreted in several ways. They could simply have been removed when the burial chamber was constructed. Another interpretation sees the

absence as an indicator for the use of a sail. The way the planks were attached to the stem and stern posts is unknown. There is no trace of a steering oar but the disposition of the ribs in the starboard quarter indicates the existence of one that resembles the one in Nydam.

It has been suggested that the ship was already old when buried, due to the additional nailing in the stern scarf and in a seam amidships that might have strengthened and repaired a worn joint (Green 1988, 61). The burial is considered to be a royal burial because of the wealth of its artefacts. It has been suggested that the burial belonged to the East Anglian king Raedwald.

Despite the fact that sails had been used in the British and Irish archipelago from the 6th century at the latest, it is generally accepted that in Scandinavia there is no evidence of sail before the 8th century. As for Sutton Hoo the main argument against her sailing suitability is the lack of a projecting keel, but since other ships could sail despite their flat keel (Cameron 1982), this might also be possible for the Sutton Hoo ship.

According to the Giffords the Sutton Hoo ship has other sailing features. The elements of Sutton Hoo that they point to are: the mid-ship section of the ship (flat bottom with round bilges, good for carrying sail), the waterline shape, the plan form (leaf shaped, generally associated with sailing vessels), the absence of oar tholes in the midship area, the steering provision (additional frames in the stern to strengthen the hull against the heavy rudder for sailing), the stern and stemposts with their considerable gripe or projection as cutwater and the assumed mast support (Gifford & Gifford 1995). This last point refers to the fact that the closely spaced gunwale to gunwale frames would give sufficient strength to resist sailing forces. The Giffords stressed their arguments through trials with a half-scale model trial. The usefulness of half scale model results is open to debate.

In many respects it seems logical to integrate the Sutton Hoo ship in a discussion that tries to understand the development of shipbuilding around the North Sea. It seems to fit well with the evidence from Scandinavia.

Anglo-Saxon clinker boatbuilding

Some scholars distinguish an Anglo-Saxon tradition as a subdivision of the wider Northern European developments. There are some characteristics that

are attributed to that tradition of the pre-Viking period, in which both the Sutton Hoo and the Gredstedbro ships are put (Goodburn 1986):

- shallow and broad plank keels without much projection
- short horizontal scarfs between keel and stem and sternpost
- heavy frames fastened directly to the hull planking, mainly by treenails
- absence of so-called bitr and stanchions
- side rudder
- flattish midship section and hard bilges (low deadrise)
- straight raking stern and stemposts with sharp cutwater risings
- short horizontal scarfs between floors and side timbers

Moreover, some of these crafts might have had a false keel, attached underneath the keel plank.

The Graveney Boat

The Graveney Boat was discovered 1970 during the deepening of drainage channels in the Graveney Marshes (Kent, England). The boat was buried beneath more than 2 m of marsh clay and quickly recognized to be of considerable age.

Figure 13. The Graveney boat. From http://www2.rgzm.de/navis/ships/Ship088/Ship088.htm. (23.03.2007.)

The Graveney boat (Fenwick 1978) was abandoned more than 1 km from the sea on a "hard" of sticks and supported by vertical poles, possibly a landing place. It was built of oak. Frames were attached to planks by treenails (like Gredstedbro and Sutton Hoo). It was clinker built with a

“low” T-shaped keel (plank keel). The exact shape of the boat is unknown because the bow is missing. Upper strakes are also missing. Strakes have been fastened to each other by iron rivets through wooden pegs. Planks were originally wedge-shaped with the thickest edge uppermost. This indicates that the planks have been radially split. However, the sternpost was tangentially cut. The iron rivets were corroded away, but they had been square with sides of c. 4 mm. The average distance between the nails was 16-17 cm. There is no distinct meginhufr or wale, although plank 8 is a little thicker than the others. The boat had a caulking of wool with vegetable tar.

The holes for tree nails have been drilled with an auger. Other tools that have been used are an axe or chisel, a hammer and mallet. No signs indicating the use of a saw were found. Frames are fairly solid with an average distance of 0.5 m. No mast step was found, but one may previously have been mounted on frames 5-7. It is believed that the Graveney boat has been a sailing vessel and that the mast step was removed after the hull had been seriously damaged.

It is radiocarbon dated to 930 AD +/- 20 and dated by dendrochronology to 927 +/- 2.

The Bårset boat

In 1931 a boat was excavated from a bog near Bårset, north of Tromsø. The boat was reconstructed to have been 13.07 m in length, with a maximum width of 2.64 m and a maximum depth of hold of 0.57 m from the gunwale to the upper edge of the keel. It has been built of pine and fir. The shell consists of six strakes on each side. These are of pine, with the exception the top strakes which were made of fir. All ribs in the front part of the boat were present. A large part of the keel, including the scarf with the stem post, was also found. The ribs had been inserted with unequal spacing, although the variation is not large. It ranges between 0.86 m and 0.98 m, with an average of c. 0.90 m. In the aft-part there is a specially constructed rib to hold the rudder. It is asymmetrical and it is reinforced on the starboard side. This arrangement is also found on the Kvalsund boats and the Oseberg, Gokstad and Tune ships. It looks like a bulkhead and has been cut to fit inside the clinkered shell. It had been fastened to the strakes with large iron spikes. No fittings or other items were found that relate to the boat’s propulsion apart from a piece of an oar. Pine and fir have been used exclusively, with the

exception of a few pieces of birch on the keel, probably a repair. The first five strakes are laid in overlapping clinker with iron rivets, as is usual in Nordic shipbuilding. The fir top strakes have partly been fastened by sewing and partly by tree nailing. The diameter of the iron clinker nails is 0.7 cm. They are spaced at intervals of c. 0.21 m. The ribs have been lashed to cleats that protrude as integral parts from the planks. The upper part of the ribs has been treenailed to the two uppermost strakes, also into cleats. It has been suggested that the reason for using cleats for lashing as well as for tree nailing was to be certain of having sufficient wood for the nailing and to keep the ribs clear of the strakes in order to ease the movement of water inside the boat and thus to prevent rot in the ribs.

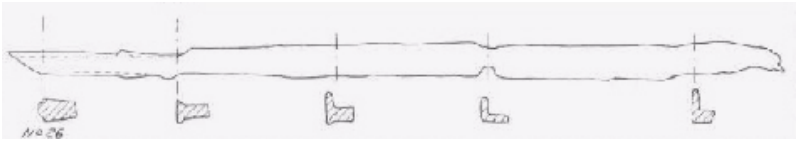


Figure 14. The keel and a part of the top-strake from the Bårset boat. 1:25. From Gjessing 1941.

The cleats have been shaped for a perfect fit with the ribs. The ribs have not been fastened to the keel. The ribs have been made of naturally grown crooks that range from gunwale to gunwale. The keel has been clinkered to the garboards. From the location of the horizontal scarf it can be seen that the stem and stern posts have been erected and scarfed to the keel prior to the attachment of the garboards. The keel is T-shaped with a height varying from 7.2 cm at the stern to 12.2 cm at the stem near the stem post scarf. It is 4.6 cm wide and the rabbets are projecting up to 6.2 cm out from the sides. This makes the keel much more prominent as compared to boats known from earlier periods.

Figure 15. The ”rudder”- bulkhead. From Gjessing 1941.

It is needless to say that the boat has probably been double-ended. This interpretation is derived from knowledge of other pre- or protohistoric boats of 'similar' construction (Gjessing 1941, 9-37; 85-105).

The Kvalsund boats

The Kvalsund ships were found in a bog c. 200 km north of Bergen in 1920. They were more or less in a dismantled state. The smallest of them was preserved in a relatively fair condition while only fragments of the large one have been found.

The small boat (Kvalsund I)

Much of this boat had been preserved. The part of the keel that was found was 7.20 m long. It had a T-shaped cross-section. Its maximum height is 12 cm and it is 16.2 cm wide including the bevel. The keel had horizontally been scarfed to the stem and stern posts. The ribs have a drop-shape-like cross-section, the narrow side being laid against the strakes. All ribs were treenailed to cleats integral to and protruding from the strakes. The parts of the ribs which are not near the nails are slightly hollowed on the side facing the strakes. The ribs have been spaced at an average of 1.05 m. The reason for nailing the ribs to cleats and shaping the ribs may be the same as for the Bårset boat, to prevent rot and ease water movements inside the boat. The "rudder-rib" or bulkhead has been made especially for the purpose of attaching the rudder. Its construction is similar to that of the Bårset boat. The ribs as well as the rudder-bulkhead have been made of pine. The shell is composed of five strakes on each side. The uppermost strake is made of fir; the other strakes have been made of oak. The strakes had been fastened clinker-wise with iron rivets, in what has been called Nordic style.

The boat is estimated to have been 9.56 m in length, 1.50 m in maximum width, with a depth of hold of 0.495 m (Shetelig & Johannessen 1929, 57-60).

The large boat (Kvalsund II)

This boat was in a bad condition when excavated. The keel fragment that was found had a T-shaped cross-section. The bevel is 7.5 cm wide on each side of the keel. Whether the keel had been made out of more than one length of wood is unknown. The shell consisted of 8 oak strakes on each

side. The stem post had been scarfed to the keel horizontally. The ribs had been coarsely made with a similar cross-section as in the Kvalsund I boat. Each had been made out of one piece of naturally grown pine that ran from gunwale to gunwale and projected a little above the gunwale. The projecting parts had been roughly shaped – maybe they have had a function as handles. The ribs had been lashed to cleats integral to and protruding from the strakes. The shell was composed of eight strakes on each side. The ribs had been lashed to the lower strakes. The connection to the fifth and sixth strake was by lashing as well as by treenails. To the seventh strake the ribs were connected by treenail only and the eighth strake was spiked with iron nails clenched on the inside.

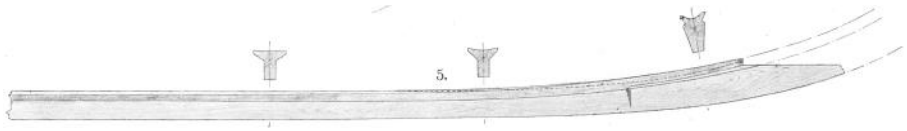


Figure 16. The keel from Kvalsund II. 1:25. From Shetelig & Johannessen 1929

The keel had integrated cleats as well. However, there were no holes in them. Evidently they only functioned as support for the ribs. The strakes were fastened together with iron rivets.

A rudder has been found that belonged to the boat (Figure 17). It is quite a long rudder (2.54 m). It is also narrow – not as broad as the rudder from the Nydam boats – and it was, like the rest of the boat, coarsely made.

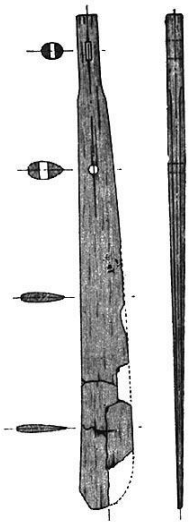


Figure 17. The rudder from Kvalsund II. From Shetelig & Johannessen 1929.

The boat has, with some uncertainty, been reconstructed to have been c. 18.00 m in over all length, 3.20 m in maximum width and with a depth of hold of 0.785 m. What really distinguishes the Kvalsund from earlier boats is the addition of a keel fillet giving the bottom-plank a T-shaped cross-section. Moreover, the strakes are much narrower than the broad strakes on the Nydam ship. The Kvalsund ship thus has eight strakes on each side whereas the Nydam ship has only five. The rudder had a deep draught and had

firmly been fastened to the starboard strakes and ribs by means of a withy. In was fixed through holes in the strakes and rested on a boss attached on the outside. The purpose of this feature was to keep the rudder and the strakes apart to prevent wear and destruction of the strake. The construction of the rudder is similar to that found on the Sutton Hoo ship dated to c. 600 AD. A special rib with extra strengthening to the starboard side, very much like a triangular bulkhead, had been constructed to support the rudder, just like in the Bårset and Kvalsund I boats.

It has been suggested that this boat might have carried sail. This is mainly based on the presence of a large rudder. However, the limited depth of the boat has been cited to speak against this. There is no evidence for the use of sail in the associated finds at all.

The differences have been interpreted as improvements that point toward the development of the classic Viking ship which culminates in the construction of a ship like the Gokstad ship around 900 AD. The T-shaped keel helped to strengthen the hull when hogging, which made a wider construction possible and which facilitated the use of sail, although Kvalsund II itself is considered to be a rowing boat. The narrower strakes as compared to for instance the Nydam boat, increased flexibility and the rudder construction eased steering and helped decreasing leeway (Shetelig & Johannessen 1929, 60-66). The large Kvalsund ship has been dated to 690±70 AD.

The few parts of the Gredstedbro ship that currently are available for assessment suggest a slightly different construction as compared to that of the Kvalsund and Nydam ships. Judging from the shape of the ribs they seem to have been notched over and tree nailed to the strakes. No holes for lashing have been found.

The Fjørtoft boats

Two small boats from Fjørtoft, a little north of Kvalsund, dated to somewhere between the 5th and the 8th century AD show constructional features that seem to be similar to what we know of Gredstedbro. Like Kvalsund, the boats from Fjørtoft are bog-finds. The largest of the boats is c. 10.00 m in length. Unfortunately no dimensions for width and depth of hold are specifically mentioned. Nor is anything mentioned about

dimensions of the keels. The hull of the largest boat has been made of oak and the interior structure was made of fir. Apparently the boat had some kind of a keel-like bottom plank. A side rudder had been fastened in a similar way as in the large Kvalsund ship. The sides consisted of six strakes on each side and all strakes were smooth on the inside without any carved protruding cleats. Instead of having the ribs lashed to the strakes they were notched and nailed to the strakes – presumably with iron nails in the large boat and with treenails in the small boat. The small boat was c. 5.70 m long and had been built entirely of fir. It was severely damaged when found, although it is assumed that both boats had been left or deposited undamaged. However, it could be seen that the small boat had a so-called "dragkjøl" attached – a kind of false keel intended to protect the "real" keel when beaching. Furthermore, the small boat had a very low length/beam ratio. What the actual ratio was is not specifically mentioned, just that it was a little broader and a little deeper than the small Gokstad boat or færing. The boat is likewise interpreted as a ferry/carrier. Even though both boats had keels, neither of them had fittings for a mast. Thus, both boats were intended for rowing. The largest boat had 12 oar tholes, six on each side (Brøgger & Shetelig 1950, 66-68).

Figure 18. Replica of the large Fjørtoft boat. From: http://home.online.no/~joeolavl/viking/fjortoftbaaten.htm. (20.03.2007.)

The Mangersnes boats

Remains of several boats and fish traps have been found in a lake on Radöy, north of Bergen, Norway (Christensen 1995). The identifiable ship remains consist of frames, oars, oar tholes and the possible fragment of a plank with

a cleat. The finds are dated broadly to the Iron Age, with C14 datings ranging from 30-250 AD to 560-670 AD.

It is interesting that the frames generally have a pronounced drop-shaped profile, like in the Gredstedbro ship. The Mangersnes frames, however, have holes for lashing, except for the fragment 60/1986-7, where the only trace of fastening is an iron rivet at the top of the frame. There are no clear rabbets for the strakes indicated on the illustration, and the dimensions indicate a much smaller boat than at Gredstedbro, probably used for local fishing. Despite these differences, the fragment may be considered a constructional parallel to the Gredstedbro ship.

Discussion

Interpreting the Gredstedbro ship on the basis of the accessible finds is by no means easy. Whether the ship carried sail or not has traditionally been a question of most interest and much debate. In this respect the shape of the keel is taken as the crucial point in most discussions. A T-shape of the keel is thought to have been necessary in order to strengthen the ship's longitudinal rigidity, while on the other hand an increased depth/width ratio would make the ship better suited for stabilizing the forces from a mast and sail. Other factors may, however, also be of interest when deciding on a ship's ability to carry a sail. The shape of the boat in cross-section, the depth of hold and the height of the freeboard might also be of some importance. Nonetheless, even though the Kvalsund II (Figure 16) and Bårset (Figure 14, figure 21) boats, for instance, had T-shaped keels of considerable depth/width ratios, they are not believed to have carried sail. This is concluded from the combined evidence that they had a large length/width ratio, a barrel-shaped cross-section amidships, a low depth of hold and thus a low freeboard. As a result of the keel shape, both ships would probably have had sufficient strength to carry sail, although it would possibly have been an unpleasant experience to be on board when under sail due to the modest freeboard which would probably have caused the boat to take in water when heeling. Consequently both boats have been interpreted as rowing-vessels. A feature believed to distinguish the sail-carrying ships like Oseberg from the other – earlier – boats presented in this paper is the large dead rise of the garboards. Such dead rise gives the ship a more pronounced V-shaped cross-section beneath the waterline. Also both width and depth of hull are larger. This probably results in a more stable ship that is more suitable for carrying sail.

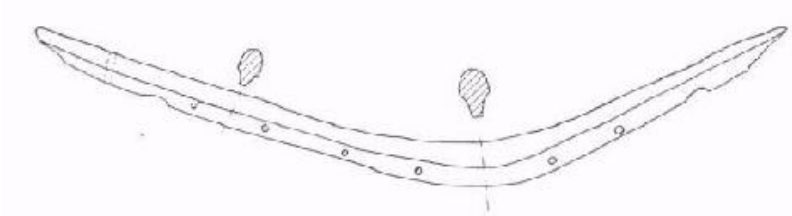


Figure 20: Midship floortimber of the Bårset boat. From Gjessing 1941. Scale 1:25

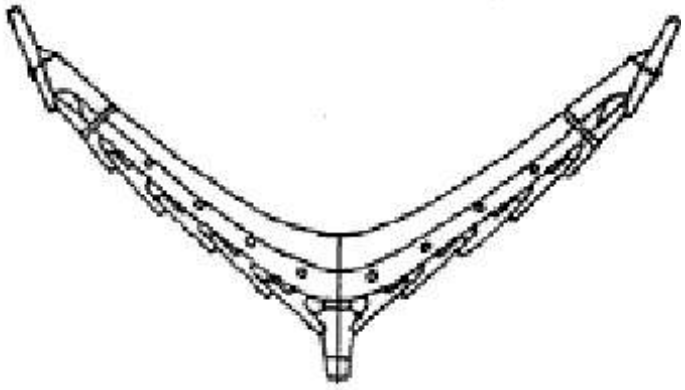


Figure 19. Floortimber (reconstruction) of the Bårset boat. Located c. *3 m from the stern. From http://www.arctandria.no/artikler/barsetbaten/barset.htm. Scale 1:25*

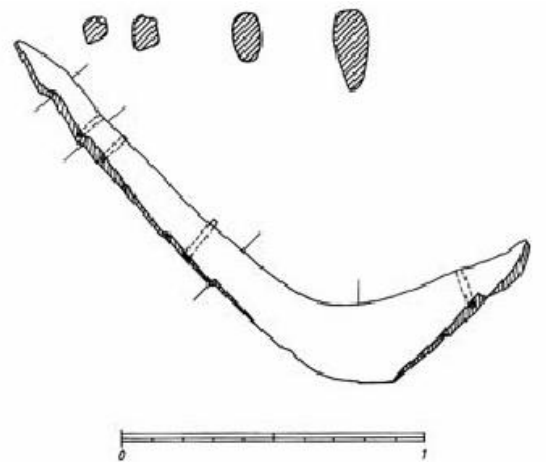


Figure 20. Floor timber from the Gredstedbro ship. From Crumlin-Pedersen 1968. Scale 1:25

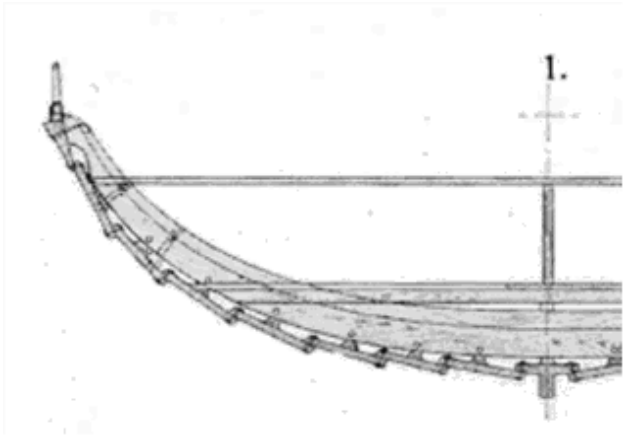


Figure 21. Midship (rib) cross-section of the Kvalsund II. From Shetelig & Johannessen 1929. Scale 1:25

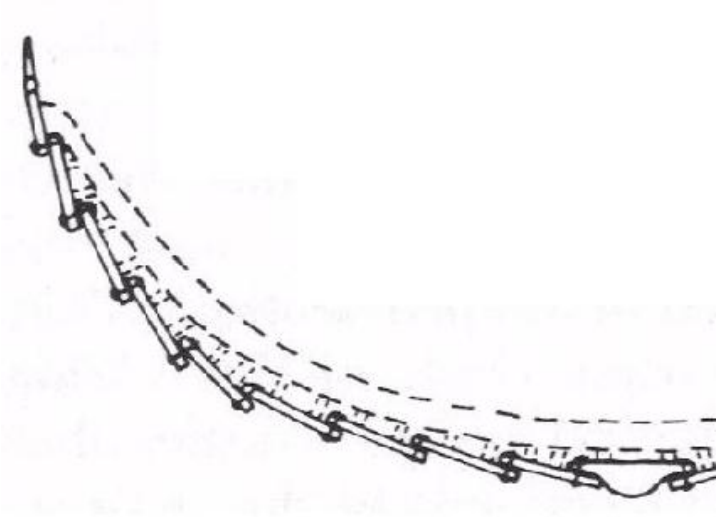


Figure 22 .Sutton Hoo II. Midship cross-section. From Green 1988, who has indicated lashing cleats. Scale 1:25

Judging from a comparison between the Norwegian finds of Kvalsund II (Figure 16, Figure 21) and Bårset (Figure 14, Figure) and the pieces of the Gredstedbro ship (Figure 11, Figure 20) it seems evident that the first two boats are much lighter and more elegantly constructed with their lashed ribs of comparatively small proportions and their pronounced T-shaped keels compared to the coarsely made rib and broad, low profiled, though still T-

shaped, keel of the Gredstedbro ship. Furthermore, looking at the heavy treenails used on the Gredstedbro ship for fastening the rib to the strakes, it seems, despite its clinker laid strakes, to have its origin in a somewhat different boat building tradition. In the Norwegian boats a mix in methods for assemblage of strakes as well as ribs etc. ranging from the use of treenails, iron nails and lashings is observed. These different methods were also sometimes used in combinations on the same boat. In the Gredstedbro ship we also see a mix of fastening methods, but a different one: wedged tree-nails in the rib, rivet-holes on the rabbet of the keel-piece. No lashing is used, planks are flat on the inside and the rib is notched so as to fit tightly to the strakes.

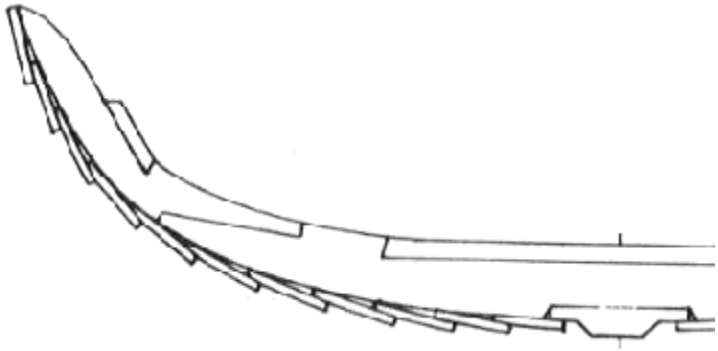


Figure 23. The Graveney boat. Midship cross-section. From Fenwick 1978. Scale 1:25

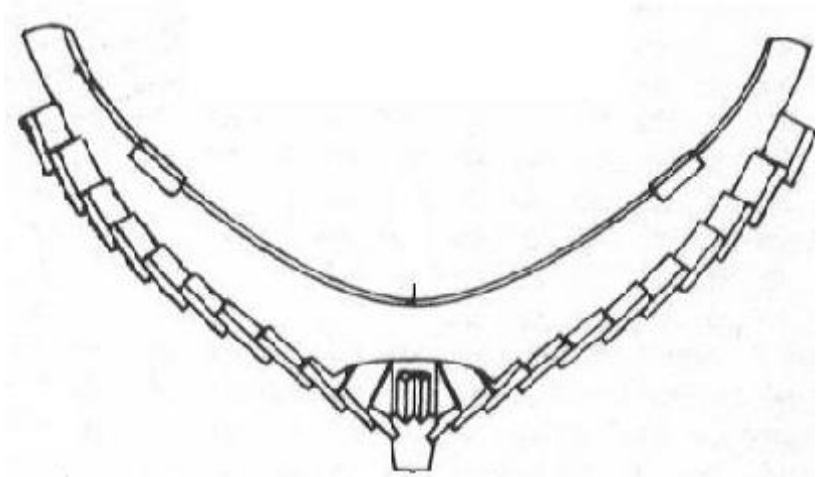


Figure 24. The Graveney boat. Cross-section. Near the stem. From Fenwick 1978. Scale 1:25

The number of parts of the Gredstedbro ship that are available for study is very limited. It is hardly possible to draw firm conclusions based on this evidence. The rib of the Gredstedbro ship was presumably placed 2-2.5 m from one end of the ship. As a result it is hard to decide on the exact shape of the cross-section amidships. One could speculate that it had a barrel-shaped cross-section like the Nydam boat (Figure 12), the Kvalsund (Figure 21) and the Bårset boats (Figure). Evaluated solely on the shape of the keel it can be seen that it was not protruding much less below the rabbet than those of the Kvalsund and Bårset, though it is about four times wider. If the few finds that we have are representative of a chronological development, as is often presumed, the Gredstedbro ship looks like a transition form in between the Nydam boat to the more "elaborated" types of the Kvalsund and Bårset boats that in turn are a 'step' pointing towards the keel-shape of the Viking ship (Oseberg, Gokstad, etc).

If, however, we compare the Gredstedbro remains to the Sutton Hoo and the Graveney boats (Figure 22, Figure 23, Figure 24) the keels/bottom planks of these boats show much more resemblance. Especially the very low height/width ratio, the rounded shape of the protruding "keel"-piece and the relatively large rabbets are similar. The heavy floor timbers of the Graveney boat have been fastened to the strakes by large wedged treenails. Moreover, the floors are notched to fit the clinker-shape of the inside of the hull and the scarf between keel and stern/stem posts is horizontal. The same basic features have been found on the few pieces from Gredstedbro and despite the distance in time the two boats apparently have many structural similarities.

While the midship sections discussed so far might help to understand what the Gredstedbro ship may have looked like, it does not seem to be very helpful in a direct comparison of the timbers that were actually found. In a broader analytical and cultural context, looking at the Anglo-Saxon material does, however, seem to give vital clues to understanding the find. Although not of Graveney dimensions, the frame of Gredstedbro is heavy as compared to the Norwegian finds or to the gracefully shaped timbers of the later Viking Age finds. The thick bottom part of the frame, just above the keel, is a characteristic feature not displayed by any of the other sections. The Sutton Hoo ship, however, actually has a direct parallel to the Gredstedbro frame. Towards the stern of the ship, three frames (24-26) are placed close together, apparently to support the rudder section of the ship. The first of

these frames (frame 24) closely resembles the Gredstedbro frame (Figure 25).

On closer inspection, this general resemblance is not only in shape, but also in dimensions. For both finds the exact measurements are difficult to determine, for obvious reasons. But in the reconstruction of the ship (Evans & Bruce-Mitford 1975, figure 325), frame 24 is interpreted to be *c*. 1.6 m high (along the frame), and *c*. 2.4-2.5 m wide at the top. The equivalent measurements of the Gredstedbro frame are 1.50-1.55 m high and 2.2-2.4 m wide. Given the inherent imprecision of the measurements, these figures are very close. The similarities may even explain the oddities in the width of the garboard strake on the Gredstedbro frame, as was discussed on page 68.

Figure 25. Photo of frames 24-26 in the aft section of the Sutton Hoo ship. Frame 24 is in the front of the picture, cf. *Figure 20. From Evans & Bruce-Mitford (1975, 360).*

In Crumlin-Pedersen's reconstruction (Figure 12), a full-width eighth garboard is added without any contact to the frame, a somewhat wobbly construction it seems, and indeed unsubstantiated in the archaeological evidence. We have previously suggested (p. 68) that the garboard might have been wider than the other strakes. The Sutton Hoo ship, however, may provide the explanation. In this ship the eighth strake tapers off exactly at frame 24, where it joins the keel. This strake is thus not at its full width where it meets this frame.

The strong similarities between Sutton Hoo frame 24 and the Gredstedbro frame, together with the general resemblances in keel-shape, the lack of cleats and the use of tree-nails for fastening almost begs the conclusion that the two ships are close parallels, and that excavating the Gredstedbro ship would produce a wooden version of the soil imprint in East Anglia. However such a conclusion would be premature. It would be wise to see the Gredstedbro ship in full before trying to ascertain its structural affinities.

No convincing proof for the presence of masts is found in the Anglo-Saxon boats. In the Sutton Hoo ship the midship part was destroyed by the grave chamber. On the Graveney boat indirect evidence for a mast might be inferred. It seems that parts have been removed from the midship section. This may suggest that a mast step had been present at some point. The Graveney boat was found more than 1 km inland. Due to her stability (very low length/width ratio) she might have been able to carry a substantial area of sail. However, her low freeboard might have posed a problem. The find of an unfinished millstone and residues of hops are taken as proof for her seagoing ability, which means that she had crossed the Channel. On the other hand, her general shape and cross-section do not contradict that she was a barge that was used locally and the finds of trading goods are no definite proof of cross-Channel activity. But similarly, the fact that she was found at a distance from the coast certainly does not prove that she was not seaworthy. It is likely that a ship that is found under conditions like the Graveney boat is deposited or abandoned on purpose. Such controlled destruction rather than destruction by accident means that the relationship with its original purpose is hard to ascertain.

The Fjørtoft boats resemble the Gredstedbro ship and the Graveney boat in that the ribs/floors were notched to fit over the internal clinker-built shape. However, the keels resemble Kvalsund II; they are basically made of

a plank, only protruding a little below the bottom of the garboards and with rabbets like those found on the Gredstedbro, Graveney, Nydam and Sutton Hoo vessels. By adding a fillet or false keel to the underside, however, the keels had been given a more pronounced T-shaped cross-section and a much larger height/beam ratio. This also improved the structural integrity previously mentioned as facilitating the use of sail.

The use of sail in the Migration Period largely remains an open question. There is no direct evidence for the use of sail in the North West European clinker building tradition before c. 800 AD. The Graveney boat is dated to c. 927 AD. It might very well have carried sail. If this interpretation is correct, it might unsettle the current understanding of the use of sail on early boats of the Migration Period. It is generally agreed that the shape of the keel is crucial for the ability to carry mast and sail as only a pronounced T-shaped keel provides the rigidity and strength needed for withstanding the impact from sail and mast. If the Graveney boat however, despite its very flat plank-keel, was able to carry sail through the fitting of some kind of mast step, then the interpretation of other boats might also have to be reconsidered. Also, there are many boats of later periods that carry sail despite a flat keel. An extensive study of the minimum requirements of fittings for rigging and a close reassessment of the early boat finds with a view to recognize traces of these might help to solve these questions. Also, however, we must be aware that the present sample of finds, with the exception of Graveney and perhaps Gredstedbro is more or less unequivocally interpreted as crew-carrier, 'Mannschaftsboote' in German (Ellmers 1972, 35). Such ships may be more likely to depend on the crew for propulsion, than ships that serve another purpose.

It is hardly possible to divide the boats into definite geographical groups on the basis of specific constructional features. The number and distribution of finds is such that a regional division and a chronological one hardly go hand in hand. Nonetheless, it seems that plank-keels are found mainly in the areas impacted or influenced by the migrations (if we consider the Migration Period as being c. 400-900 AD): Eastern Britain (Graveney and Sutton Hoo), northernmost Germany (Nydam) and Southern Jutland (Gredstedbro). T-shaped keels are apparently predominantly found in Norway (including boats with "false" keels, such as Fjørtoft and Kvalsund II). However, fastening and shape of frames do not follow these clear divisions. Neither do choices of assembling methods: treenailing, riveting, spiking, lashing or a mix of these assemblage methods seem to be more or

less randomly distributed. The choice of treenails to connect the heavy, notched frame to the strakes, however, does apply to the Graveney boat, possibly to Sutton Hoo and to the Gredstedbro ship. The possibility that heavy frames to some degree compensated for the surmised lack of strength and integrity of the keel-plank and the possibility that some kind of mast-carrying timber (keelson) could be notched over these heavy frames should not be excluded at all. While it is most doubtful that the lightly constructed Norwegian boats that are included in the present discussion were carrying sail, the possibility should certainly be taken into consideration when dealing with the heavier constructions found further to the south. Future finds or new excavations at Gredstedbro might shed light on some of these interesting questions.

Log boats - the other tradition

Vaaler Moor

While the tradition of plank-built Iron Age / early medieval boats and ships is relatively well established around the North Sea, as exemplified with the finds mentioned above, it is perhaps also worth while to point to another, and probably also strong tradition in boatbuilding, namely the log boats. The Vaaler Moor boat is a prominent exponent of this tradition, which may easily be overlooked in the literature on boat development during this period.

The Vaaler Moor log boat was found in 1870 in a peat bog in Süder-Ditmarschen. The boat is 11.90 m long. Amidships it is 1,30m wide and 0.50 m deep. It is made of oak and contains 12 frames that are also made of oak branches.

The frames are not fastened to the bottom of the boat, but are treenailed at their heads. The frame-fastening-holes have a diameter of *c.* 3 cm which makes them perhaps bigger than those used for thickness gauges (McGrail 1987, 79). Even though the boat has a little sheer, it has well-built ends, similar to plank built boats (Åkerlund 1963, 118-120). The bottom of the boat is 4 to 5 cm thick. The boat has small opposing pairs of protrusions with vertical holes in the top edge of the sides between the ribs. Because of their position, these holes are interpreted as thole-holes. Nevertheless, according to Åkerlund the holes are for thwarts treenailed in position, and the ribs between them are functioning as foot-timbers for paddlers.

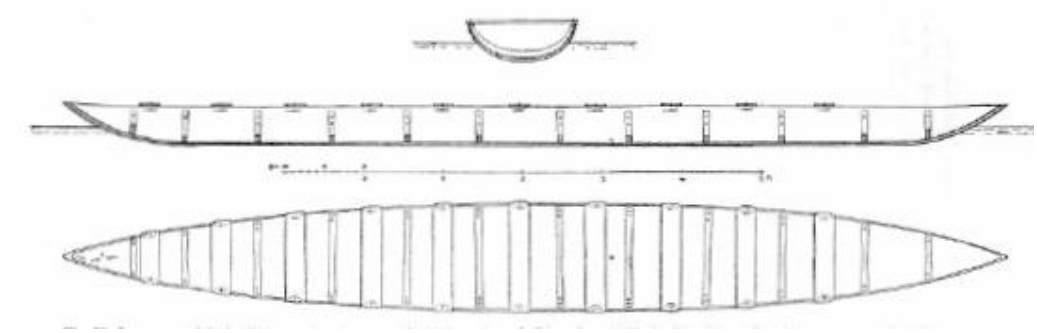


Figure 26. Reconstruction of the Vaaler Moor boat. From Åkerlund 1963

In the Vaaler Moor boat there are three dove-tailed clamps across a split, which are locked by treenails across. Similar double dove-tailed clamps have also been used in repairing the Bronze Age Appleby logboat (McGrail, 1987, 66). The Vaaler Moor logboat is not dated with certainty. It is generally dated to the 4th century AD or earlier and it is thought to be a "primitive imitation of the Nydam ship type" (Åkerlund 1963: 120).

This boat, even though it was built in a simple and easy way, must be considered to have been seaworthy. It has a close parallel in the boat from Leck, found just south of the Danish-German border (Crumlin-Pedersen 1990).

Perhaps this was the kind of boat that was used by the Angles and Saxons in their early travelling in England. By staying close to the coasts and in fine weather, it could be possible to cross the English Channel. Angles and Saxons were already making raids to England, which was under Roman control, from the 3rd century AD onwards. Pliny describes pirates in hollowed tree trunks with a capacity of 30 men travelling on the North Sea.

Log boats in everyday navigation

With a length of almost 12 meters, the Vaaler Moor log boat is a relatively rare form of vessel in the archaeological record, although that should not lead us to conclude that such boats were rare in the period. Log boats of more moderate sizes are known in comparatively large numbers from

archaeological excavations across the North Sea area. The boats from for instance Slusegård (Crumlin-Pedersen 1991), Snape (Filmer-Sankey 1990) and Björke (Humbla 1950) are well known examples among many of this type of vessel. As such they are indicators of more modest ship building traditions than what presumably is represented by the Gredstedbro ship as well as the Vaaler Moor boat. They demonstrate how small vessels were in use for everyday navigation in littoral and inland waters throughout the period. For continental Europe these boats are still to be subject to a thorough archaeological examination.

IV

THE SITE

8. Archaeological Investigations at Gredstedbro

Discovery

As is often the case with archaeological discoveries, the Gredstedbro ship was not discovered as the result of a directed archaeological effort, but was unearthed by accident. While regulating the lower reaches of the Kongeå in 1945, the dredging machine hit a large and compact structure of oak. The wood was well preserved and posed some difficulties on the work crew. They managed to break off sufficient parts of the wood to be able to continue their work. Most of this wood was discarded, but three characteristic pieces were handed in at the museum in Ribe. The pieces were interpreted as having belonged to a bridge, and deposited in the stores.

This history of discovery contains a small and slightly paradoxical history in itself. The Danish drainage networks have in general been thoroughly regularized. Only about 2% of the entire network has been left in a more or less natural state (Hald-Mortensen 1992). Incidentally the only major exception to this rule is the Kongeå, which has largely been left unregulated in its entire length above Gredstedbro. Historically this is probably related to the Kongeå's status as a border between the kingdom of Denmark and the Duchy of Schleswig, and in the years from 1864 to 1920 also as a border between Denmark and Germany. But from Gredstedbro and along the last *c.* 7 km towards its mouth, the course of the stream has been regularized indeed. While the Kongeå in general is an exception to the rule, the normalization done along its last few kilometres must then form an exception to the exception, and this is how a major archaeological discovery was made.

The interpretation of the timbers as being from a bridge is possibly easier to understand with knowledge of Danish language. The ending "-bro" in Gredstedbro means "bridge", and in the historical record the site has been an important crossing at least since the Middle Ages. It was logical to think of a bridge when wood was found here.

Identification

It was only during a reorganization of the storerooms in 1964 that the Museum's curator Mogens Bencard realized that the wooden pieces from Gredstedbro might not stem from a bridge after all. This was two years after the Skuldelev excavations; an event which must have significantly raised the awareness of ship finds within the Danish archaeological community, and elsewhere as well.

Ole Crumlin-Pedersen was called in to assess the Gredstedbro timbers, and they were immediately identified as being ship timbers. The timbers were temporarily transferred to Roskilde for further examination. The find was published in Danish in 1967 and in English in 1968 (Crumlin-Pedersen 1967; 1968). Today the timbers are on display in the museum *Ribes Vikinger* in Ribe, 7-8 km south of the site.

Dating

The comparative analysis of the timbers produced an archaeological dating of the ship somewhere between "*the Nydam ships (300-400 A.D.), and the ships of the Viking period*" (Crumlin-Pedersen 1968, 263).

In 1966 a treenail from the ship was dated by radiocarbon. The result was a date to 1400±100 bp (K-1094). Calibrated date is AD 652 (562-689) (Stuiver *et al*. 1998). The nail was cut from a larger piece of oak, with no sapwood preserved, so the ship would probably be slightly later. A more recent calibration is less outspoken (see p. 67).

The Wormianum dendrolaboratory in Højbjerg did an analysis of a part of the keel in 1995. With only 64 year-rings and no sapwood preserved, the result is uncertain, but it produced a dating to 622 AD, with a felling date no earlier than 630. Again this date is probably too early.

While the typological and the two scientific datings correspond well, placing the ship in the 7th (or early 8th) century, it would probably be worth while to do more dendrochronological work on the find, especially if more timbers are found.

Surveys

Several attempts to find more timbers have indeed been made at the site, although so far none have been successful. The work can be followed through the Museums file on the site (ASR 155) which is a main source for the following.

The exact location of the find was forgotten by 1964, but through the attention in the media contact was established with one of the workers of the 1945 crew, Mr. Christian Hansen, who pointed out the site in the landscape. The location was stated as being on the south side of the present riverbed, and on the eastern side of the earlier south going curve's left arm. This explanation is easier to understand when looking at the topographical maps (Figure 27). The normalization project cut off an entire loop meander, and the ship should be located where the two runs meet. With the two maps present in a relatively detailed scale, one should think that it would then be relatively easy to pinpoint the exact location of the site. Unfortunately the site is situated near the edges of the topographical map sheets, where there are noticeable tensions in the maps. Therefore the mapping is not very precise in this area, and even with modern GIS techniques the two maps are difficult to overlay with sufficient precision. Only a general indication of the position is obtainable.

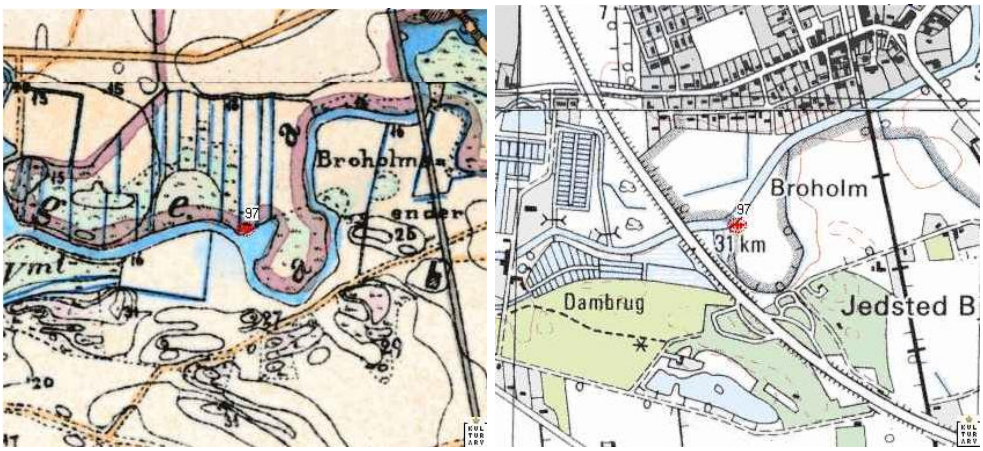


Figure 27. Topographical maps from c. 1880 and the present showing the approximate location of the ship and the change in the landscape. Maps reproduced from www.dkconline.dk. © Kort & Matrikelstyrelsen (216)

1965-66: Surveys

The years after the recognition of the timbers as being from a ship, several surveys were made at the site, during which the banks of the river were examined. Curator Mogens Bencard arranged with local boy scouts to probe for the ship using steel rods. No records have been found as to the exact location or extent of this survey, which was unsuccessful. A survey of the river bank by local sports divers in 1966 was also without results, but again there is no exact mentioning of the location and extent of this work in the museum file.

1981: Ground penetrating radar

In October 1981 another attempt at locating the ship was done by the Museum, as funding was raised to do a georadar survey (Christoffersen & Pedersen 1981). A local site grid was set up and fixed to the road bridge just west of the site, allowing us to re-establish it by using GPS. The grid was oriented after the site, with a main line following a compass direction of 75°, and covered an area of 90 × 14 meters.

The survey was done using a 120 MHz georadar unit, with survey lines being drawn both along and across the survey grid. The result of a georadar survey is not easy to interpret, and the following is mainly based on the report (Christoffersen & Pedersen 1981), although some work has been done in re-establishing the grid system and results. Depth expressed in nanoseconds (ns) is converted to meters by assuming a conversion of 0.35 m per 10 ns. As part of the present work the penetration depth has been re-mapped and geo-referenced as shown in Figure . Although difficult to reproduce in greyscale, the general results of the survey should be discernable on this figure. For a large portion of the area, shown in lighter colours, the penetration is no more than 40 ns, roughly equivalent to a penetration of up to 1.4 m. But in the westernmost part, and extending east along the southern edge of the survey system, there are areas of deeper penetration to 60-85 ns (2-3 meters) locally to 140 ns (4.5 meters). This area probably corresponds to the latest course of the river before normalization (compare Figure 27 and Figure). Within this area, which is also the most likely area for locating the ship, some anomalies can be seen in the radargrams, leading the surveyors to recommend intensive coring in this area. Areas of deeper penetration in the central and eastern parts of the grid were less deep – generally up to 60 ns, or 2 meters – and were interpreted as responses to the complicated geology of the riverbed.

The result of the survey was inconclusive, but pointed to the same area as previously, where the old and the new river beds meet. This interpretation could possibly stem from the fact that the two surveyors had already read the old reports.

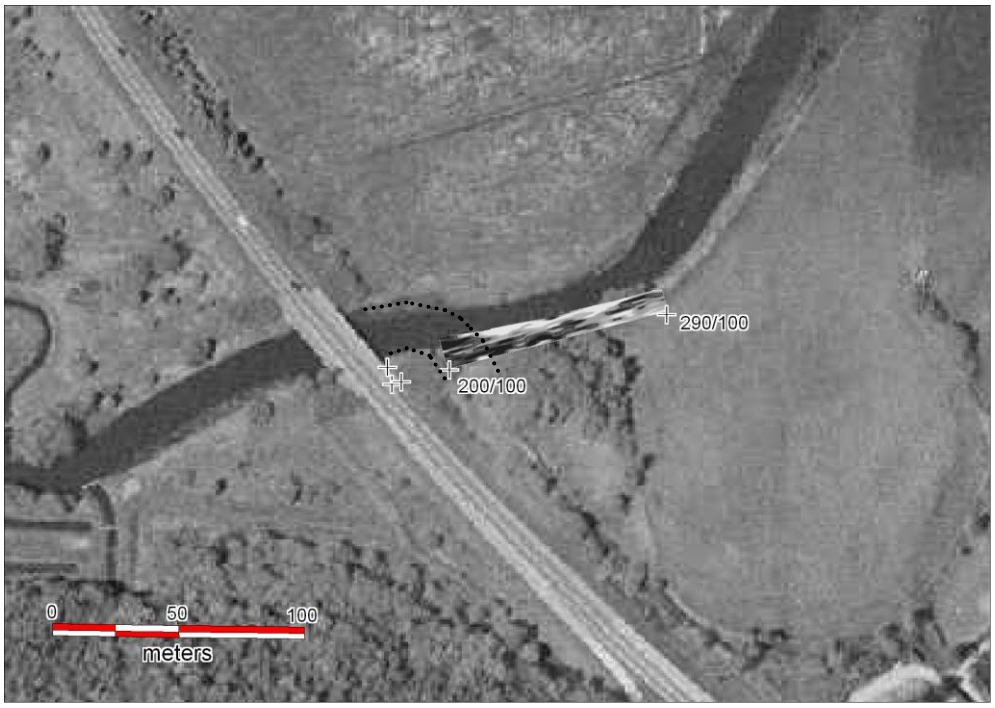


Figure 30. The result of the 1983 radar survey draped on top of an orthophoto (from www.dkconline.dk). Darker colours = deeper penetration. The approximate position of the old river bed is indicated with dashed lines. Scale 1:3000.

Dowsing and coring

Probably as a spin-off of the radar survey, a Mr. Helge Rasmussen volunteered his help to the project by dowsing for the ship using cobber wire. This attempt, done in September 1981, was apparently more than successful as Rasmussen was able to locate not only one but five "Viking ships" at this particular location. The event attracted some media interest, and several letters from Mr. Rasmussen are kept in the museum file explaining the high level of knowledge of our ancestors on electrical ground currents and ground-water currents, and the never failing correlation between ship burials and ground-water veins.

Being an open minded institution, the Museum in Ribe followed this work up by coring at three locations (up to 3.5 m depth) in the area. At least this part of the activity was potentially useful for further studies. Unfortunately there is no record of the exact position of these cores, but judged from the plans prepared by Mr. Rasmussen, the cores may have been taken slightly more easterly than where the ship can be expected to be found. The result of these cores was indeed also negative.

2008: Diving

In continuation of the work presented in this booklet, and as part of the professional diving training that is offered to students at the Maritime Archaeology Programme, an underwater survey along the southern bank of the Kongeå was made. The purpose of this work was two-fold: apart from the obvious ambition of finding parts of the ship, an equally important goal was to train the students under the relative adverse condition of river diving.

The survey was done in January 2008. A site grid was laid out to control the position of the divers, and any finds they might produce. This grid had approximately the same origin and orientation as the 1981 grid, as both systems follow a local foot-path in the area. The area is otherwise overgrown with scrubs and small trees, vegetation which must have developed since 1945.

Two diving teams with tenders and supervisors worked at the same time, with a stand-by diver acting for both. The bank was systematically inspected along a stretch of about 90 m from the bridge and upstream. Conditions were indeed adverse as the current was very strong; while visibility never exceeded 30-50 cm. Diving in the central part of the stream was virtually impossible. The bank was surveyed using steel rods and utilizing whatever visibility there was.

The ship was not found. But one piece of worked wood was found in the bottom sediment just off the riverbank (Figure 28). The fragment seems to be of oak and is irregularly shaped with dimensions of *c.* 29×16×6 cm. The surface is partly deteriorated, but there are very visible tool marks on the piece. Both ends are broken off.

The piece was found exactly where also the earlier investigations tend to locate the ship, at the junction between the old and the new river bed. While it is very tempting to see this piece as a part of the Gredstedbro ship, it is too small and uncharacteristic to interpret. Numerous man-made objects would end up in a river, and this may simply be the remains of a discarded fence post, flushed down by the current.

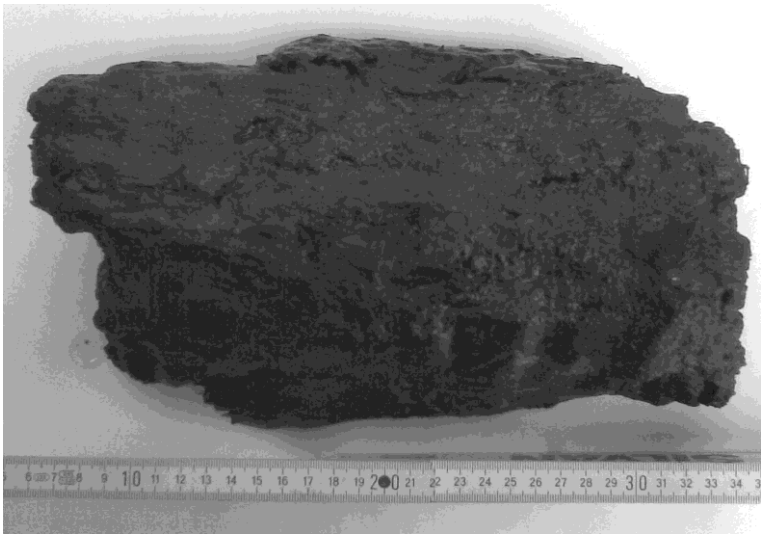


Figure 28. The piece of worked oak found during the 2008 survey. Scale 1:3.

Future investigations

So far there has been an archaeological attempt to locate the Gredstedbro ship just about once every two decades. So far all attempts have been unsuccessful, although we know relatively well where to look. Especially the effort of combining the different maps and surveys, as shown in this chapter, has helped in clarifying the possible location of the ship.

It may not be entirely necessary to wait another 20 years before doing the next field work on the site. The significance of this find is such that an excavation seems warranted, although this would require several cycles of considerations pertaining the decision to dig.

The first consideration is possibly, that there is not one site, but that the timbers reside in at least two different circumstances. When the workers discovered the ship in 1945 they broke parts of it off, leaving others behind.

We do not know what happened to the destroyed parts of the ship, and whether the timbers were left somewhere on the site, or whether they were removed. If they were left, were they deposited in the rubble, or left on the surface? In all likelihood it will be more difficult to locate the discarded timbers, than those preserved *in situ*.

There is no way of knowing beforehand how much of the ship is preserved in its original location. But it is certain that some timbers are not *in situ*, although we have no sources telling where they are or even if they are preserved at the site. Neither are there any sources on the structural integrity of what was left. This can only be solved by excavation.

What we can see is the vegetation which has covered the site since 1945. The trees stand up to – approximately – 5 to 8 meters tall at the site, indicating that the vegetation is not very old. It cannot be seen on the BASIC COVER air photos of the mid 1950s and must have developed since then. The significance of this vegetation is that it may help in protecting the site in that it may hinder more profound interference on the site, archaeological excavations included. But more likely the development of root systems under the surface is a potential threat to whatever remains of the ship are down there; all depending of course, on the level of the ground water table, and the actual position of the ship.

To solve these questions, some form of excavation is necessary, although it need not be a full uncovering and lifting of the ship. Test pits in the area could solve important questions on the state of the site, and would also be a prerequisite before planning and conducting a full excavation.

This obviously leads to the important question of *in situ* preservation. Should we uncover the Gredstedbro ship at all? Or should we leave the site as part of the archaeological reserve for future generations of maritime archaeologists to work with. There are good scientific reasons to uncover the ship, and figure 1 of this booklet illustrates an important point of the potential significance of knowing more about the ship: Ships from this particular period are in short supply, and the scientific value of knowing one more of these ships would vastly surpass that of another Roman or Viking ship. To put it rudely, ships from these periods are in a sense more eligible for *in situ* preservation, because in excavating them we risk damaging a site without gaining further knowledge, than was gained from last year's excavation of a similar ship. An opposite perspective, however, could

convince us that ships from periods with few finds should have higher priority for *in situ* preservation, as they represent a more scarce archaeological resource. The balance is difficult, and the pros and cons of each scenario must be discussed thoroughly within the archaeological community, especially in this instance where an excavation is not necessitated by development, and hence inevitable destruction, but would be conducted purely for scientific reasons. And then again, the discussion will obviously be influenced by the fact that we do not know how much the site has been disturbed or if anything remains *in situ* at all, whereas on the other hand each bit that can inform us on the ship's construction would be of enormous scientific value.

In any case the ship remains should not be excavated before there is a full plan for the further fate of them. The plan for any excavation at the site should include a plan for long-term conservation and storage – preferably exhibition – of the ship. Such a plan must prepare for the contingency that the structural integrity of the ship may be severely damaged, and that only little remains to exhibit, but also for the contingency that considerable remains will be located indeed.

9. CONCLUSION

Three pieces of timber. That is in fact the total body of archaeological data which makes up the Gredstedbro find. The ship was uncovered without any archaeological supervision, timbers being torn apart, and it took almost 20 years from the discovery of the site to its archaeological identification as a ship.

Despite the incomplete character of the find, the Gredstedbro ship has been mentioned widely in the archaeological literature since its initial publication in English by Crumlin-Pedersen in 1968 (e.g. Ellmers 1972; Evans & Bruce-Mitford 1975; Muckelroy 1978; Cameron 1982, Crumlin-Pedersen 1997, Gould 2000; McGrail 2001; Bill 2003). As such these three pieces of timber hold a central position in the archaeological analysis and interpretation of the development of ships in early medieval Northern Europe. For this reason alone the ship merits further investigation. The special significance of the find was demonstrated already by figure 1 of this workbook. Ships of the 7th century – especially well preserved ones – are very rare in the archaeological record. It is obviously this scarcity of finds that makes the Gredstedbro find so important, despite of its incompleteness.

Nonetheless this workbook, and the course work that lay behind it, does not focus singly on the development of ships during the Early Middle Ages. There is more to maritime archaeology than the description and comparison of floor timbers, futtocks, and length-width ratios. A ship-find – or any archaeological find, for that matter – is significant only when it can be contextualized; compared not only to other ships, but even to other spheres of contemporary life and society. There is, in a word, more to learn for a student in Maritime Archaeology that nautical typologies, and this view on the discipline is reflected in the present book. Paraphrasing that well known sentence once again, Maritime Archaeology is archaeology or it is nothing (Maarleveld 1998, 32).

Applying the broader approach to the Gredstedbro find, this workbook has covered a range of subjects. Due to the nature of the work these subjects have obviously been covered in varying degrees of depth. Some sections of the text have the character of literature reviews, and indeed are written as

weekly assignments with a short deadline. But for others we have endeavored to make an original contribution to research questions that were seen as important for understanding the Gredstedbro ship. The outcome may open more questions than that it answers. But clarifying what these questions are – and how we may perhaps answer them – is then possibly the most important result of the work towards this book.

One thing our work has certainly demonstrated is the importance of understanding the palaeolandscape. Looking at the strong meandering of the Kongeå on older maps – or even on satellite images on Google Earth where its traces are still visible – makes one wonder how larger vessels could possibly enter as far as Gredstedbro. The location of maritime sites relatively far inland is typical for this general area, where settlements are plentiful just inside of the salty marches of the Wadden Sea (Jensen 1998). But in reality there is not much particular knowledge on the long-term development of the Wadden Sea in the Kongeå area. Further projects would benefit from the contribution of geologists, palynologists, palaeo-entomologists or other experts that can inform us further on the surroundings of Gredstedbro at the mid-first millennium A.D. Our work on the landscape has only scratched the surface, so to speak.

Chapters 3, 4 and 5 covered aspects of the cultural environment during the Early Middle Ages. The massive redefinition of economic, political and social structures which happened during this period does not make the Gredstedbro ship less interesting. It is not unreasonable to interpret the ship as a tool, or at least a small stepping stone, in that process of profound change. The decline in formal and systematic trade also helps explaining why we have so few ship finds of the period. Not only would a reduction in trade lead to fewer ships sailing the seas, but without the towns acting as focal points for trade, modern Maritime Archaeology looses an important hunting ground for discovering the wrecks of the period. In chapter 5 we tried to zoom in on the cross-cultural contacts of the North Sea. Inspired by the theoretical work on maritime cultural landscapes this chapter is an attempt to bring such theories into a more operational and empirical form. Interesting about the results is the clear coastal orientation of the contacts. There is nothing indicating the direct crossing of the North Sea, but rather seafaring following the coastlines. Ships of the period may primarily have functioned in the projection of military and social power, thereby shaping exchange systems, while merchant trade only gradually redeveloped, being facilitated by the stabilization of new political structures. While our analysis

was designed to uncover large scale structures of the exchange systems, there is still much to do in investigating their local realization in the form of landing and trading sites along the Wadden Sea coasts. Recent discoveries indicate a complex and hitherto unknown network of local sites across the entire area. Much more work in this direction is essential to understand the ship and its specific context.

Finally the ship itself was presented and compared to other contemporary finds. The find itself has not changed since the years of the original publication, and therefore there is not much to add in the formal description of these timbers. What may differ is the further analysis and interpretation of the ship, and this issue did spawn some debate during the sessions leading to this book. One can reasonably question the methods that are used to classify ship finds in contemporary Maritime Archaeology, where it may be high time to debate how contemporary these methods really are. Is it reasonable to fit in our ship finds into evolutionary typologies, especially for periods such as the one dealt with here, where only few finds are known? Will a 'numerical taxonomy' actually describe the relations and classifications that we are looking for as archaeologists? That different systems and traditions of classifications can be found in the archaeologies of different countries and linguistic zones is known to every archaeologist, but possibly these differences become more apparent for a university programme such as ours, where archaeologists and archaeology student from several countries cooperate. The solution we have arrived at here is partly a compromise and in many respects reflects several traditions. And at the heart of the problem for this particular period is obviously, that typology is all about generalization. The validity of any such work would benefit from a larger number of observations, than is the case here.

The final chapter discussed the site, and the work that has been done on it so far. After several campaigns there still is no more solid archaeological evidence from the site, than the three pieces of timber that were handed in to the museum in 1945. There is no doubt that excavating whatever remains are still left of the Gredstedbro ship would mean a leap forward in our understanding of the ships of the period. In fact, it may be more meaningful to explore the site than to tacitly choose for passive *in situ* preservation without having any idea of the integrity of the remains. But, of course, such an intervention for scientific reasons needs to be based on a conscious decision, taking the contingencies into account. With the increasing awareness of the importance of *in situ* preservation across the archaeological

community it quite rightly needs to be well argued indeed. The work presented here has not involved much field work. Hopefully it will still represent a step forward in the understanding of the ship which still lies in the banks of the Kongeå at Gredstedbro.

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