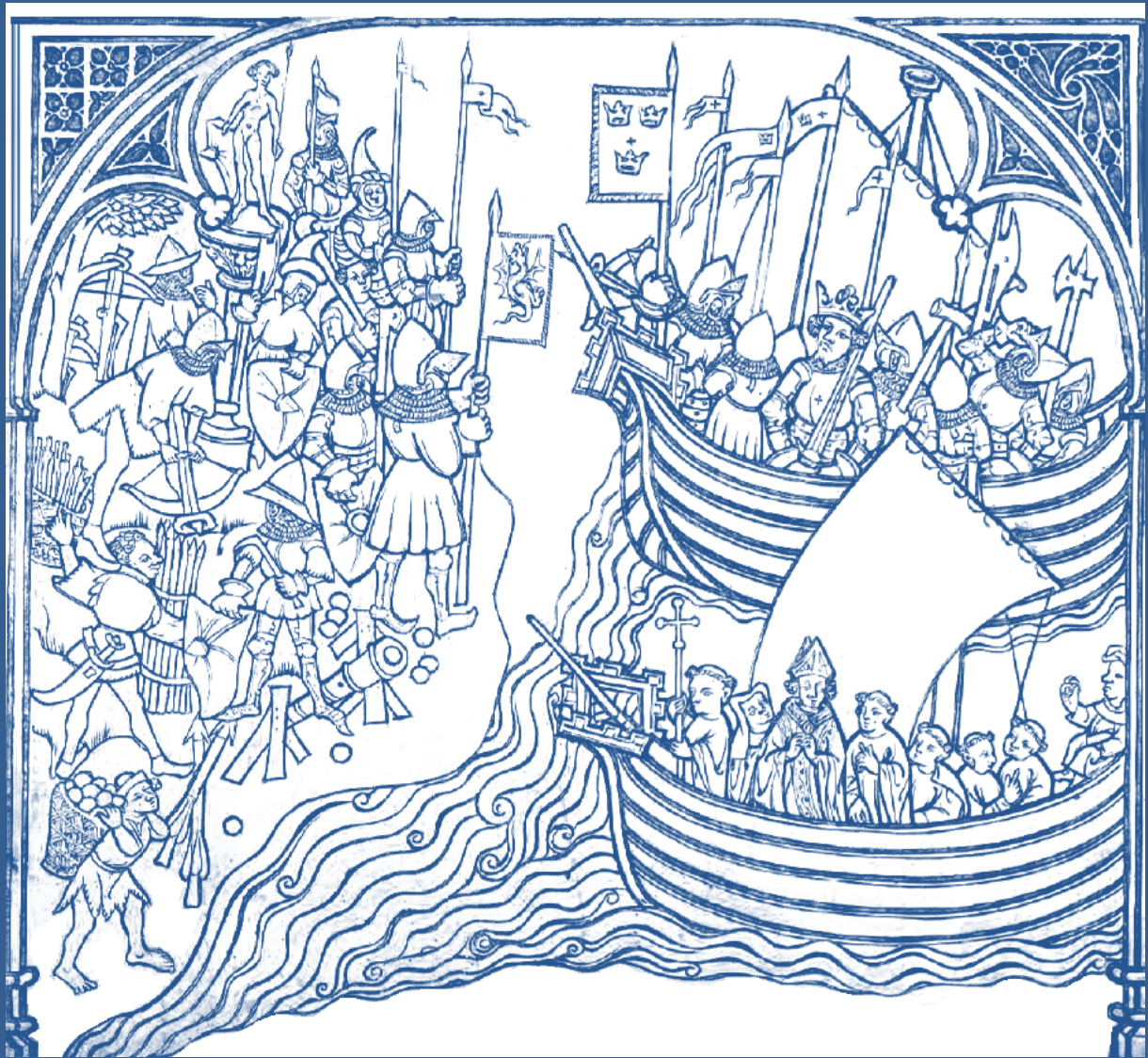


# MARITIME LOGISTICS IN THE AGE OF THE NORTHERN CRUSADES



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KIEL MMXVII

# Maritime Logistics in the Age of the Northern Crusades

Dissertation zur Erlangung des Doktorgrades  
der Philosophischen Fakultät  
der Christian-Albrechts-Universität  
zu Kiel

vorgelegt von  
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Kiel  
31.03.2016

Ein deutsch-dänisches Promotionsprojekt in Zusammenarbeit mit



*Cover:*

*A reproduction of a brass plaque from the 1420's on Bishop Henry's sarcophagus in Nousis Church, Finland, commemorating the Swedish crusade against Finland under King Eric IX and the aforementioned bishop around 1150 (Bengtsson & Lovén 2012, fig. 7).*

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Zweitgutachter: Prof. Dr. Jörn Staecker

Tag der mündlichen Prüfung: 21.11.2016

Durch den zweiten Prodekan Prof. Dr. Elmar Eggert zum Druck genehmigt: 24.11.16

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\*since Oct. 2014 he is not affiliated with the museum anymore, but has agreed to continue his role as external co-supervisor.

\*\*in late 2014 he changed his affiliation to Stockholm University.

## Acknowledgements

I am most indebted to my external co-supervisor Anton Englert, whose support was indefatigable and who contributed with countless insights, thought-provoking impulses and constructive criticism to this work. His eye for details has — on many occasions — triggered a new thought-process in me whereby I came to question things that I thought were set in stone. I learnt much whenever I was proven wrong and I came to appreciate to be proven wrong, as this gave me ample opportunity to hone my analytical skills. Anton’s role cannot be over-emphasised enough, as I could always rely on his good judgement and support in difficult situations and a hearty welcome whenever I was on a research visit in Roskilde. At this occasion I would also like to extend my gratitude to other staff members of the Viking Ship Museum (Roskilde) for the welcoming and friendly work atmosphere and for allowing me to join the *bådelaug* to sail on the Viking ship reconstructions in the late afternoons after having worked in the “knowledge mines” of the museum’s library.

I thank my principal supervisor Ulrich Müller for presenting me with the option to submit my thesis cumulatively. This option was hitherto mainly practised in the Natural Sciences but still considered a pioneering path in the Humanities. This “emergency cable” to pull myself out of the drift-sands came at the right time, when I went into all possible directions with my publications, but not towards the finishing line. Despite its somewhat chaotic genesis, the various strands bundled together in this cumulative thesis are proof that the particularistic themes — as a reflection of a generously interpreted *academic freedom* on my side — are interconnected after all.

I am also very grateful to my other external co-supervisor Kurt Villads Jensen’s feedback on some sections with a historical focus, for his

recommendations on literature and for making available manuscripts prior to publication.

Particularly Damian Goodburn — the ancient timber specialist of my former employer, the Museum of London Archaeology Service — provided very detailed advice on my drafts for paper C and D. Damian also honoured us with a visit, presenting a paper at the GSHDL’s bi-weekly colloquium on how ship-finds and timber structures can help us to reconstruct ancient extinct wooded landscapes. Thus he demonstrated an important intersection between Maritime Archaeology and the general ‘landscapes’ theme of my Graduate School.

I am indebted to Johan Rönby for making available samples from the Kuggmaren wrecksite, and to Wiebke Kierleis and Helmut Kroll for their guidance in analysing the samples. I am indebted to Maili Roio for making available an unpublished catalogue of finds and for sending dendro samples of the Matsalu and Lootsi wrecksites to Aoife Daly, who was commissioned by this author with their analysis. Aoife’s work as such was of central importance in many respects, and she kindly provided elucidations when necessary.

For correspondence and kind exchange of ideas, information, unpublished or hard-to-get publications I wish to thank Jon Adams, Jan Bill, Aoife Daly, Jens Auer, Dieter Bishop, Anton Englert, Mikael Fredholm, Rolf Hammel-Kiesow, Kristof Haneca, Dieter Heckmann, Christina Link, Carsten Jahnke, Juhana Kreem, Jens Lindström, José Manuel Matés Luque, Thijs Maarleveld, Marika Mägi, Oliver Nelle, Kim Schou Nørøxe, Waldemar Ossowski, Alice Overmeer, Reinhard Paulsen, Johan Rönby, Jürgen Sarnowsky, Albrecht Sauer, Mikel Soberón, Katrin

Thier, Mikkel Thomsen, Vello Mäss, Per Kristian Madsen, Peter Marsden, Gustav Milne, Stuart Jenks, Staffan van Arbin, Jeroen Vermeersch, Stefan Wessmann, Christer Westerdahl and Maris Zunde. This list is probably not complete and thus I would like to extend my apologies to individuals who I may have forgotten to mention.

For the opportunity to get involved in an orlop-deck survey on *Vasa* (1628) during my time as Ph.D. student I wish to thank Fred Hocker. Although not factually related to the topic of my thesis, this gave me the opportunity to hone my recording skills and appreciation of the complexities of shipbuilding. On the basis of a rigorous critique of a first draft, Fred (now within the capacity of the 2nd examiner) recommended a thorough revision of the first draft, which led to the current version, resubmitted in March 2016. Although this can be perceived as a setback, this author appreciates the instance of a hard quality control hurdle within a section of the humanities' academic culture, where the "anything goes" mentality is seemingly spinning out of control. Although exasperating at the time, this gave the author a chance to rethink some earlier assumptions and to construct arguments and hypotheses in a more rigorous manner, which added to the overall benefit of this work considerably.

During my doctoral years I took part in numerous activities like fieldschools, underwater surveys and excavations, workshops and conferences. In 2010 I had the opportunity to present a paper at the *Gentes trans Albiam* conference in Toronto, Canada, organised by Sunhild Kleingärtner and Sébastien Rossignol. I am grateful for having been invited to the 'International Workshop on Underwater Archaeology' in Gdańsk 2010 by Waldemar Ossowski and Iwona Pomian, to the 'Bologna Summer School' by Massimo Capulli in 2011, twice to the 'Baltic Workshop for PhD Researchers in Maritime Archaeology' in Stockholm and Helsinki, 2010 and 2011 respectively, organised by Johan Rönby, Niklas Erikson, Kristin Ilves, Riikka Alvik and Minna Leino. I am also grateful for having had the opportunity to

participate in the underwater excavation of the *Hedvig Sophia* in 2010, organised by Jens Auer, Sunhild Kleingärtner, Thijs Maarleveld and Martin Segschneider, and an underwater survey of the harbour barrier in Flensburg in 2011, organised by Ruth Blankenfeldt, Erich Halbwidl and Martin Segschneider. I am particularly grateful for having been invited to the 'Hanseatic Trade in the North Atlantic' conference 2013 in Avaldsnes, Norway, organised by Endre Elvestad, Natascha Mehler, Arnfrid Opedal, Mark Gardiner, Rolf Hammel-Kiesow and Claus von Carnap-Bornheim, which gave me the opportunity to set "my" Beluga Ship — excavated in Bremen 2007 — into the wider context of other clinker-built shipwrecks.

In October 2014 I also acquired a certificate as Scientific Diver. I am particularly indebted to Roland Friedrich — a lieutenant commander of the German Navy — as our kind, principled and committed training officer, ably assisted by Fabian Schuster. The training was hard but hearty, and my fellow divers made this a great overall experience.

More often than not, the task of writing a doctoral thesis was a strain on social life. The only time where I could truly escape were the hours spent sailing with my firåring *Skjðblaðnir*, which was even converted into a "research vessel" for a sailing expedition into the Stockholm Archipelago in 2010, where I followed a leg of a 13<sup>th</sup>-century route description — King Valdemar's Itinerary (section 3.3) — with my brother Tobias Zwick and Alexis McEntyre. My student years were enriched by all the nice people who joined my crew on the weekends and the annual Rum-Regatta in Flensburg.

Last not least, I would like to thank my parents Wolfgang and Gisela Zwick for their indefatigable encouragement and continued support during all these years in which I chose the uncertain, stony and hazardous path of pursuing a career in the Humanities. Words cannot describe my gratitude and I therefore wish to dedicate this work...

to my parents

**Wolfgang & Gisela Zwick**

## List of papers

This is in part a cumulative and monographic doctoral dissertation. The cumulative part is based on the following papers published by this author during the doctoral years. The facsimile or manuscript version of the respective papers are included in the appendix.

- A** ZWICK 2013: D. Zwick, **Dynamics for Cultural Change in the Baltic Sea Region in the Age of the Northern Crusades – a maritime archaeological perspective.**In: S. Kleingärtner, S. Rossignol, D. Wehner (eds) *Landscapes and Societies in Medieval Europe East of the Elbe / Papers in Mediaeval Studies* 23, Toronto: Pontifical Institute of Mediaeval Studies, pp. 329-376.
- B** ZWICK 2014: D. Zwick, **Conceptual Evolution in Ancient Shipbuilding: An Attempt to Reinvigorate a Shunned Theoretical Framework.** In: J. Adams, J. Rönnby (eds.), *Interpreting Shipwrecks: Maritime Archaeology Approaches / Southampton Monographs in Archaeology - New Series* 4. Southampton: Highfield Press, pp.46-71.
- C** ZWICK forthcoming: D. Zwick, **A 15th-century shipwreck with Scandinavian features from Bremen, Germany.** In: B. van Tilburg (ed.) *Ships and Maritime Landscapes / 13th International Symposium on Boat and Ship Archaeology.* Amsterdam. Groningen: Barkhuis.
- D** ZWICK forthcoming: D. Zwick, **Interpreting a Scandinavian-built shipwreck from Bremen in the context of late medieval clinker constructions and northern European timber trade.** In: E. Elvestad, M. Gardiner, N. Mehler, (eds.), *German Trade in the North Atlantic 1400-1700: Interdisciplinary Perspectives.* Arkeologisk museum Stavanger Skrifter. Stavanger.
- E** ZWICK 2016: D. Zwick, **Bayonese cogs, Genoese carracks, English dromons and Iberian carvels: Tracing technology transfer in late medieval Atlantic shipbuilding.** In: *Itsas Memoria. Revista de Estudios Marítimos del País Vasco* 8. Donostia/San Sebastián : Untzi Museoa/Museo Naval, pp. 647-680.

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## 1. INTRODUCTION

Archaeologists define eras of human development in technical terms, namely the Paleolithic, Mesolithic and Neolithic — i.e. the Stone Ages — and the Bronze Age and Iron Age — the Metal Ages (*sic!*). This categorisation does not measure up to the most important of all resources used in construction: wood. Its omission can be attributed to its omnipresence; it is simply taken for granted throughout all periods. However, particularly for seafaring cultures the availability of certain wood species, the management of woodlands, timber conversion techniques and workmanship, and its culmination in artisanry and artistry is of most central importance. This is nowhere as well reflected as in Viking Age shipbuilding, where ships were not merely utilitarian, but became a strong expression of cultural identity in its own right — artefacts of a genuine “wood culture”. Wood continued to play a great role after the decline of Scandinavian Viking Age and woodland products — such as timber, tar, pitch and ash — were exported as bulk commodities from the Baltic Sea region into central and western Europe and beyond. The Hanseatic League is credited in opening

up a vast mercantile network through which Baltic bulk commodities were shipped to central and western Europe, but another underlying factor is often forgotten, which can be seen as precondition for the export of central European urban culture — on which the Hanseatic League was footed — into the forested wilderness of the East: The crusading movement in northern Europe, colloquially known as the “Northern Crusades”. The study of the maritime past in general and conflict at sea in particular has been almost exclusively the domain of historians. With an ever growing database of shipwrecks and other archaeological finds, however, archaeologists are increasingly able to complement or even transcend the ‘big picture’ drawn by historians. This study aims to bridge the two fields with an archaeological driven subject — primarily shipwrecks — embedded in the historically defined period of the Northern Crusades. Several case studies are “outsourced” and have been published as papers in their own right. Therefore this study is submitted as cumulative (i.e. publication-based) thesis and the results of the respective papers are alluded to in the text.



## 1.1. Principal aims of this study

The principal aim of this study is the evaluation of maritime organisation in medieval frontier zones for which the Northern Crusades provide an inspiring spatiotemporal setting. Rivers and seas are often perceived as frontier zones, forming a natural border not only in the geographical sense, but also a cultural boundary dividing different world-systems. This was indeed so decisive in human perception that the boundary between land and sea has attained a liminal metaphysical symbolism, which could even demarkate the worlds of the living and dead (Westerdahl 2005, 10ff.). Yet, at the same time, maritime and fluvial environments could be also important arteries of communication and trade. Whether preventing or facilitating cultural contact solely depends on a society's degree of maritime organisation. The implications of this duality — both in terms of shipbuilding and navigation — are a recurrent theme of this thesis to be explored from a historical and archaeological perspective. This study addresses the question how this boundary was transgressed, how geographical information was compiled and organised

in order to reach foreign shores, and how a maritime network was put into place to sustain and support new overseas enclaves, which were surrounded by pagan — often hostile — territories. In many respects, several allusions can be drawn to the Age of Discovery and the colonisation of the Americas, with the decisive difference that large ships suited for long-distance voyages were just emerging on the scene around the time of the crusades and that the navigational methods — or ways to organise geographical information — were rudimentary. The major focus lies on an assessment what requirements navigation in frontier zones put on shipbuilding techniques and equipage, for which reason shipwrecks as distinctive archaeological find category is highlighted in the following section. Aside from this technical focus, another major focus lies on the question how mariners perceived foreign landscapes at a time, in which mundane geographical information were intertwined with mythical and ecclesiastic views of the world.

## 1.2. Scope, limitations and some research history

The Northern Crusades were chosen as chronological frame in order to characterise a period of naval warfare and colonisation with a distinctive frontier zone dynamic. This time frame spans about four centuries, roughly from 1150 to 1550. Or to be more precise, from 1147, the date when a third major crusading front was opened up against the pagan populations of northern Europe (paper A), to 1561, when the last northern European crusader state — the Livonian Confederation — was dissolved (section 6). The primary geographical focus is on the Baltic Sea and some of its major river-systems, and to a lesser extent the wider North Sea area (paper D) and the Atlantic and Mediterranean Sea (paper E), in order to set the developments in the Baltic Sea into the wider geographical context. The latter is also in so far relevant, as this case study draws parallels to the maritime logistics of the two other major crusading movements: the *Reconquista* — on the Iberian Peninsula — and the crusades in the Holy Land across the Mediterranean Sea.

The subject title reflects an archaeological focus viewed through a historiographical lens by invoking a historically defined period. This bipolar focus is intended, and to merge both poles it is considered important not to just focus on shipwrecks *per se*. Since there are no shipwrecks from this period, which could be explicitly associated with crusading missions, it is important to infer general patterns of how ships were operated, navigated, maintained, built, and how expeditions into unfamiliar or even hostile waters

were planned, equipped and provisioned. Although case studies of individual shipwrecks are the most integral part of this thesis, which study affords a discrete methodology, it should not be the actual object of study that is the determining eponymous factor, but what could be inferred by their study, i.e. the maritime logistics. The following sub-sections provide the research historical context to elucidate what the concepts of 'Maritime Logistics' and the 'Northern Crusades' entail, as well as their respective scopes and limitations.

### 1.2.1. 'Maritime Logistics' — A better way to contextualise shipwrecks?

It has been often stressed that not only a precondition for the study of shipwrecks — namely Underwater Archaeology<sup>1</sup> — but also its method of examination requires a distinctive approach. Like any other archaeological object, a shipwreck or a ship-timber can be measured, recorded and described, yet it seems that the scientific value cannot be fully

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<sup>1</sup> Underwater Archaeology is not really a discipline, but a set of distinctive methods suited for a subaquatic site. It is often used synonymously to Maritime Archaeology, which is a more adequate term, as it is not restricted to sites below the waterline — an arbitrary boundary — but to all human interaction with the sea.

unleashed, as its study is very technical, descriptive and barely comparable to a wider context, thus too disparate to be meaningfully integrated into the wider field of archaeology, as noted by several archaeologists (e.g. Cederlund 1995, 103ff., Maarleveld 1995, 3). In order to come to terms with this underlying problem, it was suggested that Maritime Archaeology in general and the study of shipwrecks in particular ought to be no longer perceived as discrete subdiscipline, but rather as integrated discipline to understand wider socio-economic factors (Gibbins & Adams 2001, 287). But how exactly can this be achieved?

Christer Westerdahl once pointed out the unique value of shipwrecks for the study of communication and landscapes by alluding to the absence of an equivalent on land: cargo-bearing carts and wagons (Westerdahl 2006a, 60). The cart load would have been retrieved — like in de-commissioned vessels — and the cart itself broken up or perished. Due to favourable preservation in an anoxic submarine milieu, wooden shipwrecks and other organic materials, however, can survive for many centuries, and thus have the unique potential to represent ‘fossilised mobility’, a snap-shot in time of a transport and communications network. There is no comparable source category on land. A more integrated approach can be achieved by embedding shipwrecks into the wider context. Rather than plotting shipwreck-sites as dots on the maps — as their isolated nature inadvertently suggests — they should be conceived as dots on trajectories, corridors of trade and communication, coined by Christer Westerdahl as “tradition of usage” or “zones of transport geography” (Westerdahl 1992, 8ff.). Both concepts differ, in that the first describes the — over many generations — collectivised knowledge of a maritime landscape, and the latter defines the way how a landscape — or seascape — is segmented into different transport zones. These segments correlate to different environments, such as fluvial and coastal, and thus both required different modes of transport. But transport zones are not only defined on the basis of environmental parameters. There was no equivalent version of a medieval GPS<sup>2</sup>, so ships barely ever chose direct routes, not only because the navigation methods were limited, but also because holistic geographical knowledge was limited too. As will be stressed in section 3, maritime transport networks evolved on the basis of access to information, rights and maritime organisation — e.g. a pilot system — rather than on objectively quantifiable spatial parameters. Ships did not simply sail into the blue, but their route — unless coming off course in adverse weather conditions — was conditioned by a number of factors, which illuminate the wider context in which ships became deposited.

Therefore an attempt is made to introduce ‘Maritime Logistics’ into the debate on a conceptual level to assess the circumstantial factors (Fig. 1-1).

A few groups are overlapped by two fields, such as major harbours, which can be archaeologically excavated and directly compared to historical records about the harbour. One might argue that this should also apply for shipwrecks, which can be often identified by name in recordings. The latter was termed type A and B categories in Matthew Harpster's (2013, 592f.) analysis on shipwreck identity, in which historically known ships can be re-discovered (type A) or — in reverse — a ship can be identified through archival records after it was archaeologically investigated (type B). These categories are very much constrained to periods in which the particulars on ships, their cargoes and crews entered the archival records, which applies to the post-medieval and early modern period (as observed in paper B, 60f.). This approach can be almost completely ruled out for the medieval period, for which sources are vague, although general trends on trade and shipping can be inferred too. Thus in the case of this study, a type C affiliation (cf. Harpster 2013, 593) is undertaken, in which shipwrecks are linked to a broader historical narrative and can be associated to a culture or state, but not identified as a specific ship. Although many medieval-style technical solutions in shipbuilding survived until the recent past in rural shipbuilding, there is a great discrepancy in the nature of written sources, which necessitates a thoroughly distinctive approach between a medieval and post-medieval perspective.

Shipwrecks are not self-explanatory and linked to a shipbuilding-tradition, which are to a certain extent a cultural expression, and therefore plotted in the two intersecting circles of Maritime Archaeology and Maritime Culture. Occularly, no source group is within all three intersectioning circles. Thus, the concept of ‘Maritime Logistics’ does not refer to a tangible source category, but “intercepts” wherever the categories can be brought into relation to each other. For instance, a wreck-cluster along a trajectory or route may be indicative of a “tradition of usage”, which in turn raises the question whether this route overlapped with a known sea-route, such as recorded in itineraries (cf. section 3.3).

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<sup>2</sup> Global Positioning System

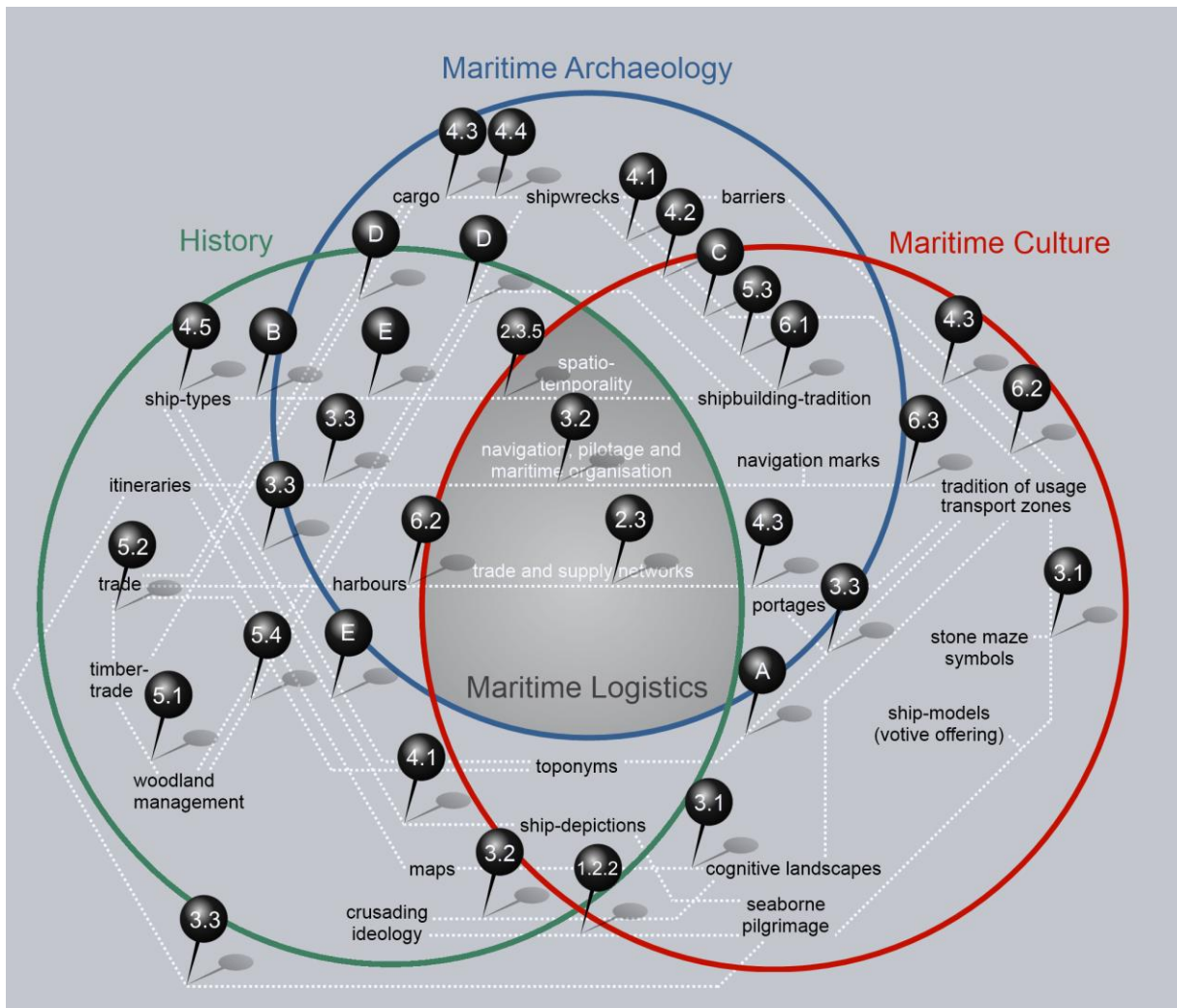


Fig. 1-1. This venn diagramme reflects an attempt to contextualise shipwrecks in a more holistic sense, combining the three disciplines of Maritime Archaeology, Maritime Culture (principally ethnological) and History. The source categories or concepts and their latent relationships are plotted in. The pins indicate the case studies — either a section (numbers) or paper (letters) — in which the corresponding relationships are explored. ‘Martime Logistics’ are conditioned by all three disciplines, not encompassing any source categories on their own, but conditioned by the relationships between the same. Three major parameters were identified: The importance of the spatiotemporal context for the study of ship-types and shipbuilding traditions, meaning that one type of ship may have meant something different at different places or different times. Although navigation and seaborne trade are often mixed together, it is considered important here to distinguish basically between a communications and a mercantile network. The first involves the geographical knowledge, access to a pilotage system and the aptitude to communicate geographical knowledge, and the second defines the maritime transport system, the stream of goods and people.

**1.2.2. The ‘Northern Crusades’ — An ahistorical construct or legitimate term?**

Since Pope Urban II’s call in 1095 for the liberation of Jerusalem, crusading has normally been exclusively associated with Jerusalem. This exclusive definition has been relativised in the 1970’s by Jonathan Riley-Smith, who fundamentally changed the perception of how we regard crusades today. He laid the foundation for an inclusive definition, which included also crusades in Spain, not only against Muslims, but also against pagans or heretics in north-eastern Europe,

where a just war against the enemies of Christendom played a superordinate rule to conventional warfare, not only in terms of an ecclesiastical mission, but also the concerted nature of papally authorised warfare. According to Riley-Smith, the precondition for warfare against pagans being defined as crusade outside the Holy Land was that it received legitimate authorisation by the pope, was proclaimed in the name of God, included a kind of vow of ‘pilgrimage’ by the participants of the crusade, and that the participants were granted indulgence, i.e. the remission of sins (Riley-Smith 1977, 74).

However, the definition of a crusade is still discussed and unclear. It is so ambivalent that even some

historians do not make the effort to narrowly define it. In fact, even in medieval times there seemed to be no consensus of what a crusade actually was, due to the contradictory and self-referential rhetoric of the organisers and chroniclers, so that a crusade can have lots of meanings at different times (Tyerman 1998, 125). Although the vagueness of the crusading concept is at odds with its perceived prevalence in medieval history, it is not really surprising, as there was no contemporary term for ‘crusade’ originally, neither in Latin nor the vernacular. Although the term *crozada* was used in southwestern France and Spain in the early 13<sup>th</sup> century, it remained unusual (Constable 2008, 350) and it was commonly referred to as *expeditio* or *peregrinatio* by 12<sup>th</sup> and 13<sup>th</sup> century chroniclers — the first can refer to a war campaign in general and the second refers to a voyage or a pilgrimage (cf. J. M. Jensen 2000, 288; Lind et al 2006, 18). A pilgrimage is often implied in ‘voyage’ like in the Old Norse term *jorsalafærd* — a pilgrim voyage to Jerusalem (Nørøxe 2009, 15), or the term *reys3* was used for the annual raids of the Teutonic Order into the Lithuanian territory in the 14<sup>th</sup> century (cf. Paravicini 1989).

To this day, the use of the crusading terminology is contested. Yet, the central role the papacy played as an intergovernmental instance is well documented. Its uniting and moderating influence on — often disaccording — Catholic factions is reflected by the surviving letters which the Pope sent in reply to (unpreserved) correspondence from various actors of the Baltic crusading movement (Jensen *et al* 2001). The papacy can be almost perceived as a clerical precursor of the European Union, which exerted its influence into the periphery of the Catholic world — monastic outposts in frontier zones. Nils Blomberg found an elegant way to avoid the problematic ‘crusade’ term while at the same time acknowledging the central role of the papacy and the significance of the Scandinavian kingdoms as new members of the Catholic entity: He equated the Catholic World-System with a “Europeanisation process” (Blomkvist 2005). This defines Europeanism in terms of a religious common denominator, undoubtedly a — if not — *the* unifying factor of western and central European medieval identity, but obviously not above criticism either. In his benchmark monograph “The Northern Crusades” — first published in 1980 — Eric Christiansen makes use of the crusading terminology with little attempts to provide a tighter definition. In one instance, he generically defined it as cultural transformation process which brought about a common ‘Latin’ civilization. He points out that the originally colonial societies in the Baltics are historically still linked to western Europe, even after the fall of the Iron Curtain (cf. Christiansen 1997, 3). Christiansen viewed the ‘Northern Crusades’ in a very inclusive sense, as an umbrella term for many

different campaigns conducted by almost all middle and northern European Catholic factions against non-Catholics in the Baltic Sea area, starting with the Wendish Crusades (1147-1185) conducted by Danes, Germans and Poles, the Baltic Crusades (1198-1290) conducted primarily by the Danes and Germans and to a lesser extent the Swedes, the Prussian Crusades conducted by the Teutonic Order (1230-83), as well as the latter’s warfare against the Lithuanians (1280-1435) and against the Greek Orthodox Russians who did not qualify as “real Christians” in the eyes of Catholic Europeans (1242-1500). In the wider sense, the Swedish campaigns (ca. 1142-1293) against the pagan Finns, Karelians and Russians and the Norwegian campaigns against the Sami, Karelians and Russians (1323) can be also regarded as part of the Northern Crusades, although the early Swedish campaign under King Eric IX of Sweden is of legendary character and its status as crusade is contentious.

Also the time frame is very inclusive, beginning in the year 1147 and ending with a crusade against the Russians in 1505. Both war campaigns have been expressly authorised by the pope. The first was issued in 1147 by Pope Eugenius III in the bull *Divini dispensatione*, referring to the wars “*contra Sclavos ceterosque paganos habitantes versus Aquilonem ire, et eos Christiania religioni subjugare*”, setting a precedent, in which a third major crusading front — after those of the Holy Land and the Iberian Peninsula — was opened up in northern Europe. The mandate remained inexplicit about its actual aims, aside from the conversion of the Slavs (Fonnesberg-Schmidt 2007, 37).

Can the precedent call for a crusade in 1147 be seen as a “blank” papal authorisation to conduct warfare against pagans in northern Europe in successive years, or did each major campaign require individual authorisation? In recent years, historical research on the crusades in northern Europe has flourished in Danish academia. This basic question, however, divided Danish historians into two camps, continuing the crusades in a battle of words ever since.

One group of historians has a very inclusive view — arguably even more so than Riley-Smith — in that all wars fought with papal authorisation against the enemies of the church were promised indulgence and could be therefore considered crusades (cf. Lind *et al* 2006, 22). This group also stressed that the motives of many of the participants of a crusade were genuinely religiously motivated and not merely a smokescreen for secular and material gains (J.M. Jensen 2007, 14), which may be indicated by the fact that no colonisation or lasting conquest ensued after the first campaigns (Wille-Jørgensen 2003, 27).

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<sup>3</sup> similar to the present German word for voyage, i.e. *Reise*



Fig. 1-2. King Valdemar I and Bishop Absalon's conquest of Arkona in 1168 glorified in a historicist painting by Laurits Tuxen (1853-1927). It shows the toppling of a pagan idol — the three-headed deity Svantevik venerated by the Rani (Rugian Wends) — after the fall of Arkona. Danish historians are in disagreement whether this conquest can be defined as crusade.

This notion has been criticised by members of the other group: Anders Bøgh scrutinised the — in his opinion — too liberal use of the term crusade regarding the Danish wars in the Baltic Sea following the 1147 crusade. He pointed out that the papacy was not actually involved in authorising any war campaigns until 1204, with the exception of a campaign to Estonia around 1171 (Bøgh 2008, 176). Thus, he sees no reason to equate 12<sup>th</sup>-century Danish warfare in the Baltic Sea with the crusades in the Holy Land, even though conducted against pagan Wendish populations, notably the conquest of Rügen in 1168 (Fig. 1-2) and the subjugation of the Duchy of Pomerania in 1184, which Bøgh sees primarily in the context of territorial expansion rather than a religious war (Bøgh 2008, 176). It was also pointed out that there is no evidence that King Valdemar I of Denmark sought papal approval for his campaigns against the Wends, by having them officially legitimised as crusade. This may be a reflection that it was part of his expansion policy, rather than lands to be won in the name of the church (Nørøxe 2009, 110ff.).

Nevertheless, a permanent colonisation was insured by systematically baptising the pagan population, which bears the mark of a crusade, especially if compared to Pope Eugenius' original authorisation

— *eos Christiania religioni subjugare* — of the 1147 crusade. Was this papal authorisation “stretched out” to include all campaigns against the Wends in the following years, or even decades?

The notion of a perpetual crusade may be reflected in the characterisation of King Valdemar I of Denmark's reign, who has been described as *pacis conservator* – the preserver of peace – upon his death in 1182. But in order to have it – the peace – preserved, it needed to be defended against the pagan Wends in a perpetual war (Jensen 2009, 141). Although one may disagree about the ambivalent meaning of this term, the notion of a perpetual crusade is also corroborated by more tangible evidence from the German crusading movement to the Baltics, namely by the letters sent by Pope Innocent III – especially *Etsi verba* of 1204 – addressed to the archbishop of Bremen. It bears the notion of a “perpetual crusade” against the pagan Slavs in a sense that it became unnecessary to ask the pope for the remission of sins for each crusading campaign to the North (Unger 2006, 272). At that time, Hartwig von Uthlede was the archbishop of Bremen and was the main initiator of the Livonian Crusade together with his nephew Albert von Buxhoeveden, who had become the Bishop of Livonia in 1199. In December of the same year, Albert was signing on participants for the

Livonian crusade in Magdeburg in the presence of the new king. On this occasion the question was posed whether the pilgrims to Livonia received the same protection as those travelling to Jerusalem, specifically a remission of sins, which was confirmed, as reported by Henry of Livonia (HCL III.5). However, the bishop may have overplayed his authority at this point, as is exposed by his later continued efforts for official papal recognition. Pope Urban II eventually acquiesced to grant Livonia the status as the homeland of the Virgin Mary, which was officially concluded at the 4<sup>th</sup> Lateran Council in 1215

(Johansen 1961, 231; Brumme 2010, 286). As such, Livonia became officially a place of pilgrimage, and – as noted above – a crusade was basically an armed pilgrimage. This association is even supported by archaeological evidence: A very uncommon type of a pilgrim's badge has been unearthed in 13<sup>th</sup>-century contexts from Lübeck and Gamla Lödöse, respectively, with the circumscription *Signum S Marie in Livonia Remissionis Peccatorum* (cf. Andersson 1989; Gassowska 2006, 151; Wittstock 1984, 16f.) (Fig. 1-3).



Fig. 1-3. Pilgrim's badge unearthed in Lübeck, bearing the inverted circumscription *SIGNUM S MARIE IN LIVONIA REMISSIONIS PECCATORUM* (transcription on the right). Cast in iron, measuring 6.5cm x 4 cm. Inventory number: 1953-36 (Photo: St. Annen-Museum, Lübeck, edited by the author).

Peter Schmidt points out that it was very uncommon to have a whole region as destination for a pilgrimage, rather than a shrine or holy site, and on this basis he doubts that these were pilgrim badges and re-interprets them as devotional objects (Schmidt 2009, 99). However, the aforementioned papally approved decision to grant Livonia "homeland-status" of the Virgin Mary clearly underlines the effort to elevate the Baltic Crusade in Livonia to a status akin to a conventional pilgrimage, which is emphasised by the *remissionis peccatorum* apposition in the badge. Paradoxically, the association to a pilgrim's badge was even made by Schmidt (2009, 99f.) himself, who observed that the Livonian badge emulates the design and figurative representation of the pilgrim's badge from Rocamadour, France. Rocamadour seems to be

spiritually closely linked to the Baltics, as a late 13<sup>th</sup> century pilgrim's badge from Rocamadour was unearthed in Tallinn (Johansen 1961, 230) and in 1312 three Rigaen citizens were sent to a pilgrimage to Rocamadour – the site of St. Amator's shrine of the Virgin Mary – in redemption for the killing of two Rigaen prelates: (...) *tres cives Rigenses ad s. Marie ecclesie de Rupe amatoris, pro redemptione animarum dictarum destinentur* (Bunge 1855, no. 637). The use of the Rocamadour badge (Fig. 1-4) as template clearly reflects the intent of having the Livonian badge recognised as pilgrim's badge as well.

Was this a shrewd make-believe assurance that a crusade to Livonia would meet the same "remission of sins" requirement as a more conventional pilgrimage? Albert von Buxhoeveden's ministry points into this direction.



*Fig. 14. A 13<sup>th</sup>-century pilgrim's badge from Rocamadour, France, unearthed in Tallinn, Estonia. Its circumscription reads SIGILLUM BEATE MARIE DE ROCAMADOR. This badge is believed to have served as template for the Livonian badge above (Photo: Johansen 1961, fig. 1).*

As the case may be in the specific circumstances, what is clearly demonstrated here is that some of the major initiators of the Baltic Crusades were eager to apply the crusading-label to their war campaigns by using the symbols, institutions and the spiritual leverage of a "pilgrimage industry". So the underlying question whether the term "crusade" can be rightly applied to the Wendish or Baltic campaigns is not necessarily conflicting, as religious and secular motives will have undoubtedly overlapped. Written sources — most of clerical origin — certainly do not reflect a true balance between religious and secular motives, at least not in any representational way (cf. Nedkvitne 2005, 47; Nørøxe 2009, 115). The political gains for territorial expansion at the expense of an old foe on opposite shores might have been the primary driving force for Danish conquests, but the promise of penance and the honour to have fought in the name of God might have made it possible to redirect streams of crusaders into a local conflict, in which the

Danish crown had a stake in. The same could be said for the German crusaders fighting for the Order of the Swordbrothers in Livonia and the Teutonic Order in Prussia and Lithuania. This may have even included the visiting English, French and other European nobles of the 14th and 15th century, who were partaking in the ritual-like campaigns of the Teutonic knights against the Lithuanians as some kind of "nostalgic adventure tourism" with a Christian touch; at a time when chivalry became gradually outdated but — as a consequence — romanticised (cf. Paravicini 1989). Many of these crusaders would have otherwise partaken in the crusades in the Holy Land, from which northern European sovereigns had nothing tangible to gain from, while it meant a less strenuous and costly alternative for a voyage to the crusaders themselves.

The absence of papal support in documented history for some of the earlier Danish campaigns does certainly not foreclose that these campaigns were advertised to its followers as something akin to a crusade. The attempt to narrow down the definition of an already ambivalent concept is somewhat ouroboric, especially if one is willing to acknowledge that the Baltic Crusades are an almost seamless continuation of the Wendish campaign in terms of a Danish long-term expansionary policy during the Valdemarian period. The links between the Wendish and Baltic campaigns have been stressed in this author's paper A.

Thus, in this thesis, a very inclusive definition of the term 'crusade' is taken. The 'Northern Crusades' is used in a similar way as laid down in Eric Christiansen's benchmark publication (1997), although in an even more inclusive sense, as the time frame is expanded to the year 1561, which marks the dissolution of the Livonian Confederation as the last remaining crusader state.

The period of the Northern Crusades was not chosen, because it is considered important to distinguish between different forms of pennital warfare and their legal status, but as a convenient umbrella term to characterise a historical epoch, in which several middle and northern European factions sent large fleets across the Baltic Sea, not only for conquests in the name of Catholicism, but also for the foundation of new colonies, the "export" of middle European urban culture into the "pagan wilderness", and the establishment of new arteries of trade in its wake. What is deemed important here is the frontier zone aspect of the crusades in the north, the clash of different world-systems divided by the sea, and human ingenuity to overcome the challenges of this element, to put it into abstract terms.

### 1.3. Methodology

The requirements of navigation in remote waters are distinctive to seafaring in domestic waters. Shipwrecks are often primarily interpreted by applying a ‘cultural lens’. Although shipbuilding traditions may indeed reflect a cultural imprint, more or less, there is also a case to be made for an entirely different approach, in which the requirements of seafaring are evaluated in a socio-economic context. There are two major studies, where this approach has been implemented, namely Jan Bill’s study on *Small Scale Seafaring in Danish Waters AD 1000-1600* (1997) and Anton Englert’s study on *Large Cargo Ships in Danish Waters 1000-1250* (2015). The first highlights aspects of the domestic — often informal — coastal trade, and the latter — in stark contrast — the early professional long-distance trade of large vessels. Ship-construction reflect not only a culturally inherited shipbuilding tradition, but were also built and fitted out to operate in a designated environment. Such an approach shall be taken in this work with regard to long-distance seafaring into frontier zones within the context of the Northern Crusades.

This dissertation contributes to the field of Historical Archaeology, and as such, two major fields are involved, which are methodologically very dissimilar. Although historians and archaeologists often deal with the same subject matter, the research questions, use of sources, avenues of interpretations and scopes vary considerably.

The angle of enquiry is primarily archaeologically, and only secondarily historical. Historical literature — chiefly secondary — are adduced for the interpretation of archaeological contexts, except in cases where primary literature is of direct relevance to the theme, like Henry of Livonia’s chronicles written between

1225 and 1228, believed to have witnessed many of the events as a member of the clergy involved in the Baltic Crusades (Reisnert 2009, 54). However, historical scholarship is treated in this work as an auxiliary discipline, thus it cannot be purposed that this work contributes an original debate to the historical field. Nevertheless, the archaeological record puts selective spotlights on historical questions, in some cases corroborates, in other cases dissents from historiographic narratives.

Given the extensive time frame and geographical scope, this study will have to be constrained on individual case studies where the archaeological record is meaningful enough to illuminate aspects of the general theme of maritime logistics in the age of the northern crusades. Thus, the northern crusades cannot be presented as an exploration of a single coherent theme, but will assess a number of aspects with a varied relevance to the general theme. The method of enquiry varies with each respective case study, which is geared to answer trends of contemporary maritime developments on the one hand, while being dependent on the highly different availability of written sources and data from archaeological sites on the other hand.

A core concern is to highlight the interpretative potential of shipwrecks by not solely breaking them up into discrete case studies on constructional and technical details on the one hand, and cargo carriers on the other hand, but to consolidate that all aspects — including their location and circumstances of their deposition — need to be understood in order to fully comprehend maritime logistics.



## 2. THE BALTIC SEA AS A MARITIME LANDSCAPE

The Baltic Sea region is the theatre of the Northern Crusades. Its eastern and southern shores were inhabited by the last pagan nations of the European continent, against whom Pope Eugenius III opened a third crusading front in 1147. Many of the principal initiators and participants of the Northern Crusades, as well as the colonists and merchants that followed in their wake, were of Middle European descent however. This raises the question of how they gained access to the Baltic Sea (section 2.3). But more fundamentally, what were the environmental particularities imposed by the natural physical landscape (section 2.1.) and how were these appropriated in terms of transport geography (section 2.2)?

Maritime logistics cannot be discussed without an understanding of these aspects. On the one hand, the natural physical landscape determines the usefulness of navigation techniques. These are influenced by topographic features, such as landmarks, as much as by hydrographic features, such as shoals or different sediment regimes, which reveal an approximate position even with no familiar landmarks in sight. On the other hand, transport history was not only influenced by the natural physical landscape, but also anthropogenic factors, which influence the evolution of transport corridors by the control of strategic bottlenecks. Urban archaeology often illustrates the longevity of places by identifying settlement horizons

### 2.1. The physical landscape

The Baltic Sea region is a unique landscape in many respects, shaping human interactions with its environment in ways directly owed to the particularities of the landscape. For this reason, the physical landscape shall be briefly described as maritime archaeological find contexts cannot be interpreted without the bigger landscape picture.

The Baltic Sea is a semi-enclosed sea with a surface area of about 386.000 km<sup>2</sup>, giving access to a vast catchment area of 1,745,000 km<sup>2</sup> (Håkanson *et al.* 2003, 127; Tuuling *et al.* 2011, 5) (Fig. 2-1). It is noticeable, that no western European river discharges into the Baltic Sea, which abbetted its genesis as a fairly isolated and self-contained transport zone, as shall be stressed in section 2.3. Rivers have formed important transport arteries throughout time, and this is particularly the case for the logistics of the northern crusades.

that could reach back centuries and even millennia. It is no different with routes or transport corridors, which often predate the towns they link, or caused their foundation or re-foundation in the first place. This can be said of Lübeck, built on the ruins of Lubice, or Stockholm as successive settlement to Sigtuna.

The street pattern in the inner cities with a medieval foundation date seem often random, yet they often followed former river courses that silted up, and other topographical features that are no longer preserved in the landscape. The same applies to the transportation networks connecting the cities although its archaeological potential is much less apparent than settlement horizons, especially those at sea, which often only come to light where they articulate with land, and are often only preserved in toponyms indicating portages (e.g. *draget*), landing sites, shipbuilding sites or sites of naval conscription (e.g. *snekke* as leding-toponyms). For this reason, maritime logistics cannot be studied in isolation from terrestrial archaeology – especially settlement or urban archaeology – as these were the nodes where transshipment occurred. For this very reason, a study of the economic histories of port cities as centres of production and transshipment will be taken into account whenever discussing the cargoes of shipwrecks.

The Baltic Sea is comparably shallow. One of the shallowest areas is the Danish straits with depths of 12 m, the Gulf of Riga with a modest depth of 26m and the Gulf of Finland with a depth of 37 m. Although there are exceptions, like the Gotland Deep and the Landsort Deep reaching the maximum depth of 459 m, the Baltic Sea is comparably shallow with average depths of 50 m (Tuuling *et al.* 2011, 5f.). This is owed to the fact that it is geologically not an ocean that divides continents, but an inland sea "lying" on top of a continent. Therefore, it would be akin to a large lake, if not for an intricate system of straits – the Little Belt, the Great Belt and the Øresund – connecting it with the North Sea. Its short geological history of only a few thousand years after the last glaciation is the reason for the formation of the largest archipelago in the world (Håkanson *et al.* 2003, 121).

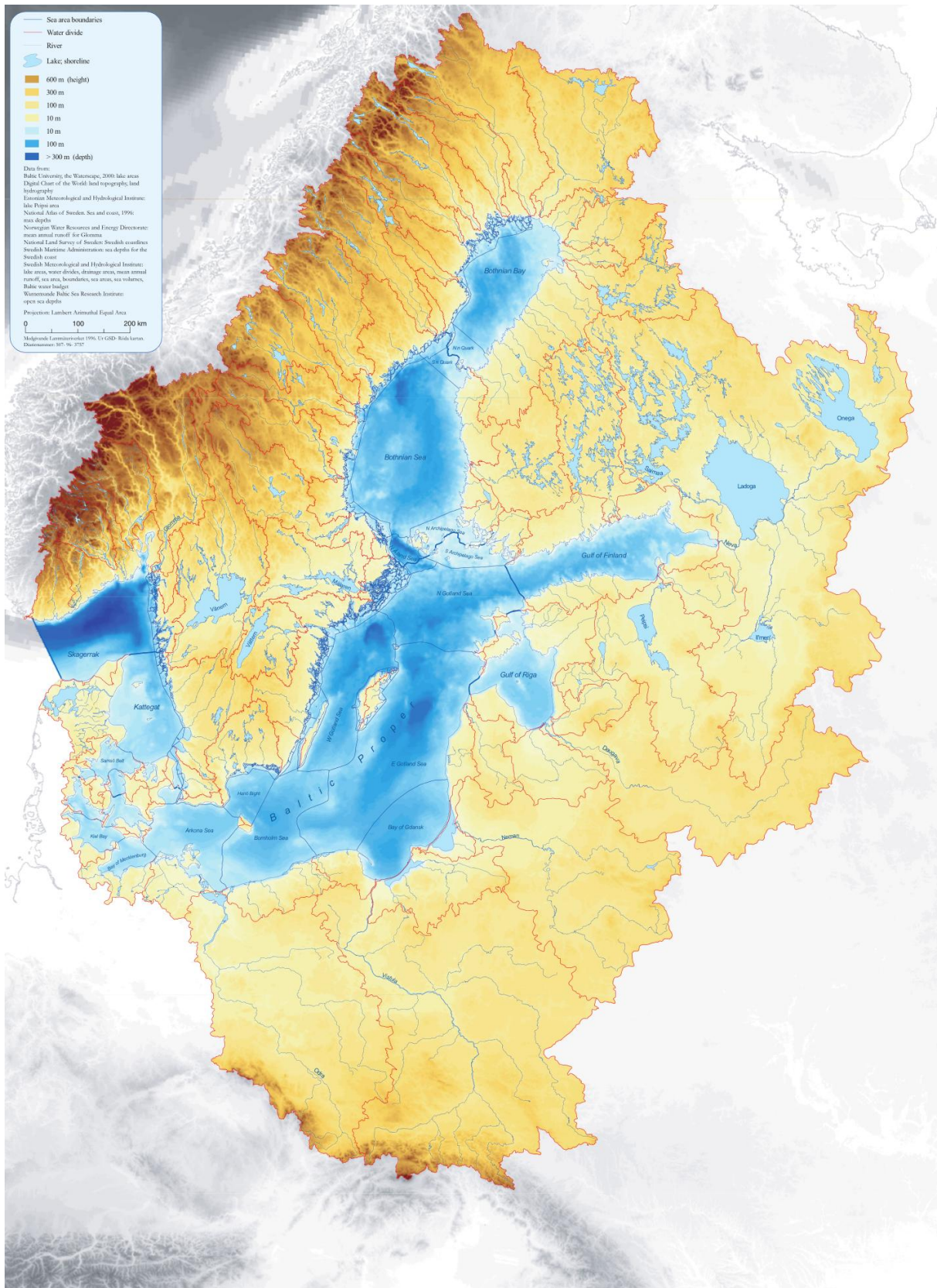


Fig. 2-1. Baltic sub-regions and drainage basins, including depth and elevation information (Source: Swedish Meteorological and Hydrological Institute).

Due to the semi-enclosed state of the Baltic Sea, the water body is brackish, meaning that it is neither fresh nor marine water, but a salt concentration in between. This is principally caused by 660km<sup>3</sup> of fresh water inflow from over 250 water courses – the largest being the Vistula, Neman, Daugava and Neva – as well as the limited water exchange at the Danish Straits. The same act also as tidal node together with the wider region of the Skagerrak and Kattegat, preventing tidal waves from entering the Baltic Sea. Thus the tidal range is almost non-existent and negligible (Håkanson *et al.* 2003, 123). This had a considerable effect on harbour architecture and navigation. The first could be accessed at all times and not only high tides, and the tidal range did not have to be taken into account in the jetty construction and other coastal infrastructure, such as dykes. Tidal currents are also negligible in the Baltic Sea, although currents are still formed by prevailing wind patterns. However, these were not as powerful as in the North Sea, so the Baltic Sea is a less challenging – if not benign – maritime environment

compared to the North Sea area when it comes to the practicalities of seafaring.

The Baltic Sea was formed by glacial processes of the Quarternary, which shaped the surface of Precambrian rocks of the Fennoscandian Shield by glacial erosion, while the lowlands of the Russian Plate and West European Platform are covered by glacial sediments (Harff *et al.* 2005, 442). This is largely owed to the post-glacial rebound (alternatively also referred to as glacio-isostatic rebound or post-glacial uplift) in which the land mass formerly under the weight of the ice shield becomes an uplift – a regression – zone, while the periphery counters this formation by a land decrease – forming a transgression zone (Fig. 2-2). Thus, ancient coastal settlements sites in – broadly speaking – Fennoscandia, are moving further away from the coastline, while ancient coastal settlements sites in the south-western Baltic Sea are becoming gradually inundated. Naturally, this affects the archaeological record drastically.

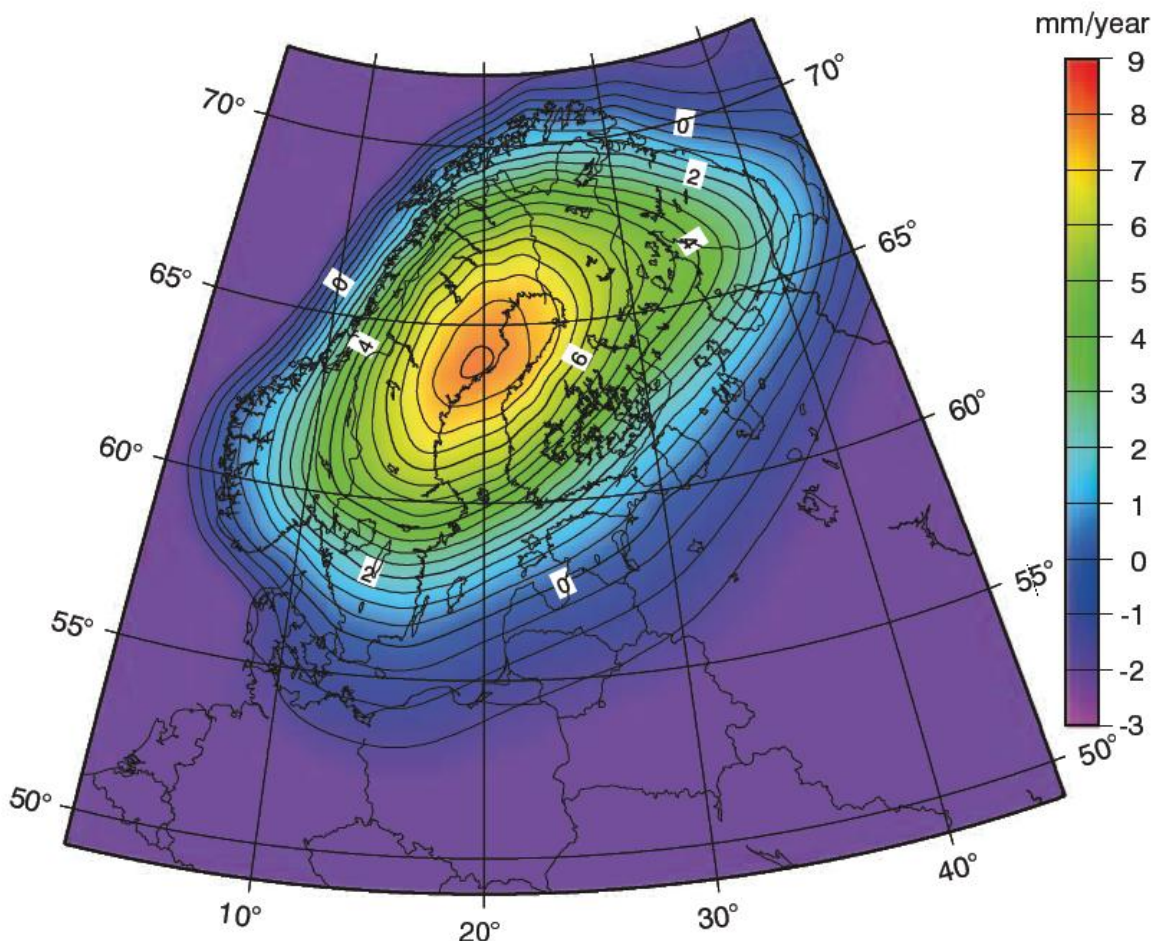


Fig. 2-2. The contour lines (mm/year) indicate the annual postglacial rebound (Source: Ågren & Svensson 2007, fig. 4.3).

Another factor important for navigation is the coast type, with great differences between the topographical and hydrological characteristics node (cf. Håkanson *et al.* 2003, 136). The Baltic Sea's

western and northern coastline is predominated by archipelagos, while the southern and eastern coastline by open sandy coasts and lagoons in the estuarine regions (Fig. 2-3).

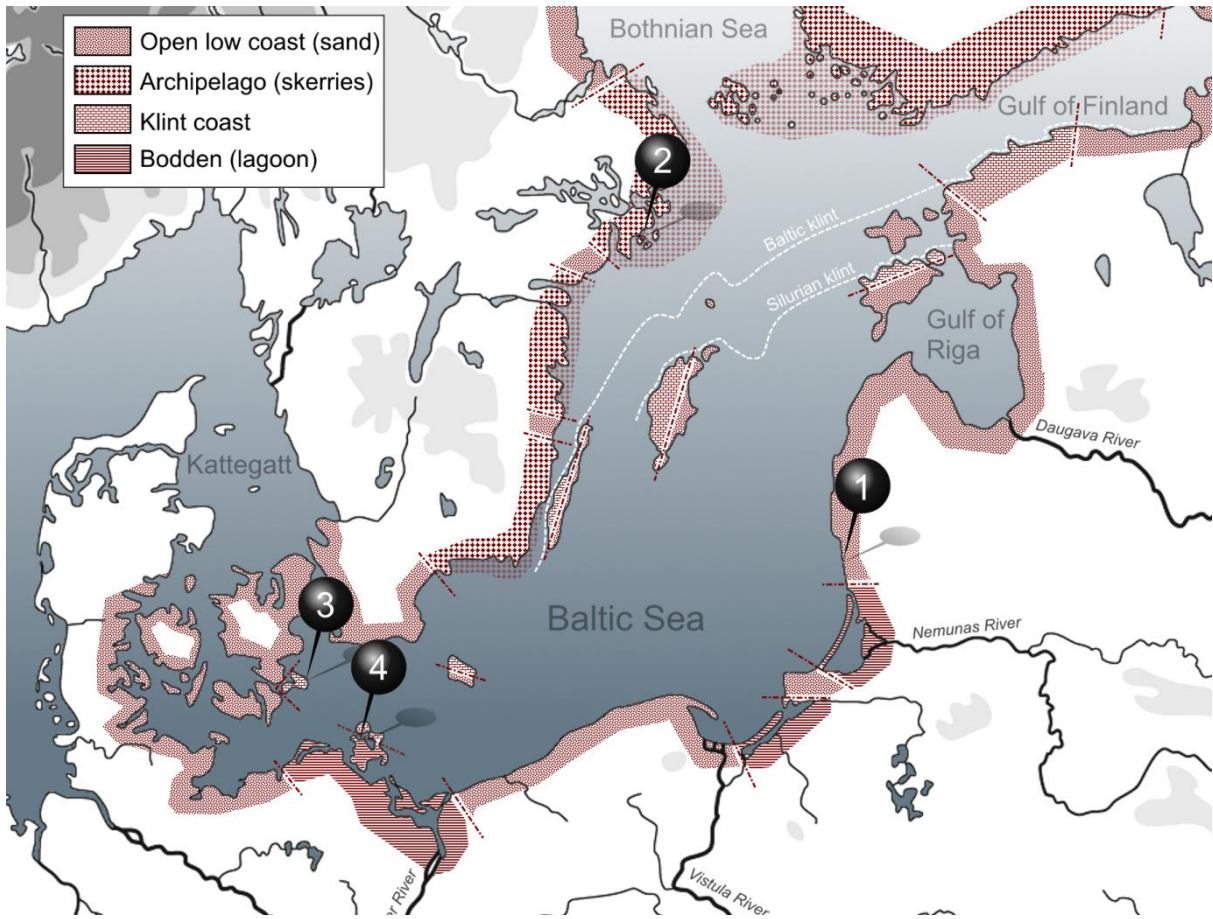


Fig. 2-3. The four principal coastine types of the Baltic Sea: (1) Open sand coast, e.g. Karklė, Lithuania, (2) Archipelago, e.g. Järflotta, Sweden, (3) Klint coast, Mon, Denmark, (4) Bodden, e.g. Schaprade Bodden, Germany (Graph: Daniel Zwick, partially based on Voipoi 1981 with own modifications. Photos: 1,3,4: Wikimedia Commons, 2: Daniel Zwick).

Particularly the Baltic and Silurian klint lines formed by Cambrian-Ordovician escarpments are the most remarkable, extending from Gotland, via the north-western part of Saaremaa to northern Estonia (Fig. 2-4) (Tuuling *et al.* 2011, 7f.). The western part of the Baltic is flanked by chalk cliffs on the islands of Møn, Sealand (Denmark) and Rügen (Germany). As will be discussed in further detail in the following section, the different coast types, particularly klint coast, were of imminent importance for terrestrial navigation.



Fig. 2-4. The Udria cliff forms the easternmost extend of the Cambrian and Ordovician North Estonian Klint (Source: Tuuling *et al.* 2011, 24).

Basically, three principal coast types prevail: The north-western coastline is characterised by archipelagos, the central part is characterised by cliffs or klints, and the south-eastern coastline is characterised by low coasts and lagoons. These principal zones in the visible topography are to a certain extent reflected – or rather continued – under water, as indicated by a concurrent alignment of the predominant sedimentary cover (Fig. 2-5). Leaving aside the insights the sediment cover can give on the geological history, the noteworthy aspect in this context is the fact that some of the sediment types could be easily distinguished by the eye, e.g. sandstone sediments stained red by oxidised iron minerals in the southern Baltic Sea (Tuuling *et al.* 2011, 16f.). The significance of visibly different

sediment types will be taken up in the following section. Moreover, sediment covers and transport are also affected by the abovementioned post-glacial rebound. As the land rises, new bottom areas are exposed to waves, washing out nutrients contained in the old sediment layers (Håkanson *et al.* 2003, 123).

Another aspect of sediment deposition concerns a modern development. Due to the human-caused eutrophication of the Baltic Sea since the intensified industrialisation since the 1940's, the deposition of anaerobic sediments is no longer confined to stagnant and deep bottoms, but a much more extensive area (Håkanson *et al.* 2003, 144). While these oxygen-free sediments are toxic to all higher life and present an ecological hazard, this negative influence has a positive side-effect as far as organic archaeological finds are concerned, now preserved by an anaerobic environment, halting biological deterioration. However, once cleared of the sedimentary cover, archaeological finds are gradually more under threat, as the *teredo navalis* population (i.e. the naval shipworm destroying wooden constructions such as shipwrecks) is spreading in the Baltic Sea. Due to increased salinity levels in the Baltic Sea, which are a precondition for *teredo navalis* habitats, wooden constructions are being under threat, particularly the underwater archaeological record.

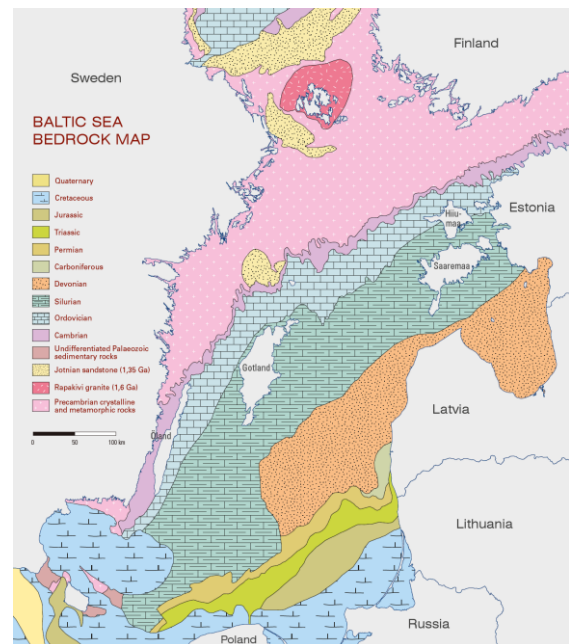


Fig. 2-5. Distribution of rocks of varying ages in the Baltic Sea (Source: Tuuling *et al.* 2011, 18).

## 2.2. The anthropogenic landscape

Many of the above described environmental characteristics can be directly linked to expressions of adaptive human behaviour, which in its sum has abetted a distinctive maritime culture of the Baltic Sea's coastal populations. Many of these cultural expressions have been observed as early as the 16<sup>th</sup> century by the Swedish Catholic ecclesiastic Olaus Magnus, who portrayed a compendium of folklore around the Baltic Sea in his *Historia de gentibus septentrionalibus* – the history of the northern people – published in Rome in 1555. It allows an invaluable glimpse of many customs that are corroborated by historical, ethnological and archaeological evidence. Factors with a maritime relevance that can be specifically linked to the Baltic Sea as geographical and geological entity shall be presented in the following.

### 2.2.1. Fishing

Due to the abovementioned post-glacial land rise, new bottom areas are exposed to waves, washing out nutrients contained in the old sediment layers (Håkanson *et al.* 2003, 123). These nutrient-rich sea-floors have led to extensive fish populations in large parts of the Baltic Sea and made it a major source of sustenance and allowed the colonisation of bleak coastal lands with few arable areas. Due to the brackishness, the Baltic Sea is home to both salt and fresh water species. The most important fishing grounds were however not located in a region affected by land rise, but the greatest shoals of spawning herring were found near the towns of Skanör and Falsterbo (Fig. 2-6), but also in Bohuslän, Rügen (cf. Jahnke 2000). All these regions belonged to the Danish kingdom for much of the period discussed here. The environmental criteria – i.e. the

rich fishing grounds – can be arguably only perceived as precondition, but not as actual driving force for the growing importance of the Scanian market. Long before the grand-scale commercial exploitation of herring for international trade, it supplied the Danish markets. In Hedeby – the Viking predecessor settlement to Schleswig – herring contributed to 38 % of all nearly 14,000 identified fish bones from the settlement horizon from 800 to 1066 (Hoffmann 2008, 54).



Fig. 2-6. The richness of the fishing grounds near Skanör and Falsterbo were legendary, illustrated – somewhat exaggerated – by Olaus Magnus, claiming that herring came in such numbers that a halberd would remain standing when stuck into the sea (Source: Magnus 1555, lib. XX, cap. 28, ed. Granlund 2010, 973).

But what was the trigger for the growing international importance of the Scanian fisheries and markets? An explanation is provided by a contemporary, Arnold von Lübeck, who refers to the Scania market for the year 1183:

*(...) siquidem Dani usum Teutonicorum imitantes, quem ex longa cohabitacione eorum didicerunt, et vestitura et armatura se ceteris nationibus coaptant; et cum olim formam nautarum in vestitu habuissent propter navium consuetudinem, quia maritima inhabitant, nunc non solum scarlatto, vario, grisio, sed etiam purpura et bisso induuntur. Omnibus enim divitiis abundant propter piscationem, que quotannis in Scania exercetur, ad quam omnium circumquaque nationum negatiores properantes aurum et argentum et cetera quaque preciosa illuc deferunt, et comparatis hancibus eorum, que illi gratis ex divina habent largitate, quasi pro vili quodam commercio sua optima, nonnunquam etiam se ipsos naufragando relinquunt. (Arnoldi Chronica Slavorum III. 5).*

*(...) The Danes, who imitate the customs of the Germans and who have become familiar due to their long cohabitation, affiliate themselves to the other [Catholic] nations in their clothing and weaponry style, while they had otherwise been dressed like mariners, as they, inhabiting the shores, were at all times engaged with ships, are now clothed not only in scarlet, in colourful and grey pelts, but also in purple and fine linen. All have become very rich due to fishing, which is done each year in Scania. Merchants from all surrounding nations are coming here with gold, silver and other valuables to buy their herring, which they have received from God's grace, while merchants bargain for the best deals and occasionally lose their lives in shipwreck. (own free translation).*

Arnold praises the cultural appropriation and self-identification of the Danes with the "other nations" in their clothing style and other customs, including their refined knowledge (not in this excerpt) of

ecclesiastic matters and canon law. With this he could have only meant the Christian nations. Catholicism formed the common denominator of a shared value system, which was certainly regarded as a stabilising

factor – if not precondition – for a common market. This marks a drastic change in perception, as Adam von Bremen referred to the Danes – only a century earlier – as pirates or *Witbingos* (Vikings), engaged in constant naval warfare with other barbarians (*Gesta*, IV 6). This would have been a very destabilising factor for conducting trade and reflects that a landscape with rich natural resources alone does not automatically lead to thriving international markets, but that it can only occur in alignment to the mental landscape: a "common Catholic sphere" in this case, with a constant demand for fish during Lent.

The rise of the Scanian markets were abetted by other external factors, namely special gutting techniques (Hoffmann 2008, 54) and salt supply. While the rough marine climate of the North Atlantic coast allowed Norwegian fishermen to preserve their catch by air-drying it (called stockfish because it was dried on stocks) and sold as early as 1100 to exporters via Bergen (Nedkvitne 1993, 195), the preservation of Baltic herring at the Scania market was dependent on salt supplies from Lüneburg, exported via Lübeck. The rise of the Scanian markets and of Lübeck were intricately intertwined, and accelerated the German influence in the Baltic Sea area via Lübeck, which will be further examined in section 2.3.4.

The extent of the fisheries is indicated by a visiting French crusader describing the Scanian fisheries as nothing less than a "wonder", estimating 40,000 fishing boats and 300,000 people engaged in the fishing industry (Etting 2004, 39). While this might be an exaggeration, the Scanian fish market remained of central importance for centuries, with 120,000 tuns of salted herring in 1368 and 100,000 tuns in 1537 (Postan 1987, 250). The historical inventory of the latter date – 1537 – highlights the validity of Olaus Magnus' near contemporary observation (Fig. 2-6), although this was certainly an exaggeration too.

### 2.2.2. Navigation

The prevailing navigation techniques can be directly linked to the natural physical landscape of the Baltic Sea. As noted above, the absence of a tidal range and thermic gales makes this sea a relatively unchallenging environment for seafarers. This seems to have halted the necessity for innovation in navigation techniques and can be understood in cultural evolutionary terms: It was observed that some archaic methods in boatbuilding are preserved in environments where the selection pressures are low, like inland waters and rural areas (paper B, 49). The same could also apply to navigation techniques, which remained

rudimentary in the Baltic Sea, not only because of the relatively benign environmental conditions, but perhaps also because it was seen as the *Hausmeer* (home sea) of the Hanseatic League, where it kept its competitors at bay in the long-distance and bulk trade. Its long-lived regional economic hegemony might have abetted an unwariness towards important progress in shipbuilding and navigation. As concluded in paper E, the Hanseatics lagged behind in adopting the carvel shipbuilding technique and continued to build large clinker vessels. The lagging behind in navigation techniques was also noted by southern Europeans. The Venetian Fra Mauro noted in his map of 1458 the Baltic mariner's particularity to use the sounding lead instead of chart and compass as local peculiarity (Fig. 2-7). This is also corroborated by an observation made by the Spaniard Francisco de Eraso in 1578/79, stating that Baltic Sea mariners had neither chart nor compass, but a small book instead (Sauer 1992, 269). The latter refers almost certainly to a compilation of navigation guidelines, of which two major manuscripts have survived, colloquially known as the *Hansisches Seebuch* (Hanseatic Sea Book). While the manuscripts themselves date around 1470, they are copies of a much older original. Contextual information suggest that the Sea Book was compiled between 1300 and 1346 (Sauer 1996, 52). It confirms the truthfulness of the southern Europeans' impression that the sounding lead was of utmost importance in Hanseatic shipping. The Hanseatic Sea Book contained 139 depth figures in manuscript A and 176 in manuscript B, covering depths between 1 and 80 fathoms (Sauer 1996, 119). A fathom corresponds to 1.83 metres, thus – theoretically – a maximum depth of 146.4 metres could be sounded. Given the overall shallowness of the Baltic Sea, with an average of 50 metres, almost the entire sea bottom could be sounded. Interestingly, the depth figures for the Baltic Sea are few, e.g. noting that the island of Karlsö off the Gotlandic shore should be passed at no less than 12 fathoms and Gotska Sandön at 19 fathoms (Hanseatic Sea Book, manuscript B, folio 27v, XII 41), arguably as a precaution to not run aground when passing the islands too closely. This seems strange at first glance, since these islands were prominent enough features to keep a safe distance by eye-sight. A possible explanation could be haze, night or other obstruction of visibility conditions. Depth sounding became almost an art in Hanseatic shipping and was of such importance that the loss of *lyne und loth* (line and sounding lead) prevented a Danzig skipper in 1449 to leave the harbour, while an English inventory of a formerly Hanseatic ship from 1414 recorded – amongst other things – four sounding leads and a spare sounding line (Sauer 1996, 119).

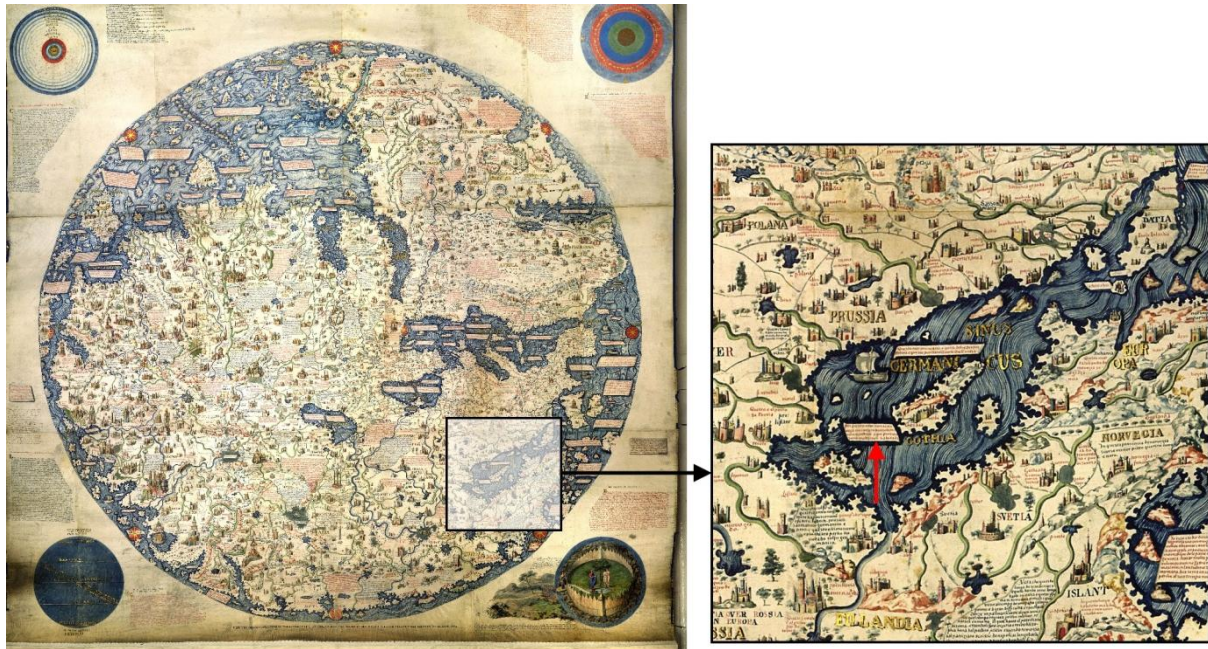


Fig. 2-7. A reproduction of the Venetian Fra Mauro's *Cosmographus Incomparabilis* (1458), showing the known world (Africa, Asia and Europe) including the new Portuguese discoveries along the African coast. The map is one of the latest T-O maps and oriented upside down. The excerpt shows the Baltic Sea (Sinus Germanicus) with a square-rigged vessel. As stressed by this author (paper E), southern Europeans perceived the square-rig as distinctive northern European feature. The map shows a wide variety of vessels meant to illustrate differences of local ships. Between the islands of Gotland (Gothia) and what can be only Saaremaa is an inscription "Per questo mar non se navega cum carta ni bossolo ma cum scandaio", i.e. in this sea one navigates without chart and compass, but with a sounding lead (Source: William Frazer: *London and Venice*, 1804 Manuscript on vellum: BL Add. MS 11267, <http://www.bl.uk/magnificentmaps/map2.html>).

There is also evidence from the time of the Second Crusade and the Wendish Crusade in 1147 that a German-English crusader fleet on the way to the Holy Land determined its position off the Bretagne coast at a sounding depth of 75 ells (45m) and the colour of the water (Sauer 1996, 119). Water colour changes in estuarine regions with the discharge of rivers with a distinctive sediment regime. Sounding leads from the time must have had an opening or an adhesive (like wax) with which a sediment sample could be brought to the surface. The Hanseatic Sea Book indicates that the position was determined not only by sounding the depth, but also by determining the sediment type. Off the southern Brittany coast with various depth soundings between 40 to 70, there is a section where the position relative to the land and offshore island is given with reference to the colour and grain size of the sediment, ranging from fine-grained sandy mud, red sand, or coarse red sand and black gravel, or silty white sand with white shell fragments and small lengthy particles (Hanseatic Sea Book, manuscript B, folio 27v, X. 27-38).<sup>4</sup> In some cases these positions were several miles off the coast, which might have been out of sight in hazy conditions. Although similar details on sediment types are lacking for the XII chapter of the Hanseatic Sea Book – i.e. the chapter covering the Baltic Sea – there is a distinct possibility that navigators took the

peculiar sediment regime into account, as described in section 2.1. The north-easterly orientation of the bedrock boundaries are corresponding to the transport zones of the Hanseatic Sea Book and a Danish itinerary, colloquially known as King Valdemar's Itinerary, which will be both discussed in further detail in the following sections. For now, however, it seems noteworthy that both occasionally include compass directions. At first glance, this seems to contradict the impression that compasses were very unusual. As a matter of fact, a rudimentary type of compass was known in northern Europe at least since the 12<sup>th</sup> century, mentioned in 1187 or 1190 in English literary references as a "makeshift" instrument (Sauer 1992, 260). The compass appears in German sources of the 13<sup>th</sup> century for the first time, and one source from 1252/55 in particular is revealing, noting that in case the night breaks or the stars are veiled, a needle is put into a barrel filled with water. A (load)stone attracts the needle, and when the stone is taken away "so wirt die nâlde des inein daz sie sich dicke umme drêt unde danne rebte bestet zugegin dem leidesterne" – i.e. the needle turns to the "guiding star" (Sauer 1996, 128f.). This reveals that the stars and the sun were used as rough approximates and the Old Norse term *leidarsteinn* (loadstone), which was used to magnetise the compass needle, seems to be derived from the similar sounding term *leidarstjarna* (Falk 1912, 16), a "guiding star" as in the above German source, meaning Polaris. But references of an actual compass on board are rare. In 1462 a Danzig ship

<sup>4</sup> a facsimile and transcription: <http://ww2.dsm.museum/seebuch/>



owner filed a complaint that his ship was taken by the Danish king, listing an inventory, which included a *compassze* and *segelsteyne* (HUB VIII, nr. 1160, 80). These kind of lists were filed with a hope of compensation, thus these devices must have been of some value and probably not very common, as compass references are extremely rare in Hanseatic correspondences or other contemporary lists. Although the impression of contemporaries that Hanseatic mariners in the Baltic Sea had no use for a compass and lagged behind the navigation techniques in the 15<sup>th</sup> and 16<sup>th</sup> century cannot be substantiated as exclusive claim, as compasses were known much earlier, it is certainly true that the compass would have been a rather uncommon device on board of a ship in the Baltic Sea. Nonetheless, the 13<sup>th</sup> century *Liber Census Daniae*, in which King Valdemar's Itinerary was compiled, features an 8-part compass rose, while a conventional 32-part compass rose forms the basis for the content of the Hanseatic Sea Book from the second half of the 14<sup>th</sup> century (Sauer 1996, 134). However, for the Baltic Sea, the Sea Book effectively uses only an 16-part division, e.g. from Södra Udde – at the southern tip of Öland – to Stora Karlsö – an island off Gotland's coast. It puts the course at NNE, i.e. north-north-east at 22,5° (XII,

43-44), which is fairly accurate with an actual deviation of ca. 2°. The deviation from the bearing point of Simpernäas to Osmussaar (*Hothenbolm*) is much greater, given as ENE (67,5°) but is 62° (Fig. 2-8). Thus, the cardinal directions are only approximate values and were probably meant to be followed by a rule of thumb – by using the sun and stars as orientation – rather than a compass. The practicality of such rule-of-thumb navigation is possible due to the landscape features of the Baltic Sea, where there are few areas completely out of land-sight. This is highlighted by the fact that both the Hanseatic Sea Book and to a lesser extent King Valdemar's Itinerary refer to points, which would have been ideally suited as landmarks, such as offshore islands and steep cliffs. Thus, scientifically advanced navigation with compass and portolan charts – as practised in the Mediterranean, the Atlantic coast and elsewhere – was not necessary. Even if a vessel got off course with a considerable deviation, the next landmark would have gotten within sight anyway and the steersman could have corrected his course. This can be demonstrated with a formula used to calculate the geometric horizon on the basis of earth curvature and the respective heights of the observer and the landmark (Fig. 2-9).

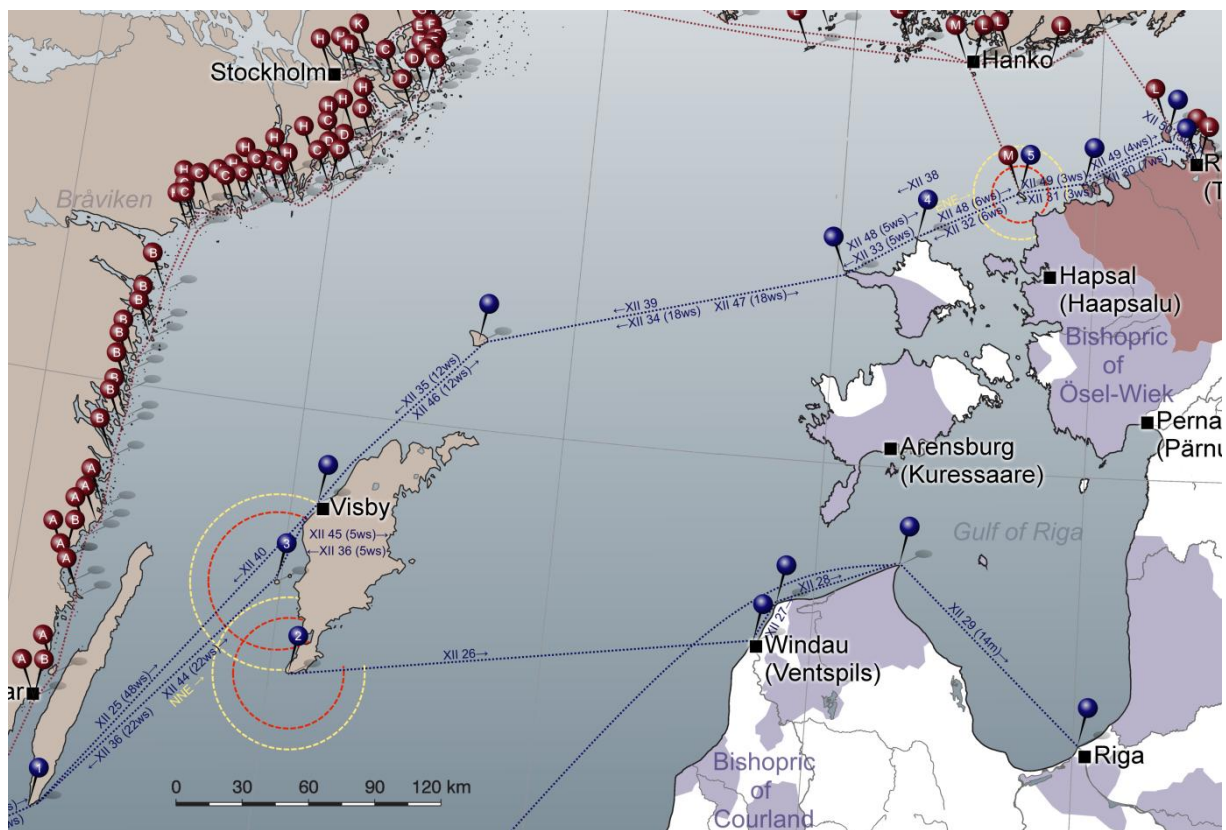


Fig. 2-8. This excerpt shows parts of the routes described in the Hanseatic Sea Book (blue pins) and King Valdemar's Itinerary (red pins). The approximate horizon distance is calculated for some of the landmarks that were referred to in both sources from two hypothetical observers positions, the first at a height of 3m (*hs1*) and the other at 18m (*hs2*), as schematically shown in the following graph. The abovementioned places relate to the following pin numbers: (1) Södra Udde, (2) Hoburgen, (3) Stora Karlsö, (4) Simpernäas, (5) Osmussaar.

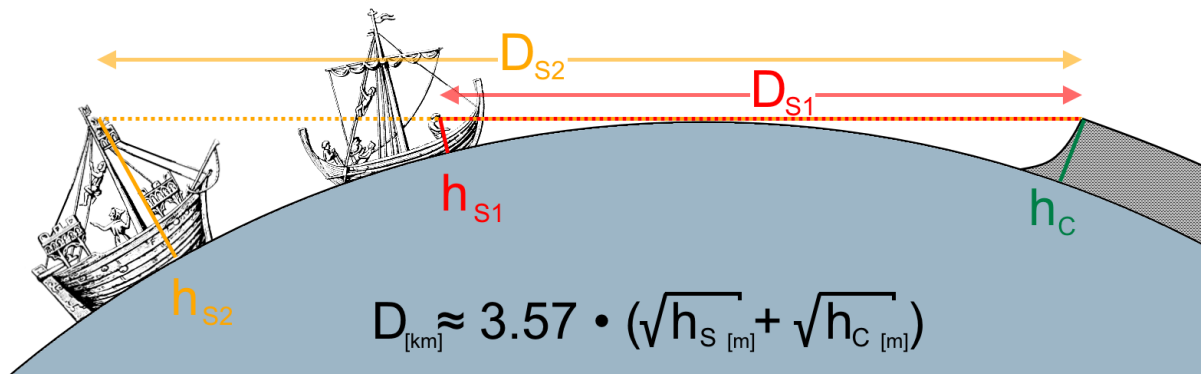


Fig. 2-9. This formula is used to calculate the horizon distance (D) in km, i.e. the minimum distance when landmarks become visible at the very earliest. This is not only dependent on the height of the coast itself ( $h_c$ ), but also the height of the viewing point. For the sake of experiment, this was determined with 3 metres for the first ship ( $h_{s1}$ ) and with 18 metres for the second ship ( $h_{s2}$ ), using appropriated ship-depictions from the medieval seals of Winchelsea ("longship") and Damme ("cog") (Graph: Daniel Zwick).

As will be shown in the following sections, there were basically two principal types of vessels engaged in the long-distance logistics: Longships and cogs. Although there seems to be a clear visible distinction between both types in pictorial and iconographic evidence, there is still an ongoing debate amongst historians and archaeologists on the exact definition, which will be duly addressed in the last section of chapter 4. For now, however, we set the premise that a longship was a double-ended vessel, usually without superstructure or other elevated platform for a lookout. Thus, for the sake of a calculation example, an observer's height of 3 metres above the sea level is assumed, e.g. when the lookout stood in one of the raised ends of the vessel. As for cogs or large ships in general with a top or crow's nest (and pushing aside the question for now of how cogs could be actually defined), the Kiel reconstruction of the "Bremen Cog" was reconstruct-

ted with a mast length of 22m (Baykowski 1994). Considering that the mast-step was below the waterline and the fact that the crow's nest was not at the very upper end of the mast, an observer's height of 18 m is assumed. In the following three hypothetical examples, the horizon distance of three known landmarks are calculated. The island of Osmussaar off the Estonian coast was included in both King Valdemar's Itinerary (as *bothensholm*) and the Hanseatic Sea Book (as *Odensholm*). The island articulates with a zone where the Baltic Klint emerges from the Baltic Sea (Fig. 2-3). The island has a modest elevation of ca. 6 m (Fig. 2-10). Osmussaar is in a zone where the annual land rise is about 2mm per annum (Ågren & Svensson 2007, fig. 4.3). Extrapolated to 800 years ago, the early phase of the Baltic Crusades, this would have meant an elevation of ca. 4.4 m above sea level.

The klint coast of Osmussaar (4.4 m) from an observer's height of in a longship (3 m):

$$D_1 \text{ [km]} \approx 3.57 \cdot (\sqrt{h_{s1} \text{ [m]}} + \sqrt{h_c \text{ [m]}})$$

$$D_1 \text{ [km]} \approx 3.57 \cdot (\sqrt{3\text{m}} + \sqrt{4.4\text{m}})$$

$$D_1 \text{ [km]} \approx 12,28 \text{ km}$$

The klint coast of Osmussaar (4.4 m) from an observer's height of a mast top (18 m):

$$D_2 \text{ [km]} \approx 3.57 \cdot (\sqrt{h_{s2} \text{ [m]}} + \sqrt{h_c \text{ [m]}})$$

$$D_2 \text{ [km]} \approx 3.57 \cdot (\sqrt{18\text{m}} + \sqrt{4.4\text{m}})$$

$$D_2 \text{ [km]} \approx 19,95 \text{ km}$$



Fig. 2-10. A limestone cliff of Osmussaar. This Swedish-colonized offshore island on the Estonian coast was mentioned in King Valdemar's Itinerary of the Liber Censu Daniae and the Hanseatic Sea Book (Photo: Tõnis Saadre).

As fig. 2-8 illustrates, the island was not visible from the previous landmark of Simpernäs, but it was also hard to miss it even when the vessel would have gotten off course by ca. 10° (for the longship) or 20°

(for the cog). The klint coast of Hoburgen at the southern tip of the island of Gotland is mentioned in the Hanseatic Sea Book and was considerably higher than the previous example (Fig. 2-11).

The klint coast of Hoburgen (30 m) from an observer's height of in a longship (3 m):

$$D_1 \text{ [km]} \approx 3.57 \cdot (\sqrt{h_{s1}[\text{m}]} + \sqrt{h_c[\text{m}]})$$

$$D_1 \text{ [km]} \approx 3.57 \cdot (\sqrt{3\text{m}} + \sqrt{30\text{m}})$$

$$D_1 \text{ [km]} \approx 25,74 \text{ km}$$

The klint coast of Hoburgen (30 m) from an observer's height of a mast top (18 m):

$$D_2 \text{ [km]} \approx 3.57 \cdot (\sqrt{h_{s2}[\text{m}]} + \sqrt{h_c[\text{m}]})$$

$$D_2 \text{ [km]} \approx 3.57 \cdot (\sqrt{18\text{m}} + \sqrt{30\text{m}})$$

$$D_2 \text{ [km]} \approx 34,70 \text{ km}$$



Fig. 2-11. The cliff of Hoburgen, marking the southern tip of the Island of Gotland, Sweden (Photo: Wikimedia Commons).

Although no previous landmark is recorded, it can be assumed that it branched of the route between Södra Udde and Visby. This course barely forms a tangent to the visibility radius of Hoburgen and for ships bound to Visby, coming into sight of Hoburgen would have meant that they were approaching the island at a closer angle than necessary. This may

sound trivial, but could have been an important poece of information, especially if eastern winds turned the Gotlandic shore into a dangerous lee shore and sailors had to keep the coastline at a convenient distance for as long as possible. The next landmark was the Island of Stora Karlsø with even steeper limestone cliffs of an impressive height of ca. 52 m.

The limestone cliff of Stora Karlsø (52m) from an observer's height of in a longship (3 m):

$$D_1 \text{ [km]} \approx 3.57 \cdot (\sqrt{h_{s1}[\text{m}]} + \sqrt{h_c[\text{m}]})$$

$$D_1 \text{ [km]} \approx 3.57 \cdot (\sqrt{3\text{m}} + \sqrt{52\text{m}})$$

$$D_1 \text{ [km]} \approx 31,92 \text{ km}$$

The limestone cliff of Stora Karlsø (52m) from an observer's height of a mast top (18 m):

$$D_2 \text{ [km]} \approx 3.57 \cdot (\sqrt{h_{s2}[\text{m}]} + \sqrt{h_c[\text{m}]})$$

$$D_2 \text{ [km]} \approx 3.57 \cdot (\sqrt{18\text{m}} + \sqrt{52\text{m}})$$

$$D_2 \text{ [km]} \approx 40,88 \text{ km}$$



*Fig. 2-12. The limestone cliff of Stora Karlsö would have been sighted by vessels frequenting the Södra Udde – Visby transect of the Hanseatic Sea Book in good weather conditions (Photo: [www.utsidan.se](http://www.utsidan.se)).*

The visibility radius of Stora Karlsö and Hoburgen overlapped and there was little chance to miss this landmark, as the visibility radius extends half way to the Island of Öland. However, what needs to be

considered is that these calculation examples are solely based on the premise of geometric horizon visibility, which was usually limited by meteorological factors, such as rainfall, haze or fog (Fig. 2-13).



*Fig. 2-13. Skuldelev 2 reconstruction Havhingsten sailing along a limestone cliff coast, forming an important landmark for terrestrial navigation. The geometric reconnaissance distance was limited by meteorological factors, as the coastline on the right hand side shows, which is not only further away, but also veiled by blue haze (Photo: Viking Ship Museum Roskilde).*

Conclusively, it can be asserted that Baltic Sea mariners relied principally on terrestrial navigation throughout the period examined in this study, while dead reckoning and astronomical navigation can be almost entirely ruled out. This has several implications, as it put the mariners into the dependency of landmarks, both natural and anthropogenic, local pilots able to recognise these landmarks and – of course – the ability to safeguard and protect these coastal areas against enemy fleets, of which there were not few. Especially in the early phase of the Baltic Crusades, where a multitude of crusaders, merchants and settlers without local knowledge were making their arrival, these factors were of imminent importance. The limitations and avenues of navigation as presented above are important to keep in mind in order to understand the way geographical relationships were conceptualised

(section 3.1. and 3.2) and why certain coastal transit corridors were preferred that would have made little sense from a modern point of view (section 3.3).

### 2.2.3. Seasonal logistics

Traffic arteries are bound to features of the physical landscape, abetting the formation of transit corridors on navigable rivers and coastlines with natural harbours, while restricting access in places where navigation is impeded by shoals, reefs, strong currents or other impediments. Aside from the natural physical landscape, logistics – both on land and water – are affected by another "layer" – the seasons. Monthly seasonal variability is wholly dependent on the respective climate zone. Even in a

sub-tropical and temperate climate zone like the Mediterranean, the year was divided into two main seasons – summer and winter – separated by the "gates of the year" which to miscalculate was perilous for traffic, future harvests as much as health and was in many places perceived as a "winter standstill" when the rules of the game were drastically changed, often leading to a complete shutdown of all warfare and trade (Braudel 1992, 183f). Maritime statutes and codes from Pisa in 1160, from Venice in 1284 and from Ancona in 1387 stipulated compulsory maritime inactivity between St. Andrew's Day (30<sup>th</sup> November) and the Kalends of March, precautions and prohibitions dictated by experience and in some places even extended to the period between the October and April months (Braudel 1992, 186). Although the Mediterranean had mild winters, there were other climatic obstacles for shipping, such as river floods due to strong rainfall, blizzards, or strong winds like the mistral occurring in winter or spring, which can be directly linked to the Mediterranean's mountainous topography, when cold air is drawn from the foothills into the sea with great velocity due to pressure differences, which led to many ship losses. The Baltic Sea is not exposed to similar katabatic winds, and winds do not usually reach gale force, due to the mild influence of the North Atlantic climate and the Gulf Stream. The Baltic Sea is a temperate zone during the summer, so the sailing period does not differ much to that of the Mediterranean, astonishingly. Yet due to its northern location, encompassing a portion of the continental subarctic zone in its north, the winters are long and harsh, which restricts navigability, as great portions of the sea are regularly frozen over, especially in the north-eastern parts where salinity is low, which facilitates a much earlier formation of ice than water with a high salinity. This is a particularly important aspect for the maritime logistics, as ice shields would have not only made navigation impossible in some winter and spring months, but would have also posed a threat to water-craft, as drifting ice floes or the pressure of the ice shield could have threatened frozen-in watercraft, if not moored or anchored in a sheltered location.

There are a number of historical references from northern Europe on what was considered a viable sailing season. The Norwegian *Konungs Skuggsjá* — the King's Mirror — of ca. 1260 notes that overseas voyages should not be undertaken after early October (Larsen 1917, 158). At Eastern in 1211 (3<sup>rd</sup> April) merchants who stayed in Riga during the winter and would have normally sailed to Gotland at this time of the year delayed their departure to defend Riga and wait for the arrival of the crusaders, when they learned about imminent attacks of the Estonians (HCL XIV, 12.; cf. Bauer 1975, 127). This reference contains a number of significant information: It

shows that 10 years after the foundation of Riga the town was already safe enough to stay during the winter, that sea voyages were undertaken in early April, and that the crusaders from Germany have not arrived yet. For the early phase of the Baltic Crusades, Henry of Livonia starts almost each chapter of his chronicles – synonymous to a year – with the shipment of a crusading contingent, which he raised during the winter months throughout the German Empire. This shows that these voyages must have taken place early in the year, although some arrived as late as September, as in 1204, when other crusaders were preparing their home voyage (HCL VIII, 2). The very same crusaders, who have started their home voyage in September were delayed by adverse weather conditions and sea battles against Estonian ships, as vividly described in Henry of Livonia's *Chronicles*. They ran out of provisions and were close to starving, picked up Christians who have suffered shipwreck, got into a storm and nearly wrecked off a cliff themselves, but eventually reached Visby on the 29<sup>th</sup> November. After having bought new provisions, they continued their voyage and approached Denmark's coast, but could not continue their voyage, as the coastal waters have already frozen, upon which they decided to abandon their ship and travel across the frozen sea via Denmark to their German homelands (HCL VIII, 3, ed. Bauer 1975, 35). This trouble-stricken voyage took about 3 months and was certainly an exception, especially with regard to the late departure from Visby.

This episode sheds not only light on the restricted navigability of the Baltic Sea in the cold seasons, but also the use of frozen waterways as crossings. The Swedish bishop Olaus Magnus refers in 1555 to a historical report of Albertum Crantz for the year 1323 and 1399, in which – allegedly – the Baltic Sea froze to such an extent, that one could walk across the western Baltic Sea – from Lübeck, Stralsund or Prussia – all the way to Denmark, which became a road at which temporary wooden lodgings were built (lib. 1, cap. 26). Olaus Magnus goes into much detail in this chapter, stating that when storms have devastated roads they are either cleared to make way for sledges, or if too labourousome, a new road is set up along the frozen seaboard with lodgings at regular distances, which offered stoves and protection against robbers, a practise particularly done in Livonia and Prussia due to its many trade missions (Fig. 2-14.1).

Since medieval times, the concept of a border was primarily defined by landscape features, like rivers, coast or forests, as is particularly well shown on the *Carta Marina* (Katajala 2011, 69f.). This is also reflected in this region's warfare, when former (watery) borders became solid frozen "land" and could be easily crossed with an army.



Fig. 2-14. Sledge transport across frozen waterways: This illustration compares Olaus Magnus' Carta Marina (1539), of which an excerpt is shown in the background, and illustrations from his Historia de gentibus septentrionalibus (1555), of which two (book I, chapter 26 and 27) are superimposed. Chapter 26 of his Historica describes temporary lodgings built on the ice, marked with wreaths (1). These are actually plotted in on the map along the coast of Courland and (not shown here) along the entirety of the southern Baltic Sea coast. The next chapter 27 describes sledge travels across the ice. Some crossings are sketched in here, (2) and (3) are military campaigns (not with sledges) to Ösel/Saaremaa, (4) represents the aforementioned route of the Flemish merchant between Polotsk and Dorpat/Tartu across Lake Peipus, and (5) describes the route from the Nena estuary to Novgorod. Interestingly, Reval/Tallinn is depicted as ice-free close to the ice border, which indicates its strategic importance as relatively ice-free port in the far north.

Henry of Livonia notes that the Baltic people – for the year 1205 the Lithuanians – had the custom to go to war in February and moved along the frozen rivers with an army on horseback (HCL IX, 1). Frozen rivers must have been perceived as a "medieval highway" equivalent. The crusaders soon adopted the winter warfare themselves, as they too had difficulty to cross the boggy and swampy grounds of the Baltic regions on horseback in the summer, so incursions

were made in the winter, when the grounds and lakes were frozen solid (Benninghoven 1965; Jensen 2011, 258; Paravicini 1989, 53f.). This was probably even more advantageous to the crusaders: While the Baltic pagans had light and swift horses, the heavy-bred war horses of the crusaders would have had even greater difficulty to cross soft swampy soils (Jensen 2011, 258; cf. also HCL XI, 5; HCL XII, 2). The winter warfare also undid the strategic advantage of the

Oselians, who were feared pirates and whose island lay protected in waters surrounded by shoals and rocks with no deep-water harbours. Although various sea battles between them and the crusaders have taken place, the decisive battle was fought by the crusaders with a conventional army, which crossed the frozen Moon Sound in 1227 (HCL XXX, 3) (Fig. 2-14.3), as vividly described in the Livonian Rhymed Chronicles: *"Now Ösel [Saaremaa] lay locked in the sea and this protected it so that it had never been attacked by an army. In the summers they needed little defence and so for many years they remained unbaptised and free of taxes. They were a treacherous people. In the summers they ravaged the surrounding lands with their ships, inflicting great damage. This greatly disturbed the Master and he earnestly inquired how they might cross the ice in winter to that land and subdue it. It was reported to him that in winter the sound, in which the island lay froze solid. In summer, however, one had to sail twelve miles by ship, being careful to avoid the numerous rocks which lay in the water. Hence, whoever wished to attack the island with an army had to do it in the cold days of winter when the ice could bear a hundred armies. The Master rejoiced at the news and the crusaders came nobly to Riga, both noble and commoner."* (LRC 1614-1646, transl. by Smith & Urban 1977, 23). An earlier crossing to Ösel/Saaremaa had been already made by another army from Cape Kolka (Domesnäs) in 1218 (LRC 1424-1552) (Fig. 2-14.2). Winter provided also an opportunity for the relatively landlocked Lithuanians to wage war against other Baltic tribes which were normally protected by the sea, when Livonians and Lithuanians crossed the frozen Moon Sound in 1270 (LRC 7847-7944). Arguably, the most famous instance of the winter warfare is the Battle of the Ice on the 5<sup>th</sup> April 1241, in which the Teutonic knights conducted a joint crusade with the Danes against the Russians (Fig. 2-15).



Fig. 2-15. Arguably, the most iconic representation of the Teutonic Order's winter warfare is captured in Sergei Eisenstein's 'Alexander Nevsky' movie (1938) (cf. screenshot). This Soviet propaganda movie shows an epic scene of the Battle of the Ice on 5 April 1242, ending with the victory of the prince of Novgorod over the Teutonic knights, who break into the ice and perish in the icy waters of Lake Peipus.

However, the frozen "medieval highways" were not only used for military operations, but also for trade and communication. In 1413 a Flemish nobleman reportedly took the route from Pskov in Russia to

Dorpat/Tartu in Livonia (present-day Estonia) across a frozen river and Lake Peipus (Mickwitz 1938, 143) (Fig. 2-14.4). Also the waterway (*waterwech*) to Novgorod via the Russian river and lake system (Neva-Lake Ladoga-Volhov-Luga) was replaced during the winter with an alternative sledgeway (*sledemwech*), as indicated by statutes of the Hanseatic kontor in Novgorod (Kreem 2011, 264) (Fig. 2-14.5). The transport costs for the waterway in summer and the sledgeway in winter were roughly similar (Mickwitz 1938, 150).

In summary, it can be stated that warfare in the Baltics followed a unique seasonal pattern, in which the troop transport across the sea occurred in the summer months and land warfare in the winter months in an alternating fashion. This necessitated a permanent presence and fortified bases, from which war campaigns could be launched and which were inhabited during the winter. Thus, this marked a stark contrast to the seasonal merchant colonies in the lower reaches of the Daugava River in preceding decades. The two main bases for the Baltic Crusades were Riga, founded by the Germans in 1201 (section 4.1), and the castle of Reval/Tallinn, which was constructed by the Danes right after their victory in the Battle of Lyndanisse in 1219 (section 3.3). Although the latter was not located at an important river, like Riga, the location of Reval/Tallinn seem to have been nevertheless strategically chosen: Reval/Tallinn was considerably longer ice-free than the Neva. 16<sup>th</sup> century account books from merchants in Reval/Tallinn indicate that the navigation period was from April to late November (Mickwitz 1938, 156). On 11<sup>th</sup> April of 1440 a fleet bound to Reval/Tallinn could not reach the town due to ice and had to anchor in a nearby bay. However, it took not long after the ice has melted and the fleet arrived in Reval/Tallinn only 5 days later (Kreem 2011, 262). This narrow time gap is indicative of a seasonal regularity, which was probably taken into account for the decision when to leave the port of departure.

#### 2.2.4. Ship-finds as remnants of fossilised mobility?

As demonstrated in the three previous sections, environmental and climatic factors of the Baltic Sea had a great impact on the use of marine resources, as well as maritime logistics in times of trade and war. A principal emphasis of this study lies on the archaeology – especially watercraft – and the question of whether their location or place of abandonment, their state of preservation and their constructional characteristics also relate to the landscape parameters at large? How can abandoned watercraft as a somewhat more tangible category of past human behaviour and mobility contribute to the big picture? The location, deposition and survival of ship-finds is definitely meaningfully related to the landscape, as

has been already stressed in one of this author's cumulative papers (paper A, 330ff.). A slightly more detailed and – indeed – revised look is taken on this issue in the following part.

For a systematic approach, different types of ship-finds need to be categorised to appreciate the site-specific differences and limitations. The study of lost watercraft is often epitomised in the "shipwreck bias", based on the popular premise of catastrophically lost ships. Due to the abruptness with which shipwrecks usually occurred, shipwreck sites have been often referred to as "time capsules", frozen in time and equated with a "Pompeii premise" in order to underline the relative importance of such underwater sites (Gould 2000, 12). It is true that such sites often represent a closed find context with a higher inferential status, warranted not only by the dramatic circumstances of the loss, but also the fairly complete – thus representative – find assemblage (cf. Adams 2001, 296). By putting too much focus on a "shipwreck lens", however, another important category of ship-finds cannot be studied adequately, namely deliberately abandoned ships (cf. Richards 2013, 2). Their study require a separate framework as they entered the archaeological record differently. In fact, some of the most important discoveries were that of deliberately abandoned rather than shipwrecked vessels. This is particularly true in a northern European context, where ceremonial ship depositions are predominantly represented for the Iron and Viking Age, most notably by the Nydam, Sutton Hoo, Gokstad and Oseberg ship burials. Already in the 1970's a total number of 422 separate watercraft burials from 290 different sites have been recorded in northern European countries (Müller-Wille 1974, 199ff.). A recent discovery of an Iron Age ship burial of Scandinavian warriors on the island of Saaremaa, Estonia, has put another spotlight on ritually deposited find from this period (Peets 2013). The life span of such a visibly abandoned vessel was not actually over, as it was reassigned a new mission, albeit metaphysical in nature: carrying the slain into the realm of the dead (Fig. 2-16).

Such burials are a prime example how metaphysical beliefs enter the physical landscape. Although there are no such burials for the time of the Northern Crusades, many religious and mythical beliefs had a real-world impact in the way the maritime landscape was perceived and navigated, as will be demonstrated in chapter 3.

Besides re-use in a ritualistic context, watercrafts or parts thereof are also reused in articulated or disarticulated form (Richards 2002, 60ff.). Although some of the original context is blurred and partially lost, the aggregated value within the re-used context may be in no way less interesting. In order to gain a more precise understanding of the different types of deposition, Nathan Richards' systematic approach is adopted, subdivided by this author into three discrete

analytical levels: The first takes the circumstances of the abandonment into account, the second determines the degree of intentionality and the third assesses the survival of the watercraft in terms of constructional integrity, with the entire hull as the highest and disarticulated planking remains as the lowest.



Fig.2-16. The epitome of fossilised mobility? Slain Scandinavian warriors buried on foreign shores in one of their ships. This recently discovered ship-burial of AD 750 in Salme on the Island of Ösel/Saaremaa in Estonia is a prominent case of a deliberate abandonment of a nearly 12 m long vessel (its outline is recognisable in the photo on the top) used as coffin for fallen Scandinavian warriors buried with their longships (bottom) (Source: Peets 2013, edited by author).

This hierarchy is necessary to apply different enquiries to each category, which are subject to different limitations in their interpretation value. In the following, different categories are identified and ship-finds (assessed in further detail in consecutive sections) are assorted accordingly.

#### 2.2.4.1. Catastrophic abandonment

Starting with the "shipwreck bias" and what presents the typical and often most spectacular case of a ship-find, is watercraft that wrecked as a result of a total loss of control with loss of life. Watercraft which entered the archaeological record as accidental loss represent the stereotypical idea of shipwrecks, by a distress at sea situation. Their position can be very meaningful for the study of transport routes and mobility, like the 14<sup>th</sup>-century Engelskär wreck, which sank in the Finnish archipelago most likely *en route*, because the presence of ballast indicated that it sank immediately, while a great portion of the cargo was cluttered 20m away, which indicates that the vessel might have "turned turtle" (Wessman 2007, 143). The nature of the wreck-site indicates a full loss of control. This notion is important in terms of its location, as the latter might point to an *en route* transect, which correlates to that described in a 13<sup>th</sup>-



century Danish itinerary (cf. section 3.3), i.e. on a direct line between *Jurmo* (Jurima) and *Kyrkosund* on *Hitis* (Ørsund). Thus the find location of accidentally wrecked vessels can be very meaningful for the overall interpretation and allow hypotheses on navigation routes, trade networks as well as the possible ports of origin and destination.

This is neither the case in intentionally deposited or re-used wrecks, where the vessel's equipment, cargo and personal belongings would have been salvaged. This potential for time capsules, however, is site specific, as parts of the assemblage — particularly if not covered by sediments — could have swept away in currents, scattered in a high energy environment, or biologically deteriorated, as only a thick sediment cover would provide a genuine anaerobic milieu ensuring a long preservation period.

“...[Waldemarus] noctu cum suis navigationem orsus coorta subito tempestate inusitatam maris sequitiam expertus est. Ipsi quoque militibus immanium undarum aspergine prolutis tantum algoris incessit, ut singulis corporis partibus hebetatis ne uelum quidem ad navigationis commodum circumferre potuerint. Præterea tanta nympi uis antennam impulit, ut inter undas effracta decideret, nec minus ymbrium quam fluctuum moles nauigium onerabat. Gubernator omnia freto permittens abiecto regimine, qua proram deflecteret, ignarus solum uenti imperium expectabat. Aer quoque crebris internitentium fulminum ignibus micans ingenti nubium fragore concrepuit. Tandem per summam nymborum rabiem insule cuidam errore nauigationis appulsi detractum undis nauigium, quod ancora retentare nequiret, circumstantium arborum ramis in foros detortis, quo minus lapsum collideretur, tenacius astrinxerunt.” (*Gesta Danorum* 14.19.2., Friis-Jensen/Zeeberg 2005, 232).

Although the vessel was neither lost nor intentionally deposited in this instance, it highlights that a vessel in distress would not always immediately sink, but could be brought to a sheltered location, where the crew can disembark and goods and equipment salvaged. Although the vessel was not manoeuvrable anymore and took on water, it stayed afloat even in a wrecked state. When the ballast or heavy cargo is jettisoned timely, wooden constructions tend to stay afloat in advantageous circumstances. The real threats were lee shores, where the surf posed the most serious threat. For this reason, the ship of the above excerpt was moored to stop it from breaking up. Thus, intentional depositions following the wrecking should be found close to the coast, maybe even in reasonably sheltered conditions like bays or estuaries, where a foundering vessel was brought in to initiate a controlled grounding. The *Kuggmaren* wreck from ca. 1215 in the Stockholm archipelago could be such a case. It was discovered in sheltered conditions in a lagoon of an islet just 1.5 m below the present sea level (Adams & Rönnby 2002, 174), so about 4.7 m below the reconstructed sea-level of the early 13<sup>th</sup> century if the

#### 2.2.4.2. Consequential abandonment

A situation where similarly a catastrophic situation is the main reason for abandonment, but where at least some control was retained, has been introduced into the debate as "consequential abandonment" by Nathan Richards (2002, 7ff.) to indicate that some measures were seized to prevent the loss of life and to save some parts of the cargo. In archaeological terms, this would have meant that the archaeological assemblage is less complete – thus the "time capsule" aspect somewhat infringed – but that the site where the ship was set aground or scuttled under the limited control of its crew. This scenario is particularly well illustrated in Saxo Grammaticus' *Gesta Danorum*, in which a distress at sea situation is described, probably for the year 1158:

“[Valdemar] set sail with his followers at night, after he had been supplied with arms and provisions [...] but a storm suddenly blew up and he met unusually heavy seas. His warriors were soaked in the spray of enormous waves, and even they were filled with such fear that their bodies were altogether numbed, and were unable to manage the sail. And the storm strained the mast so violently that it snapped and sank under the waves, and the ship took on as much rain as seawater. The steersman let ocean rule; as he had no idea where to steer, he abandoned the rudder and let the wind take her at will. And the sky blazed with continuous flashes of contending lightning and echoed with the mighty thunder of the clouds. Finally they were driven off course by the terrible raging of the elements to some island, and since their anchor would not hold, they dragged the ship from the water and made it fast by twisting the branches of the surrounding trees through the port-holes, to stop her sliding and breaking up” (Translation: Christiansen 1981, 410).

post-glacial land rise is taken into account (Ågren & Svensson 2007, Fig. 5.1.).

Its secluded location makes it unlikely that it this was the intended destination for the vessel's last voyage. Its sheltered location would have facilitated the safe unloading and even salvage of parts of the rigging and so forth. Thus, the *Kuggmaren* wreck it is no longer a “time capsule” in a true sense, as one cannot expect a closed find context of a fully fitted out vessel. The find assemblage is obviously also restricted due to decay and deterioration, as only the bottom construction survives, while loose artefacts would have swept away from the wreck site over the centuries. Nevertheless, as will be demonstrated in chapter 4, an investigation of the wreck is not limited to technical details, but cargo remains and thus trade patterns can be inferred by a macro-botanical analysis.

### 2.2.4.3. Deliberate abandonment

Aside from intentionally deposited vessels following an accident, a vast majority of wrecks are also ships put out of commission, thus were deliberately abandoned. The most impressive medieval ship cemetery of the Baltic Sea is in Kalmar, where a variety of different types were found (Åkerlund 1951). While such vessels ought to occupy a major part of all shipwrecks, it seems questionable whether this is adequately represented in the archaeological record, because many decommissioned ships were also converted or scrapped for a secondary purpose. The survival of the Kalmar ship cemetery could perhaps be attributed to the abundance of wood in this part, where breaking up a decommissioned ship for timber re-use would have meant more investment of labour than going into a nearby forest. At least, it seems hardly imaginable that a similar collection of medieval era wrecks would have survived archaeologically in densely urbanised parts of Central and Western Europe, where secondary use was frequently practised. Secondary use can be subdivided into three categories:

(1) If left intact, an old worn-out ship in bad repair would have still been an important asset, as the loss of seaworthiness did not mean that the vessel was no longer afloat. In the post-abandonment stage many of such vessels were converted into "hulks"<sup>5</sup>, dismantled and used as floating warehouses or dwellings. Such "hulks" are primarily present in the collective memory in a post-medieval or early modern context. Some hulks were filled with sand and rocks and used as caisson for land-reclamation (Richards 2002, 63), which was also practised in medieval times, but primarily as underwater barriers to obstruct a navigable channel. This was done as defensive measure, as exemplified by the 11<sup>th</sup>-century Skuldelev ships in Roskilde fjord (Crumlin-Pedersen & Olsen 2002) or for creating a strategic bottleneck situation, like a collection point for customs duties, as the late 14<sup>th</sup>-century Helgeandsholmen wrecks in Stockholm suggest (Varenius 1989). In other cases, the reason for abandonment can be still unclear, but the deliberate act reflected by archaeological traces, as in the case of the Bossholmen wreck. Its keel was half cut through with an axe from one side, which would have been even fairly inaccessible when the vessel was heeled over on land. This cut has been interpreted as a purposefully abandonment of a vessel, severing the keel to make it uneconomic to repair in order to ensure that it never sailed in anyone else's service (Adams 2013, 19). This can be seen as maritime equivalent to the practise of razing fortifications to the ground, which could not be permanently occupied and garrisoned, lest to fall into

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<sup>5</sup> beware the disambiguation: This section does not refer to the ship-type "hulk", but to a decommissioned vessel in secondary use.

enemy hands. The lack of seaworthiness mattered little if floating constructions could be used in hostile circumstances, scuttling them to obstruct navigable channels or used as a fireship, as vividly described by Henry of Livonia – probably from an eye-witnesses perspective – for the year 1215, in which 9 German crusader cogs sought shelter in a bay on Saaremaa and were met by a hostile Estonian army, which scuttled some vessels at the entrance of the bay and set alight three structures made of huge trees drenched in animal fat. These were launched and propelled by the wind towards the trapped cogs: *Alii quoque ex eis ducebant ignes maximos tres ex siccis lignis et pinguedine animalium incensos et super structuram arborum magnarum compositos. Et primus ignis, qui erat super alios magis ardens, pellebatur supra mare et appropinquabat ad nos* (HCL XIX, 5) (section 11.2). The categories of catastrophic and deliberate abandonment overlap when it comes to traces of fire. Some wrecks to be discussed in the following sections – i.e. Riga 1 and 2 (section 4) and the Maasilinn wreck (section 6) – all show scorch marks, yet the question of whether the fire was caused by a hostile act or accidentally cannot be easily established by the archaeological finding itself, for which reason a comparative historical approach can be beneficial.

(2) Intact sections of an abandoned wreck – but not the entire hull – are referred to as articulated parts of watercraft. It is especially slabs of planking that were frequently re-used, as they provide ready-made covers, often used as cladding for wells or pits, as roofs or causeways, most frequently as waterfront revetment (e.g. Allen et al 2005, Bleile 1998, Goodburn 1997, Sorokin 2006). As such, the Beluga wreck might have served (cf. section 5.3 and paper C). Re-used articulated sections are usually found in urban contexts.

(3) Fragments of a watercraft like individual planks or ship-timbers are referred to as disarticulated parts of a watercraft. The interpretative value of these elements is considerably lower than that of an intact or articulated find, as the original or even secondary context is almost completely lost. Nonetheless, the way how planks were worked, timber dimensions, fastening and caulking methods can give enough cues to be associated with a building tradition, and thus discrete constructional elements can contain a surprising amount of diagnostic features, which makes it possible to conduct a comparative analysis. This will be demonstrated in the Matsalu case study in section 4.4. and – again – the Beluga case study in section 5.3.

### 2.2.4.4. Abandonment implications and deposition circumstances

There is a case to be made for quantifying abandonment patterns. As mentioned before articulated slabs of planking are primarily found in an

urban context. This is not surprising, as historical city centres are more consistently studied as most of the development projects requiring an archaeological pre-investigation occur in these urban nuclei. But is their relative over-representation really a distortion solely caused by modern monument protection policies? There are certainly also other factors at play, such as that river side arms often filled up with waste and debris, which would have sealed off any organic remains such as ship-timbers, and abetted its preservation in a fairly anaerobic environment, if below the ground water level. Whether or whether not we archaeologist unearth a historical watercraft depends on a number of factors, which forms an intricate web of decision-making of those who abandoned the vessel, under which circumstances and which environment, how the site continued to be used and exposed to environmental and anthropogenic development, up to modern heritage protection policies. It would be far beyond the scope of this work to make an attempt to entangle this web, let alone trace and quantify patterns. Therefore, only a few aspects shall be addressed, which might have influenced abandonment practice and representativeness in the archaeological record. The late Ole Crumlin-Pedersen pointed out that most ship-finds are that of loadbearing medium and large sized vessels, while the thousands of small fishing and work boats are almost absent from the archaeological record, as much as *leding*-ships, who were normally pulled onto the beach rather than abandoned in the water (Crumlin-Pedersen 1983, 229f.). Anton Englert observed a similar pattern, concluding that large sized vessels were primarily abandoned near prominent ports and markets (Englert 2015, 284). He also noted that there are no German and Slavonic provenances for large-scale ships in Danish waters (Englert 2015, 285), which raises the question of whether the archaeological record of abandoned ships could be biased by the tendency of ship-owners to decommission and scrap their vessels in the home port. The way ships were abandoned is considered to demonstrate a cultural aspect in the relationship and status of ships, directly reflected in the way they are discarded (Richards 2002, 6).

In this context, Jan Bill ascribed the decision where ships were broken up to *a social practice which may discriminate between different types of ships* (Bill 1997, 111f.). He pointed out that this might explain the absence of ship-timbers with diagnostic Hanseatic features in the rich maritime archaeological material from the Bryggen excavations in Bergen, Norway. Does this reflect the general preference of ship-owners to have their old vessels scrapped in their homeport? Possibly so, but not necessarily, as Hanseatic ship-owning merchants often had a share in a greater number of vessels and could have relied on their fellow tradesmen to find a transport back home. The preference of scrapping ships in homeports can also be linked to legal reasons, as the salvage rights were often infringed. This is illustrated

in a letter of complaint, sent in 1352 by the Hanseatic League to the King of Sweden and his magistrates:

*“Item cum aliquis mercatorum patitur naufragium in regnis et dominiis dicti domini regis, non potest bona et res suas salvare (berghen<sup>6</sup> et ipsis pacifice frui, prout ipsis ab antiquo in privilegio est indultum. Sed advocati dicti regis ea sibi arripiunt et usurpant.”* (HR I.2, 175.12).

\* \* \*

*Also, when a merchant suffers shipwreck in the kingdom and dominions of the said king, he cannot save (salvage) his property, which in peace to save had been his privilege since ancient times. However, the magistrates of said king seize and take possession of it. (own free translation).*

The King of Sweden replied with a counter-complaint in the same year, detailing instances in which merchants from Lübeck also disrespected property rights (HR 176.12). Thus, decommissioning and scrapping a ship in foreign waters would imply a degree of uncertainty on property rights, which could have induced the ship-owner to have a ship – even in a wrecked state – repaired in a rough-and-ready way for a last voyage to a port in home waters.

Thus, it can be presupposed (but not quantified) that the archaeological record could be somewhat biased towards locally owned and built ships in terms of ship-timbers found in a re-used context. Whenever this is not the case, however, this places a special significance on the timbers, indicative of divergent practises, which could imply that foreign-built vessels were locally owned, hired, captured or broken up, following a hostile incident. The Beluga case study (section 5.3) examines a slab of articulated planking of a deliberately abandoned ship with signs of re-use of some timber-elements and the Matsalu case study (section 4.2) examines disarticulated ship-timbers, which classification is possible by dimensions idiosyncratic for the bottom-based shipbuilding tradition. In both cases, a foreign origin can be assumed on the basis of constructional as well as dendrochronological evidence, yet both seem to have played a special role in their new respective environments.

While consequentially and deliberately abandoned ships, as well as re-used articulated and disarticulated ship-parts can be found in an urban context, the find of an catastrophically abandoned shipwreck is exceptional and can be often attributed to fire outbreak or — in the case of the ‘Bremen Cog’ —

<sup>6</sup> In the original document the term *salvare* was crossed through and replaced with Low German *berghen*, probably because the Latin term *salvare* can be also generically translated as “save” and does not necessarily imply that the salvager can keep the salvaged goods in his possession, thus *berghen* arguably reflects salvage more adequately.

major natural disasters: The hull was not tarred yet, but as part of the find assemblage a barrel of tar and some tools were discovered, indicating that the wreck must have been torn away from its slipway in a storm flood<sup>7</sup> before it was ready to be launched, drifting about 4 km downstream before capsizing, which can be partially ascribed to the fact that the ship has not been ballasted yet (Fliedner 2003, 51). Although the 'Bremen Cog' fits into the category of accidentally lost ships, it is not a closed find assemblage in the sense that it is representative of a cargo vessel, as collateral finds to be expected in such a vessel are lacking. It is, however, a perfect example of a ship-in-construction, as indicated by its unfinished state and the tool assemblage, and thus the 'Bremen Cog' represents a special case.

Generally speaking, however, the study of abandoned ships or ship-timbers excavated in urban settings will be mainly focussed on technological questions, for the lack of cargo and equipment remains. In several cases, planks, frames or other compass timber contain diagnostic information on the woodworking and building technique, so even fragmented remains have the potential to contribute significantly to the field of nautical archaeology.

In the case of consequentially abandoned — like intentionally grounded — vessels, one can similarly expect that circumstantial finds are not entirely representative of the entire shipload, since people, cargoes etc. could be salvaged from the ship. However, in several cases salvage is difficult, especially when the shipwreck occurred in a breaker zone in unsheltered conditions, as in the case of the Kollerup or Vejby wrecks, so one can expect at least some remainder of the original inventory. And when the wreck was grounded in a controlled setting, where salvage took place without haste and in a well-organised manner, some residues of the cargo can be still trapped in the sedimented bilge, as the Kuggmaren and Bossholmen case study (section 4.3.) illustrates. More often than not, only the bottom-

section of intentionally abandoned vessels survive, not only because only the bottom gets silted up, but also because worn-out vessels were run aground in shallow waters where they could be effortlessly scrapped and salvaged above the water-line. The richest find assemblage of a ship's inventory could be expected in accidental losses. The dramatic circumstances, however, often result in a scattered shipwreck site, as in the case of the Egelskär wreck (section 4.4.), which makes it difficult to excavate: Often only a few timber-samples are taken, due to the inaccessibility of the site, or the high costs involved. However, such wreck sites bear the greatest potential for being 'time capsules' in the sense of a closed find assembly, with plenty of collateral finds, which facilitate the inference of a whole spectrum of contextual information.

Why is it so important to point out the differential potentials of the way ship abandonment occurred?

It is so important, because the deposition process leads to a highly different dataset. This, in turn, determines the permissible methods of enquiry and interpretation. This ambivalence puts some limitations on the comparativeness of the material and results in case studies with different foci.

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<sup>7</sup> The North Sea coast was afflicted by a number of storm floods in the 14th century. There has been precious little published about the dendrochronological methodology and result, which was carried out several decades ago and indicated the year 1380+/- 1 (cf. Fliedner 2003, 50). This author would not be surprised if this result would have to be re-adjusted by a couple of years, as the number of dendrological samples taken in the early days of dendrochronological science were much lower than today, as scientists realised that ships were not built from timber all cut in the same year, but that timber used in shipbuilding could originate from a great variety of sources, and thus also different years. Perhaps it would be possible to link the loss of the 'Bremen Cog' to a historically recorded storm flood, once a more reliable dendrochronological dataset is established.

### 2.3. Maritime transit zones and transshipment points

Up until the 12<sup>th</sup> century, the Baltic Sea was regarded as peripheral sea from a Catholic European vantage point, at least as far as the literate class was concerned. Around 1075, Adam von Bremen observes in his *Gesta* that the Baltic Sea was almost unknown in his earth circle and that no writer other than Einhard has ever mentioned it (Henning 1928, 82). This arguably refers to Einhard's description in

*(...) soluta classe ad portum, qui Sliesthorp dicitur, cum universo exercitu venit. Ibi per aliquot dies moratus limitem regni sui, qui Saxoniam respicit, vallo munire constituit, eo modo, ut ab orientali maris sinu, quem illi Ostarsalt dicunt, usque ad occidentalem oceanum totam Egidorae fluminis aquilonalem ripam munimentum valli praetexeret, una tantum porta dimissa per quam carra et equites emitti et recipi potuissent. (Annales regni Francorum 808, ed. Kurze & Pertz 1895, 126).*

This excerpt is preceded by a Danish maritime raid on the Abodrite town of Reric while a Saxon army was marching towards the Danish border, reflecting a tripartite geo-political balance that resembled that shortly prior to that of the Wendish Crusade in 1147. Notwithstanding casual raids, the tripartite border between Saxons (Germans), Danes and Abodrites (Wends, or Western Slavs) can be regarded as a stalemate situation, in which none of the factions had an interest to grant regional supremacy to either one of the other two factions, which encouraged the Danish king to invest into a defensive infrastructure – the *Danevirke* – sealing off the southern land border with a defensive earthwork. This tripartite frontier zone remained stable until the precedent for a northern crusade was set in 1147, when the Germans and Danes were formally united under the auspices of a papally authorised crusade, overriding subliminal German-Danish rivalries to such an effect that they conquered, converted, or indeed killed the pagan Wends in a number of concerted terrestrial-maritime expeditions, in which wake the Danes conquered the island of Rügen in 1168, while the Saxons made the

the *Vita Karoli magni* as "*sinus quidam ab occidentali oceano orientem versus porrigitur*" – a bay that extends to the east from the western sea (Fraesdorff 2005, 105). Another 9<sup>th</sup>-century reference to the Baltic Sea ascribed to Einhard's authorship is found in the *Annales regni Francorum*, where it is described in the words of the Danes as *Ostarsalt* – the eastern salty sea:

*He [= Gudfred – king of the Danes] (...) shipped his army to a port which was called Sliesthorp [= Hedeby]. Here he stayed for several days and decided to protect his realm's border against the Saxons with a wall, that reaches from the eastern bay, which they call Ostarsalt, to the western sea, stretching along the entire northern banks of River Eider, interrupted only by one gate which could be passed by carts and equestrians. (transl. into German by Abel 1850, 110f. and into English by this author).*

greatest territorial gain in Holstein and Mecklenburg, consolidating their – for a long time – only Baltic Sea port of Lübeck, which was already founded in 1143 by Count Adolf II of Holstein on the ruins of the 1128 destroyed Abodrite town of Liubice. Lübeck became the hub of the German crusader movement to Livonia, and – as will be stressed shortly – its role in providing access to the Baltic Sea cannot be overestimated.

Up until then, the kingdom of Denmark had something akin to a logistical key position for facilitating transport and trade between the North and Baltic Seas. Certain landscape features abet the formation of transport arteries and nodes of transshipment, while others are restricting access, forming logistical bottlenecks. As such, southern Scandinavia – especially the Jutland peninsular – has been described; as a threshold between the Baltic and North Seas, not unlike Ancient Greece between the Black and the Mediterranean Sea, as the late Ole Crumlin-Pedersen (2010, 15) puts it (Fig. 2-17).

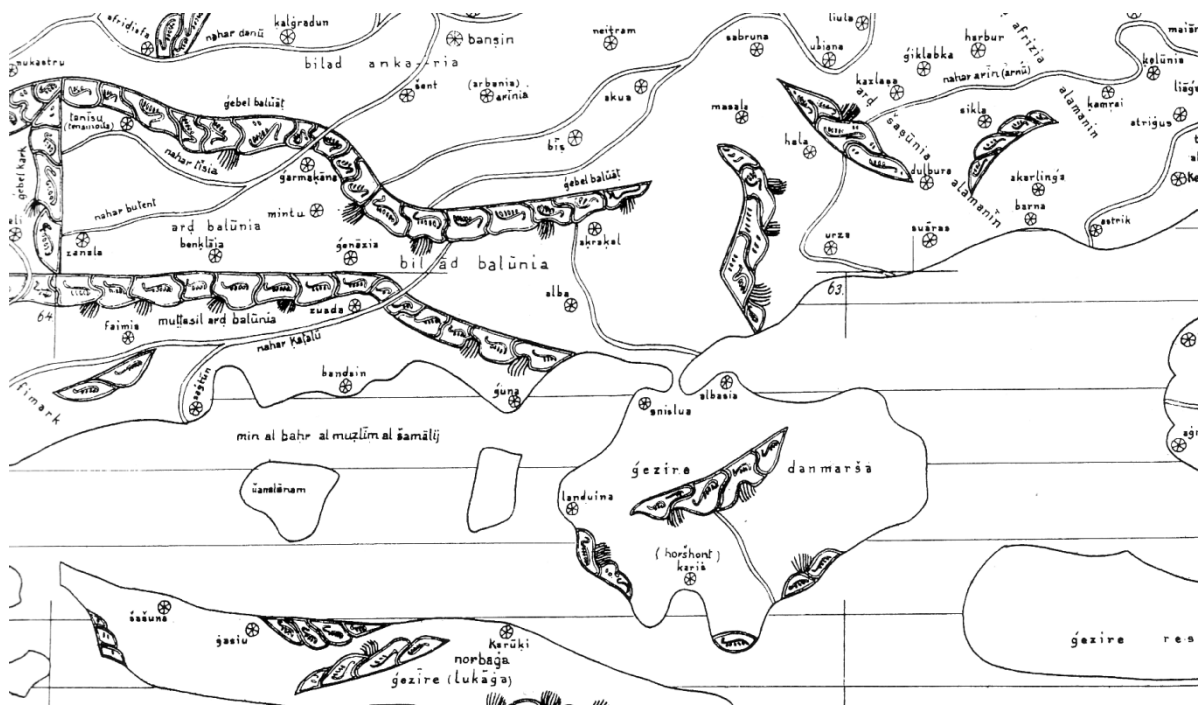


Fig.2-17. This transport-geographical 'threshold' was also perceived by outsiders, as this detail from a 1156 map drawn by the geographer Muhammed Al-Idrisi shows, who was in the service of King Roger II of Sicily. The map is upside down and depicts Jutland as a peninsular, not only forming a threshold to the Baltic Sea, but also featuring a "bottleneck" at the juncture between mainland Denmark (centre bottom) and the continent described as snislus – arguably Schleswig (Source: Jahnke 2009, fig. 2, cf. also Rathke 2007, 323).

The 'Ancient Greece' comparison is not unreasonable, both in terms of geography and epic connotation. The Danish kingdom has cast off the cloak of its Viking pagan past, became part of the Catholic family of nations and sought to embrace its new awakening as Christian nation in the light of an epic written in Latin by Saxo Grammaticus, the *Gesta*

*Danorum*. Like the Greeks, the Danes had a pagan past of their own. In its preface, written sometime between 1208 and 1223, Saxo gives an account of Denmark's geography, which reflects not only the view of a contemporary, but also that of a native and scholar of how much Denmark was perceived as a maritime landscape:

*Huius itaque regionis extrema partim soli alterius confinio limitantur, partim propinqui maris fluctibus includuntur. Interna vero circumfusis ambit Oceanus, qui sinuosis interstitiorum anfractibus nunc in angustias freti contractioris evadens, nunc in latitudinem sinu diffusiore procurrens complures insulas creat. Quo fit, ut Dania mediis pelagi fluctibus intervisa paucas solidi continuque tractus partes habeat, quas tanta undarum interruptio pro varia freti reflexioris obliquitate discriminat.* (*Gesta Danorum* 0.2.1.1-3)

*The extremes, then, of this country are partly bounded by a frontier of another land, and partly enclosed by the waters of the adjacent sea. The interior is washed and encompassed by the ocean; and this, through the circuitous winds of the interstices, now straitens into the narrows of a firth, now advances into ampler bays, forming a number of islands. Hence Denmark is cut in pieces by the intervening waves of ocean, and has but few portions of firm and continuous territory; these being divided by the mass of waters that break them up, in ways varying with the different angle of the bend of the sea.* (transl. Elton & Powell 1894, 6f.).

Interestingly, Denmark is not seen as being dispersed over many different territories, but as a heterogenic entity which seem to have existed before it was "cut into pieces by the intervening waves of the oceans". There is good reason to believe that this was not merely poetic licence on Saxo's part, but that the constant environmental change influencing the course of navigable channels was consciously perceived by him and his contemporaries, as is highlighted in section 2.3.2.; truly the hallmark of a maritime society, enforced by the belief that the continent and the edge of the world was divided by a peripheral ocean, which

was the common perception of the world as expressed in *orbis terrarum* maps, which relevance to the overall theme shall be addressed in section 3.1. In the following, four major sea and transshipment routes are briefly discussed in terms of their logistical relevance in facilitating communication between the Baltic Sea region and Western Europe (Fig. 2-18). As pointed out earlier (section 2.1), no major Western European river discharges into the Baltic Sea. Since river systems have always been important arteries of trade and communication, however, this can be certainly regarded as one of the factors why the Baltic

Sea remained relatively isolated up until the 12<sup>th</sup> century. Naturally, trade contacts to the west existed long before that time, as early medieval emporia like Birka, Hedeby, Lubice, Reric, Sigtuna or Wolin suggest (e.g. Jahnke 2013, 40). But large scale

colonisation, population movements, urban foundations and the development of new markets and trade networks for bulk commodities did only occur in the wake of the Wendish, Baltic and Prussian crusades.

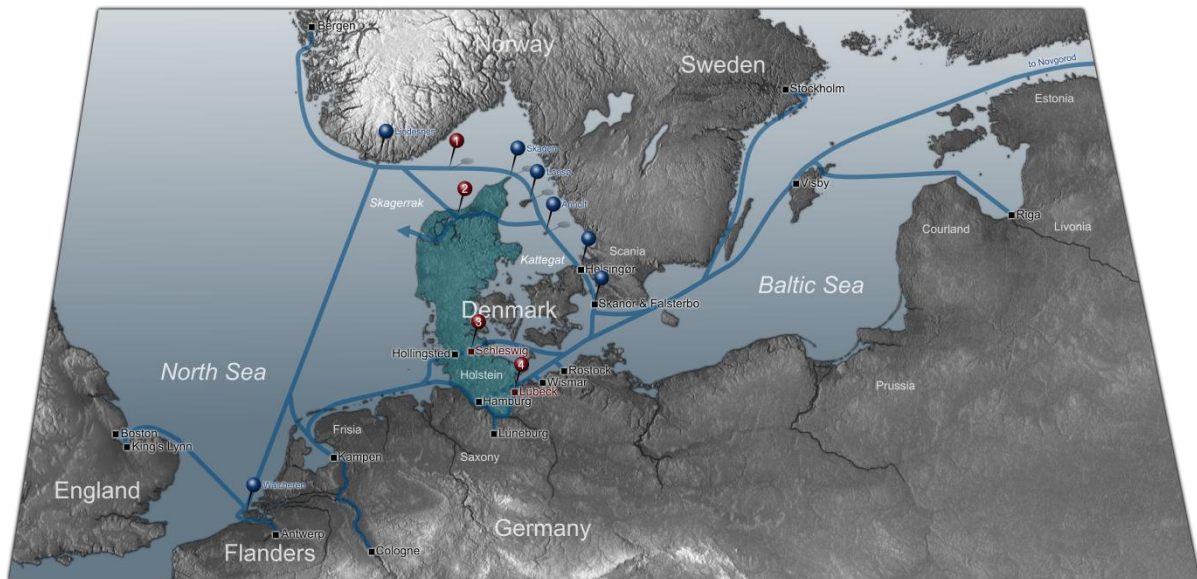


Fig. 2-18. The Jutland Peninsular (hatched in turquoise as geographical rather than territorial entity) as logistical bottleneck for four major routes into the Baltic Sea: (1) Skagen route, (2) Limfjord, (3) Hollingsted-Schleswig, (4) Lübeck. Some routes and places mentioned in the following text are schematically sketched in blue, but do not represent the entirety of the transport network. The Ummeland route through the Skagerrak and Kattegat – i.e. round Cape Skagen and past the logistical bottleneck of Helsingør – is marked with blue pins, which correspond to landmarks mentioned in the Hanseatic Sea Book. The leg between Lindesnes (Norway) and Walcheren (Flanders) is the greatest landfall distance in the entire Sea Book and may reflect that the Jutlandic west coast was avoided due to the lack of natural harbours along the coast, which could have offered protection in adverse weather conditions. In such situations, it was safer to stay at sea rather than run the risk to sail along an open lee shore (Graph: Daniel Zwick).

### 2.3.1. The Skagen route (Ummeland)

The earliest documented use of the route round Cape Skagen dates to 1251 in a form of a privilege issued by King Abel of Denmark, in which the rights of the Kampen merchants are protected, who sailed from Flanders to the Scanian markets around Cape Skagen. These merchants were called *vmlandsfaræ* or *ummelandfarer* – literally around-the-land-travellers (Hammel-Kiesow 2002, 55; cf. DD. II.1, nr. 50).

The privilege was drafted by the Franciscan Order and copies were kept in the monasteries of Utrecht (Flanders) and Lund (Scania) (Ventegodt 1982, 60f.).<sup>8</sup> In the following, an excerpt of particular interest is reproduced, in which – aside from the toll – also the ship-type from *partes occidentales* – western lands – is named, which was expected to round Cape Skagen:

*(...) Ad revocandas igitur contentiones lites et discordias necnon etiam periuria super solutione thelonei in nundinis Scanore que aliquando fiebant ab hiis qui vmlandsfaræ dicuntur que quidem sepius minime committi possunt sine discrimine et periculo non modico animarum taliter inter nos et eosdem accedente nostro et eorum consensu deliberatione sufficienti adhibita satis provide in perpetuum est statutum quod de quolibet cogone qui ad partes occidentales de Scanore redierit triginta duo solidi bonorum sterlingorum persolvantur (...). (DD 2.1, nr. 50).*

*(...) the law is to include (...) a toll payment in the Scanian fairs which is sometimes conducted by those whom we call vmlandsfaræ who shall without restriction and without discord (...) in mutual agreement henceforth provide for each cog coming from western lands to Skanor 32 solid sterling (...). (own free translation).*

<sup>8</sup>This reflects that monasteries fulfilled a notarial role in an age where literacy was restricted to mainly the clerical class. This important mediating role regarding navigation routes will be again stressed in section 3.3., but in a different context.

Notably, the privilege refers specifically to *coggonas* (cogs) to make the sea voyages around Cape Skagen. Around 100 years later, when the Hanseatic League prepared to send a war fleet against King Valdemar IV of Denmark, it stipulated that each cog should be accompanied by a *schnicke* (*sneccz*) longship, except the cogs sent from the North Sea cities of Hamburg and Bremen (Paulsen 2016, 107f., Paulsen 2010, 26). Does this imply that cogs were the only vessels fit to circumnavigate Cape Skagen and that the route was considered too dangerous for longships?

There are indeed abandoned ships on the *Ummeland* route, which have been referred to as cogs, as they relate to the eponymous Bremen-type in archaeological terms. In the following, ships with these characteristics will be neutrally referred to as Bremen-type vessels, as the question of whether the strict cog-association is correct has been doubted lately and will be discussed in further detail in chapter 4. For now, however, the possibility of them being cogs needs to be taken with a pinch of (sea) salt. One of the Bremen-type vessels is the Skagen or Hvide Fir ship, over 17,5 m in length, which is dated into the 1190's and was built of oak cut in southern Jutland. It was abandoned at the former coastline in direct proximity to Skagen, facing the Skagerrak (Daly 2015, 369; Englert 2015, 328). In this case, there cannot be a doubt that this vessel must have attempted to round Cape Skagen, but failed. This corroborates the impression of historians who assumed that the *Ummeland* route was used well before the first recorded instance, as German merchants — primarily from Lübeck but also the other Wendish towns of Wismar, Rostock and Stralsund — had already joined the Gotlandic *gilda communis* on their trade routes to Norway and England from the beginning of the 13<sup>th</sup> century at the latest (Hammel-Kiesow 2002, 55; cf. also Johansen 1955, 92ff.). Moreover, contemporary chronicles report that in July 1198 crusaders from Saxony, Westphalia and Frisia prepared, armed and victualised their ships in Lübeck, which were bound for Livonia (ACS V, ed. Lappenberg & Pertz 1868, 215). And in 1200, a Frisian ship arrived in Riga (HCL IV, 3). Both excerpts, however, cannot be seen as evidence that ships from the North Sea region — especially Frisia — sailed around Cape Skagen, as these ships could have been acquired or hired locally.

Interestingly, there is another early ship-find that seems to have come from the North Sea: The Kollerup ship, dated around 1150 and discovered in a silted up area of Vigsø Bay at Kollerup Strand, some 125 km southwest of Cape Skagen as the crow flies. Although it was built of oak which was cut in southern Jutland (like the Skagen ship), some parts of the cargo indicate that it must have previously called at a North Sea port, probably in the Low Countries, as indicated by pottery from Schinveld and Blussum, as well as large quantities of slates from the Rhineland (Khortz Andersen 1983, 16). Both the Skagen and the

Kollerup ships may be testament that the *Ummeland* route was used well before it appeared in documented history. Its use must have had a significance, as this route was generally avoided: Cape Skagen was dreaded because of its mighty cross-seas and currents, which may also be reflected in the *Ummeland* privilege, which implies a sea route along the Norwegian coast rather than the Danish Skagerrak coast in a later segment (not included in the above excerpt). This is also reflected in the Hanseatic Sea Book, in which the access point to the Baltic Sea is likewise described via the Skagen route, but also along the southern Norwegian coast, with Lindesnes (today still location of a lighthouse) mentioned as landfall or bearing position for a course set from Walcheren in Flanders (XII. 1-2). As such, it is the greatest distance out of landsight in the entire Hanseatic Sea Book, which is very significant, as dead reckoning was not in use, with which this gap could have been bridged (cf. Sauer 1996, 160). This navigational "leap", which was a risk in itself, can be explained with the even riskier prospects of sailing in landsight due to the perilous nature of the Jutlandic northwest coast, which was poor in natural harbours and was almost entirely comprised of sand dunes and beaches. So, an offshore wind could have turned it into a dangerous lee shore with no possibility to find a sheltered bay or inlet for anchorage. The increase of commercial seafaring on this route might also have been noted by the coastal population, making salvage rights an issue, as reflected in a privilege dating between 1146 to 1157, in which King Sven Grathe granted the townspeople of Ribe — amongst other benefits — half the share of recovered goods from shipwrecks (DRB 1.2.98). Ribe was for a long time the only Danish port to the North Sea. At other places along this coast water-craft was either unloaded offshore via lighter traffic or — if small enough — dragged onto the beach, a practice followed until the late 19<sup>th</sup> century (Ellmers 1997, 6). A further indication that the *Ummeland* route was considered dangerous — even though it became increasingly more frequented — is that valuable goods were still traded via Lübeck, while ships sailing round Cape Skagen were transporting bulk commodities. This basic trend can be quantified on the basis of the Sound Toll registers (*Pfundszoll*) since the second half of the 14<sup>th</sup> century with some infrequent entries since the second half of the 13<sup>th</sup> century (Hammel-Kiesow 2002, 55ff.). Thus, cogs were expected to serve the *Ummeland* route not necessarily because of their seaworthiness *per se*, but arguably more so because they were large ships. A strong case has been made for the hypothesis that cogs were unequivocally large vessels (cf. Jahnke 2011; Jahnke & Englert 2015, 37; Paulsen, 2010), although this characterisation is not shared by everyone (Ellmers 2010, 54). We will return to the cog-question later after having examined a greater number of Bremen-type ships. For now, it suffices to keep in mind that both — the historical record and archaeological finds — faintly suggest that the *Ummeland* transport zone was specifically linked to cogs, although not exclusively.



The *Ummeland* route was frequented by ships with home ports in the North Sea and the Baltic Sea. A representative cross-section on the origin of a convoy is documented by the arrest of a number of Hanseatic merchants in the English town of Ravenser in the year 1294/95, who had made an *Ummeland* voyage: Of the arrested ships, 23 were Frisian vessels returning to North Sea waters, and among those from the Baltic Sea, 16 were from Stralsund, 3 from Lübeck, 2 from Greifswald, 1 from Rostock and 1 from Riga (Hammel-Kiesow 2002, 72). The *Ummeland* route became also an alternative route to cut costs, e.g. when staple rights for textiles and wine were exacerbated in Lübeck in the mid 15<sup>th</sup> century, which hit Cologne and other Rhenish merchants trading with these products the hardest. They had transshipped their cargo via Kampen with Hamburg-bound ships, from where the products were brought to Lübeck. Since Lübeck's staple rights changed to their disadvantage, they started to use the *Ummeland* route too (Militzer 2001, 79). Conversely, when King Eric VII of Denmark built a castle in Helsingør, established a toll-collecting point and exerted total control of this logistical bottleneck, a war between Denmark and the Hanseatic League was provoked. In this time of instability, the revenues from the Stecknitz Canal between Lübeck and the Elbe River – connecting Hamburg – doubled, as merchants sought to avoid these unsave water and chose the saver alternative route (Dollinger 1970, 199ff.).

The question of whether the *Ummeland* route was of any importance to crusaders bound to the Baltics or Prussia cannot be easily answered in the light of the archaeological evidence. As mentioned before, there are references of Frisian ships in the Baltic Sea in the early phase of the Baltic Crusades, who might have taken this route, thus five decades before the *Ummelandfarer* privilege was issued. However, Lübeck was apparently successful in its attempt to keep Flemish and Frisian ships out of the Baltic Sea by way of the Skagen route, as documented in 1294 (HUB I, 1154). But this has to be seen in the context of economic competition and not the crusades. The *Ummeland* route will have gained in importance when especially visiting English crusaders joined the Teutonic Order's *reysen* into Lithuania. In fact, one could even ask whether the Prussian-built Vejby ship built in 1372 may have transported English crusaders? The ship was on the way back from England, as was in part determined by a mineralogical analysis of the ballast stones (Thomsen 2002, 69). The ship must have taken the *Ummeland* route and sank off the north Sealand coast with – amongst other things – 109 English gold nobles minted between 1370-75 (Thomsen 2002, 66f., 79f.) (Fig. 2-19).



Fig. 2-19. English gold nobles (1369-77) retrieved from the *Vejby* ship (Thomsen 2002, fig. 45).

While Mikkel Thomsen evaluated the wreck solely within an economic context, noting luxury items such as dress assessoirs and other objects connected with high status (cf. Thomsen 2002, 71), one could ask whether the English gold nobles could have filled the war chest of an English nobleman going on a crusade with his entourage, rather than a merchant's chest. This would also explain the elegant personal belongings. In the 14<sup>th</sup> and early 15<sup>th</sup> centuries – in a late revival of European chivalric traditions – the *reysen* of the Teutonic Order into Lithuania (the last remaining pagan nation in Europe) were joined by members of the European nobility with prospective crusaders of Bohemian, Dutch, English, Flemish, French, German, Scottish and even Portuguese descent; many arriving by ship (cf. Paravicini 1989, 192). English noblemen and their entourages are known to have travelled to the Teutonic Order's heartland of Prussia between 1328-1394 and 1408-1410, especially in peak phases in 1360-1369 and 1390-1394 (Paravicini 1989, 122). However, for the 1370's – i.e. the time the *Vejby* ship foundered – no English arrivals were recorded by Teutonic chroniclers (Paravicini 1989, 182). It would be perhaps too speculative to imply that they never arrived because they suffered shipwreck. However, there are several aspects which corroborate the possibility that the *Vejby* ship might have been just that, a crusader transporter, as highlighted by the custom of crusaders to take gold coins on such journeys, which would have been an uncommon currency amongst German merchants (Paravicini 1989, 202). Moreover, it was not uncommon that an English nobleman embarked on a ship commanded by a Prussian skipper, as the voyage of the Count of Derby to Prussia on the *Ummeland* route in 1390 shows, who had the interior of the ship converted to accommodate stables, bed chambers, a pantry and even a chapel for himself (Paravicini 1989, 195f.). However, this is only circumstantial evidence not directly related to the *Vejby* ship itself, so this has to remain a hypothesis.

### 2.3.2. The Limfjord passage

The Limfjord – technically a sound – offers a safe alternative route to the dangerous route round Cape Skagen across a distance of 180 kilometres, today accessible from the west at Thyborøn, and Hals in the east (Albrechtsen 2006, 40f.). This was an important commercial and military transit zone in the Viking Age and even before, as early 7<sup>th</sup> century Frankish coins from Dorestad indicate, which were found at the western entrance of the Limfjord (Jankuhn 1986, 32). The *Heimskringla* written by Snorri Sturluson around 1225 retrospectively refers to the saga of the Norwegian King Harald Hardrade and his escape from the Limfjord in 1061, which is described as accessible via a river. Persued by a mightier Danish fleet, which blocked an access point, the Norwegians managed to escape by dragging their ships over an isthmus, which divided the Limfjord from the North Sea (*Heimskringla*, cap. 60). Undoubtedly, the exact details and whereabouts cannot be reconstructed, as Snorri recited a piece of oral tradition, but the reference to a river could be very meaningful, as this could be identical to the *Slojkanalen*, which connected the Skagerrak with the Limfjord. The results of a

survey with a ground penetrating radar suggest that it was 100 metres in width and runs from Kollerup Strand and entered the Limfjord at a point located 7 km to the west of Aggersborg – the largest ringfort of the Viking Age (Andreasen & Grøn 1994, 11). Great parts of Vendsyssel – i.e. the land bar north of the Limfjord – are covered in marine sediments from early medieval times, suggesting that the landscape was dramatically different and was characterised by a number of navigable channels and rivers, which are studied in an ongoing investigation. There were probably more than one western access points, which highlights the Limfjord's importance as a highly important Viking Age transit corridor and fleet gathering point. In 1085, for instance, King Canute IV ordered his leading fleet to convene in the Limfjord to obtain the consent of the nobles to attack England (Lund 2009, 39). However, the Limfjord's importance as transit zone appears to have changed in the course of the 12<sup>th</sup> century when the navigable channels silted up (cf. <http://nordmus.dk/arrangementer-5/84-forskningogformidling/arkaeologi/94-skagerak-4-fortsat>). Through this process all western entry points seem to have completely sealed off by the early 13<sup>th</sup> century, as the following source suggests:

*Ex his Iulia granditatis inchoamentique ratione Danici regni principium tenet, quae sicut positione prior ita situ porrectior Theutoniae finibus admoventur. A cuius complexu fluminis Eydori interviatione discreta cum aliquanto latitudinis excremento septentrionem versus in Norici freti litus excurrit. In hac sinus, qui Lymicus appellatur, ita piscibus frequens exsistit, ut non minus alimentorum indigenis quam ager omnis exsolvere videatur. (Gesta Danorum 0.2.1 .4-5).*

*Of all these [Danish territories], Jutland, being the largest and first settled, holds the chief place in the Danish kingdom. It both lies foremost and stretches furthest, reaching to the frontiers of Teutonland, from contact with which it is severed by the bed of the river Eyder. Northwards it swells somewhat in breadth, and runs out to the shore of the Noric Channel (Skagerrak). In this part is to be found the fjord called Lîm, which is so full of fish that it seems to yield the natives as much food as the whole soil. (transl. Elton & Powell 1894, 6f.).*

In the above excerpt, Saxo Grammaticus refers to the Limfjord as *sinus Lymicus*, which indicates that the Limfjord was no longer a sound but a fjord (as the modern name implies) at the time when he wrote his *Gesta Danorum* in the early 13<sup>th</sup> century. It took more than six centuries until the Limfjord became a sound again, when in a series of storm floods from 1825 to 1862 the western sand isthmus called Agger Tange was breached lastingly and the Limfjord became accessible and a marine environment again (Albrechtsen 2006, 43; Pedersen 1976, 6). For much of the period discussed here, however, the Limfjord has lost its importance as transit zone for east-west communication, which will have abetted the rise in importance of the alternative routes described in this section. Although the abovementioned Kollerup ship is frequently brought in connection with an *ummeland* voyage, its finding location close to where the *Slojkanalen* would have entered into the Skagerrak also points to a possible use of the Limfjord passage. It is easily imaginable that the ship's crew miscalculated the right approach to the canal's entrance and was driven ashore, or it has already silted up to

unexpected levels and thus could not be traversed. Since it is not known exactly when the Limfjord's western access silted up, this would be a distinct possibility and would indicate – if confirmed by further geological study – that the Limfjord continued to be a transport zone for long-distance trade until at least the mid 12<sup>th</sup> century.

### 2.3.3. The Schleswig – Hollingsted isthmus

Schleswig was the successor settlement to Hedeby and its earliest settlement phase could be archaeologically dated to 1071, which is also marked – at the very outset – by a building boom phase with extensive land-reclamation into the Schlei Fjord, which continued until 1100. The reclamation could be interpreted as quay structures only at their maximum extent and last building phases, where they would have reached a water depth of a metre, whereas the initial land development is interpreted as

settlement area as it occurred in too shallow water to offer the possibility to moor vessels alongside the revetments (Müller *et al.* 2014, 28f.; Rösch 2014, 40). The town not only inherited Hedeby's old land connection to Hollingsted, which was connected to

the North Sea via the Treene and Eider rivers (Fig. 2-20), but arguably also its long-distance trade connections, confirmed by both archaeological and historical findings.



Fig. 2-20. Excerpt from the Ducatus Holsatiae map by Nicolaes Visscher and Abraham Goos in 1630, showing the Wadden Sea (North Sea) on the left side with buoys marking the entrance to the Eider River, into which the Treene River flows. At the latter – just south of the Daneverke – Hollingsted is located, not far away from Schleswig at the Schlei Fjord, connecting to the Baltic Sea in the east (both towns marked in red by the author). When this map was drawn, the old land route from Schleswig to Hollingsted has lost its importance as east-west transport axis.

The pivotal role between the eastern and western economic spheres is well reflected in the excavated material, indicating Schleswig's far flung long-distance trade contacts. Commodities from western Europe included textiles from England, Iceland and Flanders, dried fish from the Atlantic, tuff and 11<sup>th</sup>/12<sup>th</sup>-century pottery from the Rhineland, mill-, whet- and soapstones from Norway. More importantly, however, was Schleswig's access to the markets in the east, as indicated by pelts from Russia, wax from the Baltics, silk from Asia Minor, drinking vessels and amphorae from Constantinople; many of these commodities were traded via transshipment ports in Russian lands, like Kiev and Novgorod (Müller *et al.* 2014, 31; Rösch 2014, 43; Vogel 2002), partially shipped by the Russians themselves, as the presence of a Russian trade fleet in Schleswig for the year 1156/57 suggests (GD XVII, 1; cf. also Sorokin 2006, 160). The 'exotic' commodities will have arrived by the old Varangian trade network via the Russian river system, which is often – but incorrectly – exclusively associated with the Viking Age. It survived at least into the early 13<sup>th</sup> century (Lind 2009, 32ff.). Even 400 years later, this old trade connection was apparently not forgotten, when Duke Frederick III of Schleswig-Holstein-Gottorf sent his emissary Adam Olearius in the mid 17<sup>th</sup> century across the Volga and the Caspian Sea to forge a trade connection with the Shah of Persia (Olearius 1656).

The hagiography of St. Thomas of Canterbury of ca. 1170-1175 refers to a ship built by a Schleswig citizen in joint-venture with the Danish king, which was so extraordinarily large that the shipbuilders had problems launching it. The ship-owner appealed to the patron saint to help launching the ship and promised to donate 100 pounds of wax from each trading voyage, which indicates that this ship was

built for the trade with the Baltics or Russia (Englert 2015, 13). The pelt trade with Russia may even be reflected in the Karschau ship's finds assemblage itself, i.e. 300 wooden pins found as part of the cargo were interpreted as fur pins, and fur freighters into the far east were indeed attested in Schleswig's municipal law (Radtke 2004, 19). The Karschau wreck is a particularly large transport vessel of 26 m in length and a beam of 6.8 m built in the Scandinavian shipbuilding tradition of locally cut timber from the Little Belt region around 1145 (Englert & Kühn 2015, 228). Another wreck of a medium-sized vessel built also in the Scandinavian shipbuilding tradition was found nearby the Möveninsel at the entrance of the port, which dates to 1163 and was also of local provenance (Belasus 2009, 93). Both wrecks have some features, which seem to suggest either foreign influences, or in the least, a gradual change in shipbuilding technology, which will be discussed in further detail in the closing section of this chapter.

The internationality of Schleswig is also testified by contemporary chroniclers; for the 1070's by Adam von Bremen, referring to ships leaving frequently to the lands of the Slavonians, Swedish, Samis and Greeks (*Gesta* IV, 1), while Schleswig's oldest municipal law of 1216-1241 refers to Saxon, Frisian, Icelandic and Slavonian visitors (Riis 2010, 44). Adams von Bremen's reference to "Greeks" is often associated with the "Rus" due to the shared Christian-Orthodox religion, but he could have indeed referred to the Greeks, i.e. the Byzantine Empire, as the old Varangian trade route was still in use. A customs role from Utrecht dating to 1122 refers to Frisians coming from "Eastland", probably via Schleswig (Hammel-Kiesow 2002, 80; cf. also Jahnke 2013, 42). Trade confederations seem to have played a pivotal role in protruding into distant markets, especially the Danish St. Canute guilds, which protected trade interests

along the Baltic route to the east, i.e. on Öland, in Visby and Reval/Tallinn; not only for Schleswig merchants however, but also for nearby Flensburg merchants, whose guild's statutes from 1200 stipulated a course of action in case guild members suffer shipwreck or are abducted in pagan lands, which clearly point to the Baltic region (Riis 2010, 44f.) where Denmark conducted several crusades at the time. This leads to the question of whether Schleswig also played a central role in fitting out crusader fleets to a similar extent as Lübeck? There is no concrete evidence to this author's knowledge, although the crusading epic may have been widely propagated, as indicated by Schleswig's 12<sup>th</sup> century cathedral's portal, which bears the inscription that the king received the order to baptise the Rügians from Christ (Radtke 2007, 320). The Danish conquest of Rügen was completed in 1168 under King Valdemar I and Bishop Absalon, although it is disputed whether this conquest was indeed papally authorised and could be therefore regarded as crusade (cf. section 1.2.2). However, pilgrimage as such seem to have played an important role in Schleswig since the 12<sup>th</sup> century, as evidenced by a great number of scallop shells (*pecten maximus*), which were the badges for pilgrimages to Santiago de Compostella in Galicia, Spain (Köster 1983, 122f.). However, there are no finds of pilgrim badges in Schleswig that could be associated with the Baltic Crusades.

The period of Schleswig's prosperity and significance in the long-distance trading network was short-lived, which was explained by the power vacuum after King Valdemar II's death in 1242 and the disintegration of Danish hegemony and central authority in its wake (cf. Radke 2007, 331), as well as the presumption that Schleswig was superseded by Lübeck around 1200 (cf. Jahnke 2006). This decline is directly reflected in the town's topography with a new parcellation geared towards a regional rather than an international market and a standstill of port activities, while Hollingstedt lost its importance too and became a village (Radke 2007, 331). This trend is corroborated by a concurrent decline of maritime activities in Hollingstedt, as indicated by a steady decrease of *sintel* (caulking cramp) finds until the turn of the 13<sup>th</sup> century, which had been continuously present in the Hollingstedt find assemblage since the 10<sup>th</sup> century in all shapes and variations (Siegloff 2004, 129f.).

### 2.3.4. Lübeck

In 1143, Lübeck was founded by Count Adolf II of Holstein as Low German city, and by appropriating the Slavonic name of Lubice – i.e. of the ruined predecessor settlement destroyed in 1138 – it was sought to continue the emporia's legacy and its trade network. At the same time, Gotland had freed itself

from the Empire of the Svear between 1120 and 1140, and Novgorod has split off the Kievan Rus and became a republic with an elected prince (Hammel-Kiesow 2015, 26f.). These three sites are of key importance to understand the preconditions under which the long-distance trade network could develop, notably in the absence of central authority. When Henry the Lion – Duke of Saxony – re-established Lübeck in 1158, he consciously moved Saxon merchants from Bardowick to Lübeck, which inherited its salt trade route from Lüneburg (Jahnke 2013, 46).

There are several indications that Lübeck lacked a fleet and therefore sought to attract foreign merchants and ships, as indicated by messengers sent out by Henry the Lion in 1159 to Denmark, Sweden, Norway and Russia, to offer them peace and access to free trade in his city of Lübeck (HCS, 86). This effectively meant that the merchants were exempted from tolls, and from this favourable free trade arrangement the *gilda communis* could have evolved – a trade confederation between Gotlandic and Low German merchants (Hammel-Kiesow 2015, 27). Two years later, in 1161, the Arhlenburg Treaty was negotiated to insure peace between Gotlanders and Germans (Hammel-Kiesow 2015, 30). Gotlanders played not only a vital role in the city's early mercantile missions, but also in providing ships and other resources for the crusaders and colonizers arriving in Livonia. The need for ships in Lübeck seem to have frequently surpassed the supply. Even as late as 1224, Slavonic ships needed to be hired for the transportation of herring (HUB I, 174).

Lübeck's fleet became also the city's achilles heel, as King Canute VI of Denmark threatened vital mercantile interests by arresting the Lübeckian fishing fleet off the Scanian fishing grounds and freed it on the condition that it accepted him as patron, *de facto* becoming part of his kingdom (HCL II. 12.10; AAL III. 5.1., VI, 13). The decision to offer the Danish king the sovereignty over the city was certainly abetted by the disdain for Duke Adolf III of Holstein's rule, whose vicegerent's government was perceived as "*tyrannis*" (Pelc 2003, 45).

Since 1196 Lübeck was the port of the German-Livonian crusading movement, from which crusader fleets departed on an annual basis. A pilgrim's badge from Livonia was unearthed in Lübeck which is testament of this movement (Fig. 1-3). In general, Lübeck seems to have been played a pivotal role also for the crusades to the Holy Land (cf. paper E), and other destinations. This is symbolised by an early 13<sup>th</sup> century chalk painting in St. Nicolas Church in Mölln – only ca. 20 km south of Lübeck – showing a pilgrims' voyage across the sea and a pilgrim wearing a scallop shell as pilgrim's badge (Fig. 2-21).



Fig. 2-21. Early 13<sup>th</sup> century chalk painting of a pilgrim voyage in St. Nicolas Church in Mölln showing the blessing of a pilgrim by St. James (left), the blessing of the pilgrims' sea voyage (centre) by St. Nicolas – the patron saint of seafarers – and the Last Judgement (right) (Ellmers 2003, 181).

When Valdemar II attempted to gain sovereignty over Livonia in 1220, this was resisted by the bishop and merchant community of Riga who saw their interests threatened.<sup>9</sup> This induced the king to blockade the port of Lübeck, i.e. the only lifeline of the Livonian crusading movement, thereby obstructing the departure of the crusaders and supplies urgently needed to protect the Bishopric of Riga. This blackmailing attempt did not go unnoticed, as Pope Gregory IX realised Lübeck's importance for the crusading movement and forced King Valdemar II to lift the blockade by threatening to grant Livonian-bound crusaders the right to forcefully break the blockade, which would have *de facto* meant a war against a Christian king (Jensen 2001, 82f.). Not surprisingly, King Valdemar II relented at this prospect and lifted the blockade. In the ensuing period, the correspondences exchanged between the papacy and Lübeck's city council reveal the pivotal logistical importance for the crusades ascribed to the city by the papacy (cf. Herrmann 1995). Apart from this unfortunate episode, Lübeck seem to have greatly benefited from the *pax waldemariana*, as King Valdemar II did not only confirm all municipal privileges granted previously by Emperor Frederik

<sup>9</sup> section 3.2 discusses the way the local population crossed the travel plans of the Danish envoy commissioned to take over the magistracy of Riga, demonstrating the significance of local pilots and scouts and the support of the population providing them.

Barbarossa and Duke Henry the Lion, but Lübeck merchants were also able to expand their trade connections under Danish protection (Hammel-Kiesow 2015, 51). The economic development of Lübeck was decisively stimulated by the king between 1203 and 1209, and its merchants received new privileges on the Scanian markets and the right to import and export goods without restrictions, thereby even gaining an advantage over native Danish merchants (Pelc 2003, 48). The Danish rule in Lübeck has also left archaeological traces, as many construction and land-reclamation works in the harbour area and fortifications date from the Danish period, specifically brick-architecture, which was reasonably novel at that time and increasingly replaced wooden constructions (Gläser 2009; Mührenberg 2003). As pointed out by Carsten Jahnke (2015, 44), the economic ascendancy of Lübeck was not a predestined expansionist inevitability, but depended on a number of factors, which can be identified with the access to both the Lüneburg salt-works and the Scanian herring fairs, which were the initial driving force for Lübeck's swift economic growth. Another important factor was that Lübeck merchants suddenly entered into a novel and attractive situation during the *pax waldemariana*, as they enjoyed the rights of their fellow Danish merchants overseas and could join their *confederationes* on trading missions to Scandinavian and Russian markets (Jahnke 2013, 43ff.). Thus, the *pax waldemariana* would have opened many doors to merchants from Lübeck that would have been

otherwise closed, and once Valdemar's rule over Nordalbingia and Lübeck came to an end in 1223 and 1227 respectively, apparently enough trade contacts have been established for most of the doors to remain open. The sequence by which Lübeck gained access to international markets has become fossilised in the harbour geography as well, highlighting the importance of the new markets in Scandinavia and the eastern Baltic region (Fig. 2-22).

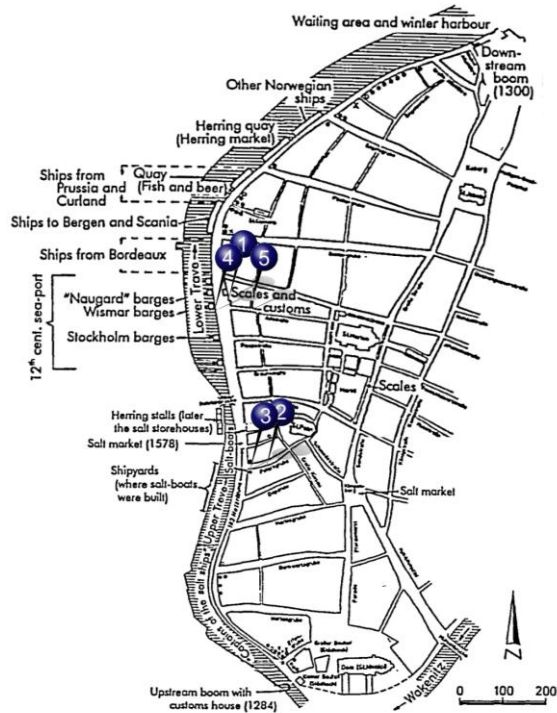


Fig. 2-22. The chronological sequence of trade routes is to a certain extent reflected in the spatiality of Lübeck's harbour development. The pins indicate maritime archaeological finds: (1) 10 cm long hooked nail around / before 1212, (2) sintel, around/after 1209, (3) cradle associated with the rigging, ca. 1193-1204, (4) sintel, between 1250-1350, (5) 10 square-shanked nails for double-bending, several clinker-nails as well as 3 nails with round-shaft and 4 pegs at the underside of the nail-head, before 1184 (Map: Hammel-Kiesow 2002, figs. 6-7. The location of artefact finds is based on Ellmers 1985 and 1992. The map was modified by the author to include the pins).

Hitherto only a few maritime archaeological finds from Lübeck were studied (cf. Ellmers 1985a, 1992), although the most recent excavations have brought numerous ship-timbers in secondary use to light, which date to the foundation period. The finds assemblage include sintels from the early 13<sup>th</sup> century (Ellmers 1985a, 156) and hooked nails (= double-bend) from the late 12<sup>th</sup> century (Ellmers 1992, 8), as indicative of the bottom-based tradition and the Bremen-type (cf. fig. 5-11). Also clinker-nails predating 1184 were found (Ellmers 1992, 10), which are – for earlier periods such as this – commonly associated with a Scandinavian origin. Given the efforts by Henry the Lion to attract ships from

Denmark, Sweden and Norway to Lübeck, the finding seems little surprising. There are several indications that Lübeck was firmly integrated in the Danish maritime transport network, as — for instance — indicated by a privilege of 1220, in which King Valdemar II granted the citizens of Lübeck to have the right to salvage commodities from their vessels wrecked off the Danish coast (DRB 1.5.171). Interestingly, even after the Danish rule in Lübeck came to an end, rights were still granted, like in 1229 to the Dominicans of Lübeck asking King Valdemar II for the permission to erect a beacon — *signum aliquod discretivum pro vitando periculo navigatium* — on Falsterbo reef to avert danger, which was granted (Ellmers 1976, 59). This reveals that Lübeck citizens continued to trade on the Scanian markets despite they cast off Danish rule and even felt confident enough to file a request with the Danish king. A *signum* was also erected at Travemünde (i.e. the Trave estuary only a few kilometres downstream from Lübeck) in 1226 (HUB I, 205) and in 1316 this *signum* was even lighted — thus has to be interpreted as lighthouse — as indicated by a reference to a *custos lucernae* (LUB II, 1080).

Not only the seaward connection was improved, but in 1241 the Duke of Saxony and Count of Holstein granted safe conduct on the road between Lübeck and Hamburg (Jahnke 2015, 49). This road may have been taken by *gilda communis* merchants — also known to have used the Skagen route — for trade between Gotland and England, as early as 1237 (Hammel-Kiesow 2002, 68; Kattinger 1999, 251ff.). The count of Holstein issued charters for merchants from Riga and Gotland in 1251 and 1255 respectively, to attract them to use this route, possibly as direct reaction and in competition to King Abel's *Ummeland* privilege of 1251 (cf. section 2.3.1) (Kattinger 1999, 308ff.). And since 1398 the Stecknitz Canal connected the Trave River with the Elbe River, thus connecting Lübeck, Lüneburg and Hamburg for river barge traffic, which became a safe alternative route whenever the *Ummeland* route became even more hazardous than it already was, especially in times of war.

### 2.3.5. Jutlandic interfaces: Assessing transitions in shipbuilding technology

Judging from a preliminary impression, there seems to be a clear pattern of ship-finds that could be associated with their respective geographical contexts: Cogs (*sic!*) or Bremen-type vessels seem to have been dominant in the Skagerrak region, while typical Scandinavian-built vessels were operating in Schleswig. Bremen-type or other North Sea vessels typically featuring *sintels* were operating in Schleswig's western counterpart — Hollingsted. And the few hitherto studied maritime archaeological finds from Lübeck seem to suggest influences from both shipbuilding traditions (Fig. 2-23).

There is, however, an undercurrent of change on a componentry level, which renders a different dynamic to the initial impression. It has been noted that the Möweninsel wreck of 1163 features a deviation from the typical Scandinavian design, as the *biti*-system is omitted in the midhip-section, thus similar to the Kyholm ship built between 1201 and 1207, which *biti*-system was likewise rudimentary and indeed the last ship to feature this system (Belasus 2009, 94; Englert 2015, 285; Crumlin Pedersen 1980, fig. 9). Both wrecks, however, have typical Scandinavian features like decorative mouldings, square-shanked clinker nails etc. The technological deviation in the case of the Möweninsel ship was ascribed to factors like the urbanisation process, population growth, differences in the societal fabric and rise in transport capacities (Belasus 2009, 97). It is difficult – if not impossible – to link any of those factors with such specific technological change, although there is a case to be made for a diverse societal fabric having a possible influence on different technological solutions. The Karschau wreck built in 1145 was (untypically for the tradition it was built in) repaired with a *sintel*-caulking (Englert & Kühn 2015, 228). Several isolated *sintel*-finds have been also made in Schleswig for the first half of the 13<sup>th</sup> century, indicating that the *sintel*-technology has apparently crossed the land-bridge from Hollingstedt to Schleswig, arguably by visiting trades- or craftsmen from the North Sea region – e.g. from Frisia, Westphalia or Saxony – where the *sintel*-technology originated. Conversely, clinker-nails – originally associated with Scandinavians – have been found in Hollingstedt since at least the early 12<sup>th</sup> century (Siegloff 2005, 129). The *sintel* technology has spread from a very early point to as far as Novgorod, with the earliest find dating to 1192, interestingly exactly corresponding to the year in which the first Hanseatic *kontor* in Novgorod was established (Dubrowin 1997, 453). Although the possibility that

the *sintel*-technology was "exported" to Novgorod by merchants from Lübeck seems very distinct, it needs to be noted that *sintels* were also known and used in Schleswig and that its merchants were likewise engaged in trade with Novgorod. *Sintels* have been also dispersed in Prussia in the wake of the German colonization in the 13<sup>th</sup> century, primarily detected in Vistulian river-craft (Ossowski 2009, 182ff.).

While having stressed that the Scandinavian ships near Schleswig incorporated some untypical components, which might be indicative of external influences, the Bremen-type ship of Kollerup of ca. 1150 (i.e. the earliest dating "specimen" of this type) is also far from being a typical representative of its alleged type. As has been stressed by this author (paper B, 49), there is a methodological fallacy in regarding ships with deviating features as "imperfect approximations" to a standard type, as this would also imply a state of equilibrium, in which a type reached its most perfect expression at a – more or less – randomly defined point in time. This is certainly illusory for a medieval context, but often determines the way how ship-finds are assorted into typologies on a subconscious level. Therefore, it was emphasised to regard such ships not as imperfect "hybrid" types, but as intermediate forms or variants in their own right, which are not yet well represented in the archaeological record (cf. also paper A, 345ff.). These have the greatest potential to indicate greater transformation processes, especially ships with short-lived features marking a transitional phase in the development of ship-technology (cf. paper E). This could be achieved by stressing the deviations rather than the similarities; an approach quite counter-intuitive to the typologist, who is primarily concerned with identifying similarities and overlaps. However, in the case of the Kollerup ship, this opens an entirely new avenue of enquiry.

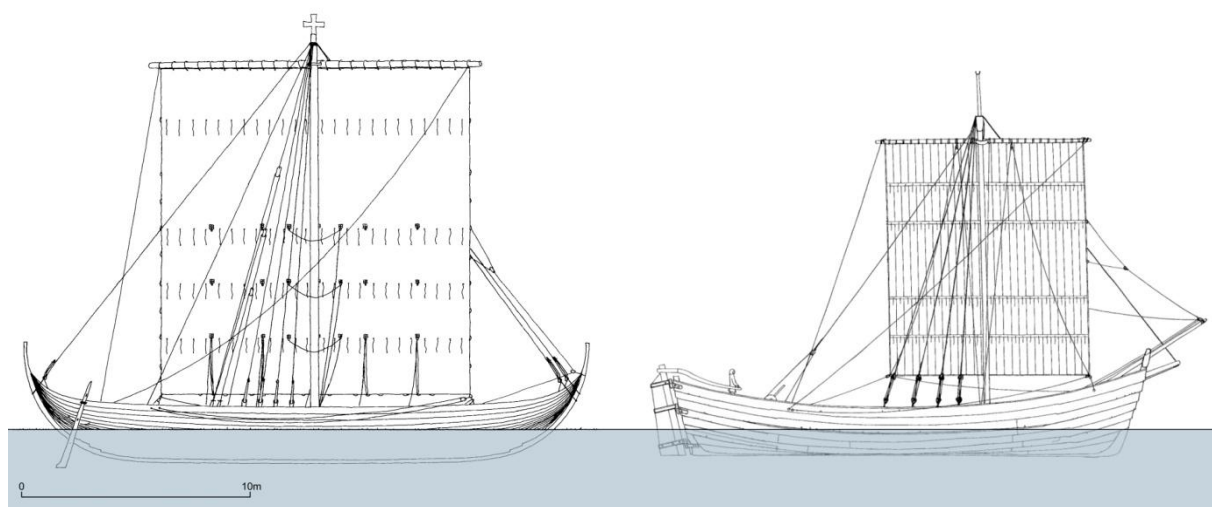


Fig. 2-23. This reconstruction shows the visual difference between the largest cargo ships built in the Scandinavian/Nordic shipbuilding tradition – represented here by the *Lynæs* ship (after 1140) on the left side, very similar to the *Karschau* ship – and the earliest Bremen-type ships – represented here by the *Kollerup* ship (ca. 1150) on the right side (Reconstruction: M. Gothche in Englert 2015, 178 (left), *Westphal* 1999, fig. 14 (right), graph modified by the author).

Although many of its characteristics are in line with the Bremen-type, like the use of tangentially processed planks, the straight fore and after stem, the stern-rudder – as verified against contrary earlier claims and reconstructions (Hocker & Daly 2006, 192f.; Westphal 1999) –, the use of *shintels* and moss for caulking, as well as hooked nails (Khortz Andersen 1983). All these criteria have been brought in connection with the bottom-based tradition of which the Bremen-type was part of (cf. definition Hocker 2004). Nonetheless, there is a significant number of criteria that is not covered by this typology, starting with the narrow hull, the unusually forward position of the mast-step in the first third, the mast's position in a floor-timber rather than a keelson, the special nails with which the plank shafts were fastened, i.e. featuring 4 pegs at the nail head's underside (Fig. 2-24). Similar nails were also encountered in Lübeck (although with a round-shaft) from a context of 1184 *terminus ante quem* and a (effectively undated) ship-find from Skien, Norway (Ellmers 1992, 10). Another interesting anomaly is the reversed L-shaped strake at the transition between the clinker and carvel planking, which has been ignored, perhaps to make it fit better into a typology with other Bremen-type ships (cf. Crumlin-Pedersen 2003, 262)? It is the inverted L-shaped 5<sup>th</sup> strake, which is reminiscent of an old Norse feature known as *meginbúfr*, literally “strong strake”, which supports the upper end of the frame on which the knees rest (Falk 1912, 53). The *meginbúfr* traditionally facilitated the transition from bottom to side planking in Viking Age vessels, strengthening the vessel laterally and in some cases jutting out like a cornice at the waterline.

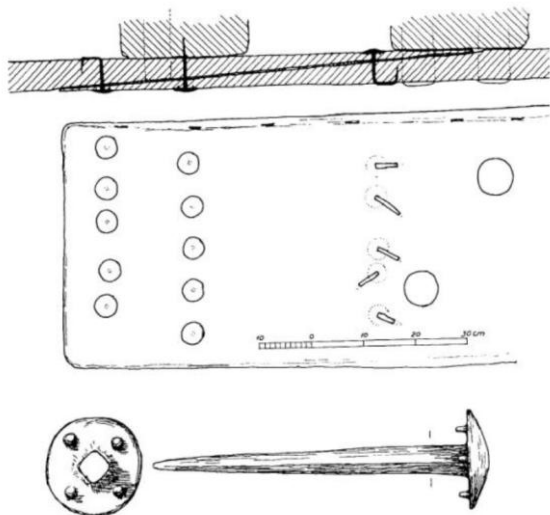


Fig. 2-24. Square-shanked nails with 4 pegs at the underside (with their tips hooked, i.e. re-entering the wood) were used to join the plank scarfs of the Kollerup ship (Source: Kobrtz Andersen 1983, 30).

In the case of the Oseberg Ship of 800 the *meginbúfr* transition was sharp and — organically speaking — gives the impression that a broader construction was

built atop a narrower hull, while the *meginbúfr* transition is less apparent and more organic in the Gokstad Ship of 890 (McGrail 2004, 216), and indeed the Kollerup ship (Fig. 2-25). Of course, it could be a coincidence if it was an analogous feature, but if it was a homologous feature — which is presently unknown — it could have been “inherited” from the Scandinavian shipbuilding tradition (cf. paper B, 50).

Because of all these anomalies, referring to the Kollerup ship merely as Bremen-type vessel would do gross injustice to the significance of this wreck, as the number of deviating constructional details clearly indicate that the shipbuilding tradition is overlapping with other influences. Thus, the Kollerup ship is not a “fresh slate”, from which the Bremen-type has emerged and developed, but an appropriation of some older design. The crucial question is, who had a share in this development? The most logical vantage point is to start with the overwhelming evidence: The provenances of the early Bremen-type ships. There are extraordinary high t-values for southern Jutlandic provinces for Kollerup (ca. 1150), Skagen (ca. 1190s), Kolding (1188/89), and to a slighter lesser extent the Kuggmaren ship (ca. 1215) (Daly 2015), which will be discussed later. Is this suggestive of a powerhouse for innovation and shipbuilding? The Kollerup and the Kolding ships may have even been built at the same shipyard, as the strikingly similar construction of their stern hooks suggests (Hocker & Daly 2006, 192f.). The provenance of the earliest three ships can be even narrowed down to the Haderslev region (ibid.). Now the question arises whether these ships were actually built there, or whether the timber could have been transported to shipyards outside this region? We know that oak timber was exported from Prussia and the Baltic region already in the 13<sup>th</sup> century, i.e. almost immediately after they were colonised (cf. chapter 5). Thus, early timber transports cannot be ruled out, although this author has not encountered any documented evidence for timber exports from the Haderslev region.

The southern Jutlandic provenance seems very meaningful within the context of both Schleswig's and Lübeck's rise as important ports for long-distance trading. As set out in the previous sections, there were merchant communities from Saxony, Frisia and Westphalia in Schleswig. Merchants from the town of Soest formed associations with the Danes in Schleswig, like the *fraternities Danicum* in Cologne (Hammel-Kiesow 2015, 38). Already in the 1130's a trading confederation was formed on the axis Cologne/Rhineland-Schleswig/Denmark-Gotland-Novgorod as could be inferred from two privileges (Radke 2007, 323). Danish crusaders are known to have sailed together with German crusaders from Cologne and Bremen in a convoy to the Holy Land in 1224 (DD.1.6.16). And between 1201 and 1227, Lübeck citizens had privileged access to Danish markets and resources during the *pax waldemariana*. Given all this evidence, it seems possible that the



mixed features in early Bremen-type ships can be explained in the light of Danish-German cooperation and cohabitation in port cities like Schleswig and Lübeck. This would explain the Jutlandic provenance and the Rhenish cargo in the case of the Kollerup ship (Kohrtz Andersen 1983, 16).

Strikingly, the emergence of the Bremen-type in the mid 12<sup>th</sup> century correlates with the earliest 'definite' cog-references, which emerged throughout Europe about the same time: To this author's knowledge, the earliest reference in the North Sea area dates from 1163 (cf. paper E), in the Baltic Sea from 1206 (HCL X, 9), in the Mediterranean from 1217 (cf. paper E), the earliest instance Danish cogs were mentioned is from 1221 (HCL XXIV, 7), and the earliest Danish document referring to cogs dates to 1224 (DRB 1.6.16).<sup>10</sup> It is quite tempting to skip academic rigor and apply the cog-label to all Bremen-type ships out of convenience, as there are additional concomitant factors which seem to suggest that Bremen-type ships were basically cogs. However, the reason for maintaining the division between a historical and archaeological type-concept – as even acknowledged by Detlev Ellmers (2010) lately who did not make this distinction until late – lies in the ambivalent meaning of historical terms, which varied in different spatiotemporary contexts. Moreover, type-concepts rarely align naturally with archaeologically traceable traditions, as has been stressed by this author (paper A, 335ff.; paper B, 49).

It can be asserted that Bremen-type vessels emerged on the scene in southern Jutland, as has been already concluded by previous authors (e.g. Daly 2015; Hocker & Daly 2006). However, there has been little debate why this type has emerged in the southern Jutlandic region. It has been often ascribed to the presence of Frisians in this region (e.g. Crumlin-Pedersen 2003, 268). Is this a subconscious homage to the popular belief that cogs originated in the Frisian area and were built in a Frisian enclave of Hedeby (cf. Ellmers 1972, 72ff.)? Interestingly, Ole Crumlin-Pedersen himself (2000) dismissed the strict association of the Bremen-type with the Frisian area – particularly the IJsselmeer – as the type's native area – as postulated by Timm Weski (1999) – on the grounds that the earliest types were all from southern Jutland and that the relative over-representation of Bremen-type vessels in the IJsselmeer can be attributed to the more systematic research conducted in this area in the wake of modern land-reclamation.

Although a Frisian influence still remains a possibility, it is just one in many possibilities. Besides, the enquiry does not go far enough, if the expected outcome is merely to affiliate an ethnic group with such ships.

The previous sections have demonstrated that shipwrecks or components associated with the Bremen-type were unearthed in three of the four entry points to the Baltic Sea so far; or indeed all four, if the Kollerup ship was heading to the *Slojkanalen* to make a Limfjord passage. All entry points fulfilled an important role in the long-distance transport and trade network, especially urban centres such as Schleswig and Lübeck, which were connected to Gotland and Novgorod. Is there a link between the emergence of the Bremen-type on the one hand and the long-distance trade networks on the other hand? Before an attempt is made to address this question, some further ship-finds from the eastern part of the Baltic Sea shall be examined in chapter 4.

But before doing so, chapter 3 discusses how maritime logistics across the Baltic Sea were actually organised and perceived on a conceptual level in an age, where geographical knowledge was communicated in a much different way than it is today.

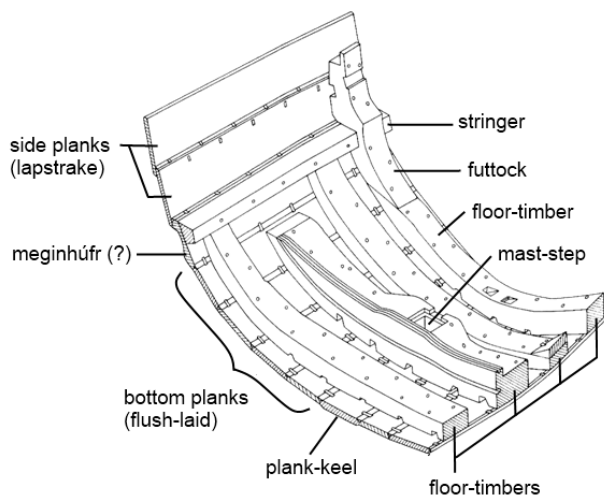


Fig. 2-25. Schematic structure of the Kollerup wreck (Source: Hocker & Daly 2006, with author's labelling).

<sup>10</sup> Although this author is aware of attempts to trace cog-references etymologically back as early as the 9<sup>th</sup> century, there seems little concrete evidence that these were actually ship-references, let alone referring to a type of ship that would have been similar to its late medieval counterpart.

### 3. ORGANISING MARITIME EXPEDITIONS INTO UNCHARTED WATERS: THE COMMUNICATION NETWORKS OF THE BALTIC CRUSADES (1198-1290)

This section examines how landscapes and the world at large were perceived in the 13<sup>th</sup> century and how fleet movements were organised in unknown waters. Since the dawn of times sovereigns strove to gain knowledge of the realms they ruled or wished to rule over. Well before geographical relationships were adequately represented in pictorial form, kings understood how to compile knowledge on the extent of their territories, the taxable fiefs, bordering territories and the transport infrastructure like roads and rivers in order to exercise state power and holding together surprisingly large and diverse territories, often with overseas enclaves. This must have been a real challenge, given the limited and deferred means of communication in that time. For the accomplishment of this greater goal, seafarers were amongst those interrogated by royal representatives or even the king himself, as in the case of the legendary 9<sup>th</sup>-century Anglo-Saxon King Alfred the Great, who invited the seafarers Wulfstan and Ohthere to his court to report about their travels (cf. Bately & Englert 2007, Englert & Trakadas 2009). The importance attached to their reports is reflected by the fact that he had their reports documented by his court secretary. As seafarers belonged to an illiterate class, most of their knowledge would have been transmitted orally and only in very rare cases — like here — preserved in written form. Thus, we owe the very circumstance of its preservation the fact that the king had this ‘protocol’ added to the Old English translation of Paulus Orosius’ *Historiae adversus Paganos*. Despite its late Roman origin in the early 5<sup>th</sup> century, Orosius’ book was still regarded as a standard work in the Middle Ages, which was more of a historical than geographical account of the pagan nations beyond the borders of the Roman Empire. Around 800 years later, paganism has not been rooted out from Europe. The southern and eastern coasts of the Baltic Sea were inhabited by Wends, Old Prussians, Lithuanians, Curonians, Semigallians, Livs, Letts and Estonians, who staunchly asserted their independence from Catholic Europe even after the Scandinavian kingdoms became part of the Catholic entity. The latter deviated from the customs of their Viking ancestors — seaborne raiding expeditions — and put themselves in the ministry of the papacy as proper Christian kingdoms, at least nominally, enabling them to continue the wars against their pagan foes, but with reference to a celestial authority: Denmark against the Wends, Sweden against the Finns and Norway against the Sami.

In Hanseatic research, the role of the Scandinavian kingdoms and the Catholic Church has only recently

captured the attention of scholars to explain the fundamental changes in the Baltic Sea area beginning to manifest in the 12<sup>th</sup> century. These changes have been previously seen in the light of the entrepreneurial spirit of long-distance merchants from Lower Germany, followed by farmers and craftsmen colonising the Baltic region, thus a very Germanocentric focus, which unsurprisingly prevailed before WWII (Hammel Kiesow 2015, 16). This shift in approach is also duly accounted for in this work.

The Danish chronicler Saxo Grammaticus mentions numerous raids of the Wends on Danish coasts in the course of the 12<sup>th</sup> century. He was however not an impartial observer and his description of Wendish seafarers as pirates may have served the justification of Danish warfare against the Wends (cf. K. V. Jensen 2000, 7). Since 1147 this warfare was papally authorised — at the initiative of Bernard of Clairvaux — to include the Wends (western Slavs) and other pagans of northern Europe to be forcefully converted to the Christian faith, legitimising a just war “*contra Slavos ceterosque paganos habitantes versus Aquilonem, et eos Christianae religioni subjugare*” (cf. Fonnesberg-Schmidt 2007, 37, 46). This has not to be seen solely from the perspective of the Catholic world-system, but an emerging Danish “thalassocracy” in the Baltic Sea, as the papal mandate arguably change little in the long-term expansionary policy of Valdemarian Denmark: In 1134 the Island of Rugia was already conquered from the Rani, and since 1147 the Danes — together with Saxon and Polish princes — subdued the Wendish lands with papal authorisation. In the beginning of the 13<sup>th</sup> century there was barely any coast left that was not somehow affected by the Danish thalassocracy: The now Swedish provinces of Halland, Scania and partially Blekinge were part of the Danish heartland, the Danes enjoyed considerable influence in Sweden through their support of the ruling Sverker dynasty — which may have also included the Swedish colonised islands and enclaves along the Finnish and Estonian coasts. Also the southern coast fell into the dominion of the Danish crown: In 1185 Duke Bogislaw I of Pomerania pledged fealty to the Danish king, in 1187 it was Borwin I of Mecklenburg, and in 1188 Bishop Valdemar of Schleswig — the later King Valdemar II — gained influence over Dithmarsia. Neglected by the German Emperor Frederick Barbarossa, who campaigned in Italy, several northern territories and cities of the Holy Roman Empire fell into the hands of the Danes: In 1201, the Nordalbingian territories of Count Adolf III von Schauenburg were ceded

after a Danish victory in the Battle of Stellau in 1201. After King Canute VI arrested the Lübeck fishing fleet at the Scanian fishing grounds and threatened the town's vital interests, Lübeck accepted in 1203 to be integrated into the Danish realm (cf. HCS II. 12.10; ACS VI. 13). In 1210, the Duke of Pomerania Mestwin I was subdued by the Danish king and had to pledge fealty. In the same year Danish campaigns took place deep into Prussia, almost advancing into Livonia (Riis 2003, 64). With the subjugation of the entire southern coast of the Baltic Sea, the power of Valdemar II was on a constant rise, not least because he effectively understood how to incorporate the new provinces in a way to accumulate his power, rather than to stretch it: He offered his subdued former foes to retain their rule, if they accepted his overlordship. This allowed them to retain their status, nobility and wealth, of which they gained arguably even more than before (Reisner 2009, 63). In exchange, the subdued Slavonic princes had to accept their former lands back as fiefdoms. Valdemar's power was probably further strengthened by dynastic bonds, as there was "more Slavonic-Russian than Danish blood" in his veins due to intermarriages in his ancestry (Lind 2009, 30).

The Slavonic nobles not only had to pledge fealty but were also to accompany Valdemar II on his crusade to Estonia, reinforcing his army with auxiliary troops, while thus preventing his new vassals to ignite a rebellion against him in his absence. Important fleet gathering points for ships joining the crusades to Estonia were probably at harbours secured by royal and bishopric castles, such as Vordingborg, Hammershus and Åhus (Reisner 2009, 56). Vordingborg had been already the major fleet gathering point during the Wendish Crusades, and ongoing archaeological research is occupied with the question whether Hammershus castle can be also seen in a crusading context (Engberg *et al.* 2015).

Interestingly, from the times of the crusade against Estonia (as part of the Baltic Crusades) a route description is preserved, which connected the Danish province of Blekinge with the crusader state in Estonia, originally compiled in the *Liber Census Daniae*. A re-interpretation of this route description — colloquially known as 'King Valdemar's Itinerary', the 'Valdemarian Itinerary' or 'Danish Itinerary' — is this section's main focus (Fig. 3-1).



Fig. 3-1. The Danish realm around 1220 and its important cities (square dot) and castles (crenellated symbol). The lightly hachured areas indicate territories that were held only for a few decades. The island of Saaremaa — albeit also claimed by the Danish crown — successfully withstood any attempts of a Danish permanent presence, thwarting a de facto rule over this island. King Valdemar's Itinerary is plotted in, evidently connecting the Danish territorial possessions in today's Sweden and Estonia. A more detailed map of the dense cluster of points in the Stockholm Archipelago (white square) is shown in a following section (Graph: Daniel Zwick).

Only the island of Saaremaa presented an impregnable obstacle for the Danes. The island was invaded in 1170, and again in 1197 under Canute VI and in 1206 under Valdemar II, who however could not conclude the conquest, as he found no volunteer willing to stay in the newly erected wooden fort

during the winter. So it was burnt down again, lest to fall into enemies hands. The exchange of hostilities was mutual: In 1203 a fleet of Estonian ships — called *piraticis* — was intercepted by a German crusading fleet anchoring off Visby: The Estonians were on their home voyage after having pillaged the

Danish coast, laden with church bells, garments and slaves (HCL VII 1.2). The Estonians from the island of Saaremaa offered the fiercest resistance to the Danes, and this has not even changed after the Danish victory at Lyndanisse in 1219, when the Estonian provinces of Revala, Virumaa and Harju fell under Danish rule, set in stone by the erection of a large stone castle at Lyndanisse, which became eponymous for the present Estonian capital of Tallinn, derived from the Estonian words *Taani* —

“Danish” — and *linn* — “castle”, thus “Danish castle” (Lepp 1995, 144) (Fig. 3-2). *Linna* derived from *litna* or *lidna* can be also translated as “town” (Pullat 1999), but the eponymous factor was probably the castle, which was built on a limestone rock. Such formations are also known to have been called *linna* or *linda* and is ambivalently used for rocks and castles alike (Rußwurm 1855, 73). According to the *Annales Ryenses* King Valdemar II landed in 1219 with 1500 ships (Breide 1998, 46).



Fig. 3-2. The end point of ‘King Valdemar’s Itinerary’ and eponymous for the Estonian capital; Tallinn, Castrum Danorum, or the ‘Danish Castle’ (Photo: Wikipedia Creative Commons).

This raises the question how a sovereign like the Danish king could achieve such a monumental logistical feat with the rudimentary geographical knowledge, as is at least reflected in documented history. Naturally, the spatial knowledge of mariners of that age cannot be accessed, but there are still indirect means of assessing fragments of this tacit

knowledge. Thus, the foremost aim of this section is to explore how sovereigns accomplished to compile factual geographical knowledge, how fleets were organised, how these information might have found expression in early maps and itineraries, and how this coalesced with more transcendent aspects of medieval life and world perception.

### 3.1. A sea of myths: Medieval maritime cosmography

The now outmoded term ‘cosmography’ describes the way how geographical knowledge was deeply intertwined with spiritual and mythical aspects, in contrast to the present ‘secularisation’ of geography to a fact-based, unbiased representation of the physical world.<sup>11</sup> At the very foundation of medieval

cosmography is the perception of the world as *orbis terrarum*, the world as circle encompassing three continents and surrounded by a marginal sea. This is very much based on the definition in Isidore of Sevilla’s Etymologies from the 7<sup>th</sup> century:

<sup>11</sup> Even today geographical information can be distorted by a religious agenda: HarperCollins omitted Israel from a school atlas destined for English-speaking schools in the Middle East: (...) *the subsidiary of HarperCollins that specialises in maps, said that including Israel would have been “unacceptable” to their customers in the Gulf and the amendment incorporated “local preferences”.*

(The Telegraph 31. Dec 2014: “HarperCollins omits Israel from school atlas”, accessed on 9.4.2015: <http://www.telegraph.co.uk/news/worldnews/middleeast/israel/11318286/HarperCollins-omits-Israel-from-school-atlas.html>).

“*Orbis a rotunditate circuli dictus, quia sicut rota est (...). Vndique enim Oceanus circumfluens eius in circulo ambit fines. Divisus est autem trifarie: e quibus una pars Asia, altera Europa, tertia Africa nuncupatur (...)*”  
Etymologiae 14,2 (Englisch 2002, 41).

“The world is named after the circle, which is like a wheel (...). Surrounded by the sea, divided are the lands in three parts, one part Asia, the other Europe and the third Africa (...).” (own free translation).

The Isidorian description is cited in numerous chronicles and other historical and geographical medieval literature (Edson 2007, 236). In pictorial form these are called *orbis terrarum* or simply T-O maps, in which the “O” represents the earth circle and the “T” the water bodies dividing the three continents: The Mediterranean, the Tanais River and the Nile (Friedman 1994, 70). This division was deeply ingrained in the medieval mind and can serve for the interpretation of many spatial concepts of the time. Most T-O maps had an easterly orientation, i.e. with the east — Asia — on top and Jerusalem in its centre. Cardinal points were to a certain extent artificially constructed entities, augmented with symbolic connotation potent enough to displace sober real-world observations. This perception is reflected in the works of Adam von Bremen and Helmold von Bosau, for whom *aquilo* — the north — did not only include Scandinavia, but also the pagan territories of the east. Also the Baltic Sea was perceived as a northern sea — an *oceanus septentrionalis* — which was the pivot of the northerly hemisphere (Fraesdorff 2005, 88ff.). This paradox can be explained in terms of the prevailing imagination of the world: In the same way, in which Jerusalem had to be *a priori* arranged in the map’s centre, *oriens* had to describe the bright and sacred lands of the east, and *aquilo* the dark and pagan lands of the north (Fraesdorff 2005, 99ff.). The Northern Crusades and the crusades in the Holy Land were, however, not perceived as fundamentally different wars, but were both part of a global strategy against the “army of darkness”, as declamatorily expressed by Eric Christiansen (1997, 57), a war against “evil” embodied by different pagan tribes, which had to be combatted at different transects of essentially the same front.

In modern times, maps are first and foremost a graphical way to communicate geographic knowledge, guided by strict norms of how physical and anthropogenic entities are presented that could be deciphered by anyone, irrespective of their linguistic or cultural backgrounds. With this implicit understanding, medieval world maps — *mappae mundi* — have been often judged from our modern perspective. The highly abstracted way geography is presented and displaced by biblical and mythological

motifs however, has cast doubt on their utilitarian use and as a consequence their compilers have been given little credit in their ability to depict geographical reality (cf. Andrews 1925/26, 65; Arentzen 1984, 12f.). In more recent years, however, the approach has shifted in not applying the standards of modern-day maps to *mappae mundi*, but to appraise them as source in their own right, reflecting medieval cosmography with all its ideosyncrasies, a depiction of mental rather than physical landscapes, of medieval people and their irrationalities, which — after all — have informed decisions of movements and migrations. In *mappae mundi* mythical and religious motives dominate the world.

Such motifs were “planted” or relocated into landscapes of the far north. On the Hereford Map from the late 13<sup>th</sup> century a maze is depicted on the island of Crete (Fig. 3-3). Undoubtedly, this was a reference to the Knossos legend, but it is notable that the maze is of the very same type as that in the Cathedral of Chartres, dated to between 1215 and 1221. Aside from its mythological Greek origin, the maze has accumulated Christian symbolism: The walk through the maze is an allegory for a catharsis and pilgrimage, with Jerusalem in its centre (Wright 2001, 39, 210). It is notable that the maze’s pathways are arranged in a manner that its structure resembles the shape of a cross.

Stone maze symbols can be also found along the Swedish and Finnish coastlines, i.e. along the route of the itinerary (Fig. 3-4). Their meaning remains unclear and is subject to much debate. There are about 350 of them in Sweden and 200 in Finland (Westerdahl 1995b, 267).

Their interpretation is aggravated by the fact that they cannot be dated by using a conventional archaeological method, although it is assumed that they are of late medieval or early post-medieval origin. A lichenometric dating attempt on Norrlandic mazes has provided no date older than the medieval period (Norman 1995, 26). The clustering along the coastline is very suggestive and appears to have had a possible Christian connotation, as evidenced by maze depictions in churches (cf. Westerdahl 2013) (Fig. 3-5).

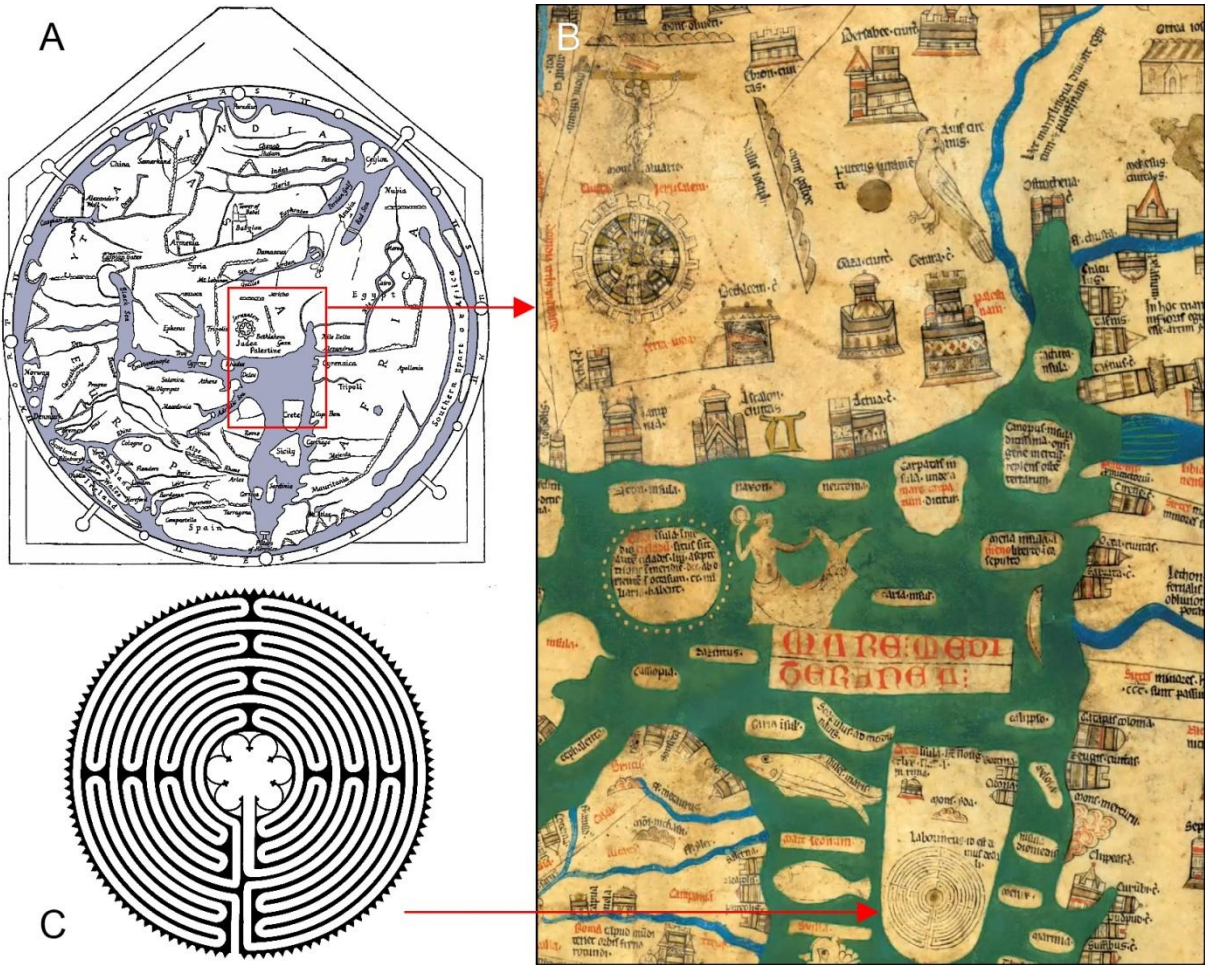
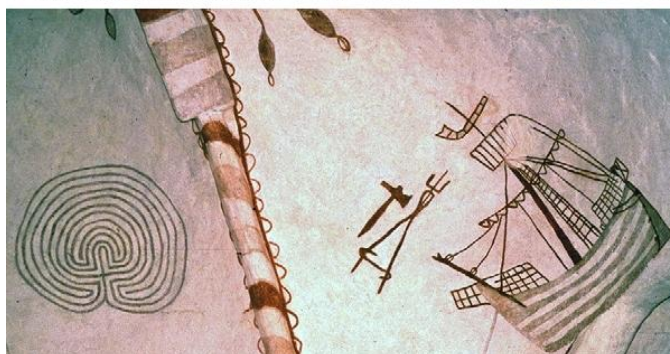


Fig 3-3. The Knossos maze: (A) Hereford Map (1285-90) with (B) an excerpt showing Jerusalem as the map's centre and a maze on the island of Crete, which looks exactly the same as (C) the maze in the floor of Chartres Cathedral, dating to ca. 1215 (Graph edited by author. image sources: A: Bevan & Phillott 1969, B: Folio Society, C: [www.labyrinthos.net](http://www.labyrinthos.net)).

Fig. 3-4. An undated stone maze symbol on the island of Blå Jungfrun in the Kalmar Strait, which was said to be cursed and avoided by mariners. Ships following the itinerary would have passed this island (Photo: Christer Westerdahl).



Fig. 3-5. A maze and a ship depiction in a Gothic parish church close to Åbo (Turku), Finland (Westerdahl 2013, fig. 7).



If these mazes were understood to mark a ritualised landscape — a pilgrim's route — they would certainly not be the only mythological element relocated from the ancient world into the northern world. Also Henry of Livonia referred to Livonia in his chronicles as *Terra Mariana* — the land of Mary — irrespective of the fact that Nazareth was not anywhere near Livonia. It seems almost, as though space and time played a very subordinate role in medieval cosmography (cf. Von den Brincken 1968, 124ff.), and this will inevitably have shaped the mindset of contemporaries.

Further insights in medieval cosmography are offered by taking a closer look on the Ebstorf Map, which date was reconstructed with 1208/18 (Hucker 1988, 535), 1239 (Wolf 1988, 84ff.) or ca. 1300 (Wilke 2001, 285). This map presents a special case, as it was not merely a pictorial addendum to a chronological cosmography, but an attempt to integrate all narratives into a holistic map of legendary, mythical, salvific and historiographic scenes, in which we find embedded ancient literature like the Alexander and Troy romances together with encyclopedic works like Isidor of Seville's *Etymologiae*, or Adam von Bremen's *Gesta* (Simek 1990, 41f.). It is taken for granted that such work must be based on an extensive manuscript, probably produced at a monastic scriptorium or chapter on behalf of an important court (Wilke 2001, 21ff.). Although the land mass and relative distances are highly abstracted and barely recognisable, the sequence of places along rivers and coastlines are actually put in their logical position to each other, as several researchers noticed (Von den Brincken 1968, Woodward 1987, 290). What is more, itineraries of that time — with an emphasis on northern Germany, Flanders and northern Italy — were incorporated into the Ebstorf map, which indicates a mercantile interest of the originators of the itineraries (Wilke 2001, 146ff.).

A similar observation — or rather hypothesis — was also made by this author (paper A, 348ff.) who pointed to the possibility that merchants may have had a mediating role in conveying geographical knowledge from the Baltics, which inadvertently included subjective networks translated into a spatial hierarchy. The depiction of wild game at the point where the Daugava 'flows out of Russia' — indicating the importance of fur trade on the Daugava River — not only reveals an underlying mundane mercantile perspective, but also a telling flaw: Smolensk was erroneously plotted on the Daugava downstream from Polotsk. In reality Smolensk is located to the east of Polotsk on the Dnepr River. This "error" probably did not occur by coincidence, as Smolensk was not just any city: peace treaties, which opened up

trade with the Russian hinterland were concluded in Smolensk in 1229 and 1250 (Blomqvist 2005, 500, 508). Some of the abovementioned (reconstructed) dates of origin antedate the peace treaties, which could either indicate that Smolensk played a pivotal role even before the peace treaties were concluded, or the mixed up sequence is in fact a coincidence. If it was not a coincidence, the political dependency on Smolensk, which opened up trade with Polotsk, was arguably translated into a virtual dependency on the Ebstorf map, by plotting Smolensk between Riga and Polotsk, as though it could physically block trade on the River Daugava (Fig. 3-6.1). This error might reflect the sources from which the monks of the Ebstorf monastery received geo-political information, people who were part of a mercantile logistical network. As early as the 1170s or 1180s a rotunda church was built in Smolensk by local contractors of the German Court in a form common to northern Germany and Scandinavia. The clients were probably Gotlandic merchants, possibly already in the company of German merchants (Hammel-Kiesow 2015, 32). This does not only reflect how deeply a well-organised mercantile network penetrated the periphery, from which map-making monks evidently received travel reports, but it also shows another aspect: A privileged access to geographical information that was conceptualised in terms of route descriptions — trajectories — to which only a select circle of people was given access. And knowledge was power, as will be stressed in the next section.

Ironically, the Ebstorf Map contains also a shred of information that we have been until recently unaware of. Recent osteological research has shown the extent to which wild animal species became extinct in the wake of the crusading movement and its ensuing colonization, suggesting a former presence of a now extinct aurochs population in the Baltic region (Brown & Pluskowski 2013, 103; Curry 2012, 1145). Likewise, a former presence of elks was attestable in the forested wetland and marshy areas of the Baltic, but there is a dramatic drop of the elk population associated with the economic activity — most notably deforestation (cf. section 5) — under the rule of the Teutonic Order (Brown & Pluskowski 2013, 112).

Interestingly, both an elk and an aurochs are depicted at the upper reaches of the Daugava River on the Ebstorf Map. So it can be asserted that some factual information reached the monks in Ebstorf by travellers, merchants and crusaders and were — however distorted — included into this patchwork of a pictorial narrative, mingled with mythical and ahistorical illustrations.

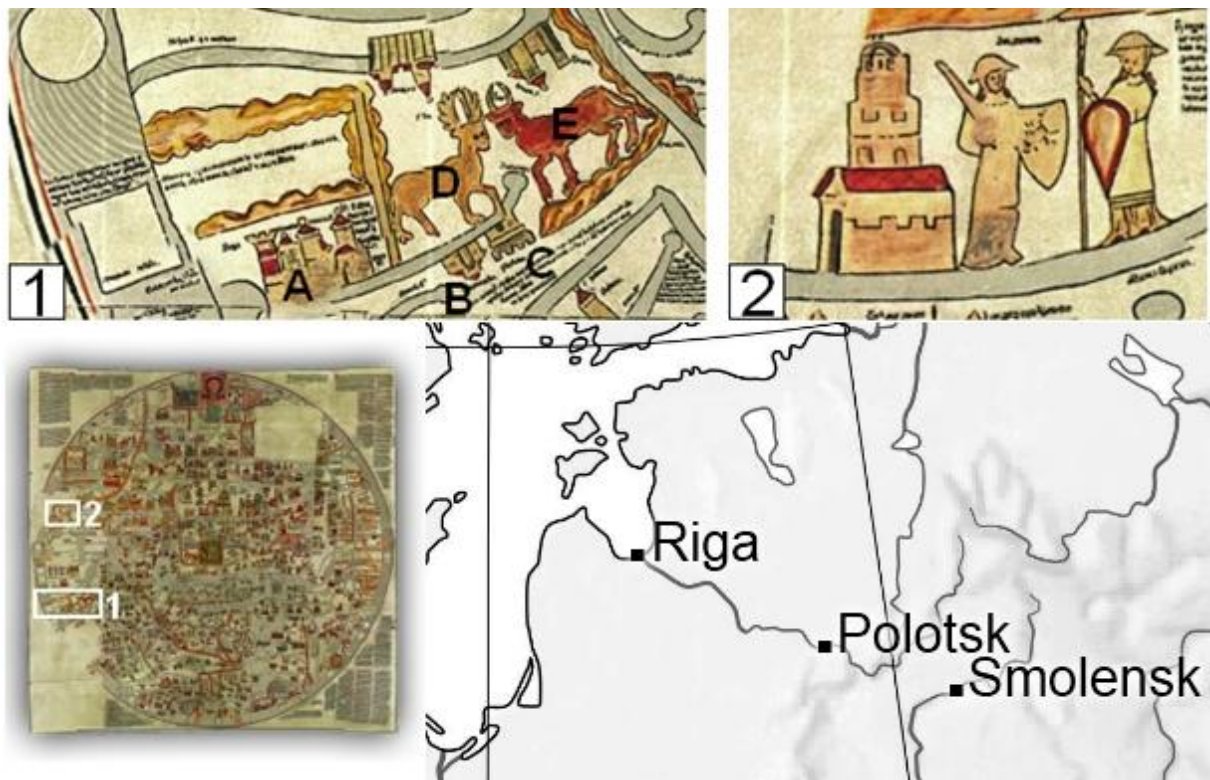


Fig. 3-6. The Ebstorf world map. Excerpt 1: Livonia — A: Riga, B: Smolensk, C: Polotsk, D: stag/elk, E: aurochs. Excerpt 2: Amazons to the north of the Baltics.

Even myths may contain a grain of truth, like the amazons (Fig. 3-6.2) in the northeast. Can this depiction be attributed to Adam von Bremen's reference to "terra feminarum" (Fig. 3-7) — the land of the women — which is said to be near Estonia and Sweden (*Gesta* IV 17) and in the sea with many islands populated by "savage barbarians" (*Gesta* IV 19)? As learned man undoubtedly acquainted with classical literature, Adam may have implied himself

that these were indeed the same amazons as mentioned in the Alexander Romance. But the question remains why specifically the region around the Finnish and Bottnian Bay was linked to a population of amazons, rather than a Greek island? An obvious association is that the nearby Russians were often referred to as 'Greeks' in contemporary sources because of their Greek Orthodox faith.

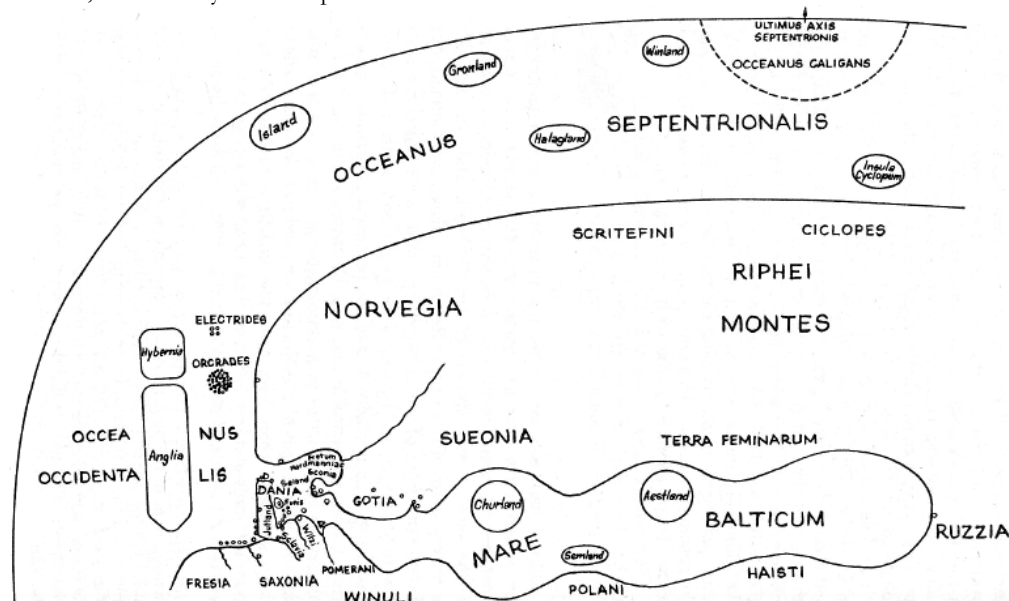


Fig. 3-7. If Adam von Bremen's *Descriptio insularum aquilonis* (*Gesta Hammaburgensis* IV) would have been translated into an orbis terrarum map, it could have looked similar to this hypothetical map drafted by the Danish historian Axel Anthon Björnbo on the basis of Adam's description (Source: Björnbo 1912).



However, another possible explanation is to be found in toponyms and ethnographic evidence. Particularly in the northern fringes of the Baltic Sea several places along the shore considered dangerous for navigation received female names, and female names were considered as *taboo* by superstitious seafarers on the principals of maritime cosmology (Westerdahl 2010, 104). The “land of the women” could have also originated quite literally, as Finland and other northern regions were predominantly inhabited by hunter-gather populations: When the men were on the hunt, bypassing sailors would have only encountered a population of women. Up to the latter half of the 19<sup>th</sup> century Karelians and Finns took part in the seasonal migrations, when the men went north to fish black cod and returned between June and September (Tegengren 1965, 440). Similar patterns were also observed in the Gulf of Bothnia, but began to disappear several centuries before (Tegengren 1965, 452). Since the male hunter population went north to inaccessible regions, they were “invisible” to bypassing mariners, who only encountered a population of women. Outsiders would have gained the impression of a pronounced female population (Tegengren 1965, 486).<sup>12</sup> As much as hunters, mariners were also seasonal folks as shown in section 2.3.3. Assuming that merchants travelling into the Baltic’s northeast would have set sail considerably earlier to return to their home ports in time — before the stormy October month began — the mariners would have missed the homecoming male hunters and were left with the impression of a female-only population. Thus, the travel reports of Christian seafarers mentioning such a “land of the women” may have been associated by clergymen with amazons. The fact that these mythological “monstrous races” were depicted on a monastic *mappa mundi* may also reflect the ethnocentric conflict, in which the “otherness” of pagan populations is emphasised in order to legitimise their conversion and colonization (Friedman 1994). Around the year 1300, Karelians were sweeping through northern Norway and were — together with the Russians and Samis — perceived as a threat by the Norwegians.

The new Christian kingdom of Norway, however, attained support by the papacy, when Pope John XXII called for a crusade in 1326 against “*infideles pagani, Carelli videlicet et Rutheni*”. (DS III.1, Nr. 2573). Although this crusade dates few decades after the Ebstorf map was made, the tensions between the Christians with the Karelian pagans might have arisen earlier and found expression in the map in the depictions of the Amazons. This shows that several motives and myths that belonged into the ancient world and the Holy Land were “relocated” to a northern setting. As mentioned earlier, some T-O maps contained a grain of geographical truth regarding the sequence of places along traffic arteries like roads, coastlines and rivers. So a central question is whether T-O maps could have served the orientation of crusaders? Presently, there is no evidence to suggest this. Although — as will be argued in section 3.3.2. — T-O maps were probably also known in medieval Denmark and may have even informed the state doctrine, it seems very unlikely that such maps were used for practical orientation. The earliest recorded instance when a *mappa mundi* was specifically issued for navigation was in the year 1270, when the fleet of the French King Louis IX on a crusade to Tunis was hit by a storm and got out of sight of familiar landmarks (Kedar 2006, 161). It is assumed that the crusaders to the Holy Land were guided by Byzantine, East Christians and Franks who have grown up in *Outremer* rather than using maps, although their almost complete absence from documented history does certainly not exclude the possibility of their use (Kedar 2006, 161f.). Conclusively, the sequence of place names on T-O maps as the only near-reliable geographic parameter, the probable use of local guides as well as the reliance on familiar landmarks suggest that crusaders — at least in the 13<sup>th</sup> century — followed pre-defined routes, of which some have survived as itineraries.

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<sup>12</sup> I am very much indebted to Christer Westerdahl for bringing Tegengren’s article to my attention, when I discussed my amazon-theory with him.

### 3.2. Itineraries as lineary networks

The principle method of conceptualising space was through itineraries, a sequence of places along a pre-defined trajectory, usually a road, river or coastline. They are in use up to the present day, as *itinerarium pictum*. The London Underground plan is probably the most iconic expression of this tradition to conceptualise travel routes (here: train tracks) and the sequence of places and nodes (train stations), where different routes articulate, while blending out the actual distances between the places. This way of conceptualising geography has evidently never really been rendered obsolete. However, the train-tracks already redefines a fixed route, which – in ancient or medieval times – might have been invisible or difficult to identify in the physical landscape, so an even closer equivalent to itinerary maps would be the London Underground map, which included the walking time between the tube stations when some connections were cancelled or delayed during a strike (Fig. 3-8).



Fig. 3-8. An excerpt from the London Underground plan released during a strike included average walking minutes to overcome logistical bottlenecks (Source: Transport for London).

The map does neither include a truthful depiction of River Thames and the course of train tracks, nor indicates cardinal points, real distances or the actual

way from station to station above ground, which can be straight or labyrinthine streets. So it can be argued that this strike-map is best suited for people with local geographic knowledge. The distances are actually not distances in the metric sense, but time distances, thus subjectively predefined to a certain standard; in this case an average walking speed. While modern people are acquainted with itinerary maps for metros and other forms of public transport, where the actual course was predetermined by the train-tracks, it seems difficult to imagine how this principle could have been applied to the general geography, as seems to be the case for the period and region in question. The following sections explore what kind of information is included in written and graphic itineraries of the time, and what the implications are in terms of geographical knowledge and power.

Itineraries are something fundamentally different from sailing guides, also known as rutters. Itineraries were often written in Latin and treated spatial information in an abstract and conceptual way, often after a voyage, and was not designed for the practical use on board or in the field. While itineraries were used at least since Roman times, rutters are of high medieval origin. Unlike itineraries, rutters are normally written in the colloquial language and contained details for practical use, such as sounding depths, tidal currents, distances and landmarks. The earliest example for a rutter is the *compasso de navigare* from the Mediterranean and dates to 1248/56 (Sauer 1992, 255), while the surviving compilations of the Hanseatic Sea Book (*Hansisches Seebuch*) are regarded as the earliest rutter in northern Europe, dating between 1300 and 1346, although several details could be of much older origin and were added to the present version in a "successive genesis" (Sauer 1996, 52). Even in late and post-medieval times rutters were still widely used, despite the emergence of astronomical and scientific navigation, like the "*Routier de la mer*" printed in Rouen between 1502 and 1510 but probably based on an earlier manuscript from 1483/84, apparently also translated into English and published in 1528 as "*The Rutter of the Seas*". The "*Grant Routier et Pilotage et Enrage de la Mer*" was first published in 1520 and re-printed editions were in circulation as late as 1643. The structure and content of the latter reveals that it was based on the Hanseatic Sea Book (Sauer 1992, 258). The notion of a "successive genesis" for itineraries, rutters and indeed maps is important, as all these sources appropriated details from older examples, thus each particular source should not be seen as an independent observation, but rather as instances in which this knowledge surfaces, manifestations of a tacit knowledge much older than the source itself in most cases.

### 3.2.1. Written and graphic itineraries

Apart from the Christian T-O maps, based on a Roman tradition, another originally Roman method of conceptualising spatiality is preserved in the itinerary maps of the Middle Ages, which depict “vectorised” route transects in dependence to known landscape features like rivers, coastlines or mountain ranges, but in total isolation to cardinal points. This way of organising geographical relationships is also reflected in T-O maps.

The difference to itinerary maps is that these did not contain any mythical or religious elements, but were — strictly speaking — only based on the sequence of places on predefined routes. This was often amended with distances between those places. Not only medieval map making, but the perception of space as such was based on a Roman tradition, but not exclusively so: An itinerary map of Syria made in 1193 by an Arab called Al-Iṣṭakhrī was transliterated into Latin (Kedar 2006, 166) (Fig. 3-9), arguably for the crusaders' own use in the conquered territories.

From around the same time – either the 12<sup>th</sup> or 13<sup>th</sup> century (Lieb 1974, 31ff.) – the oldest surviving copy of the *Tabula Peutingeriana* (Fig. 3-10) was made, which was based on an *itinerarium pictum*, a Roman road map from the 4<sup>th</sup> century A.D. Like Al-Iṣṭakhrī's map, a sequence of places was strung along pre-defined trajectories, while the land mass was abstracted. Such details were normally communicated as *itinerarium adnotatum*, a written sequence of places, while the *itinerarium pictum* can be regarded as literal implementation of this into a graph (Hänger 2001, 104).

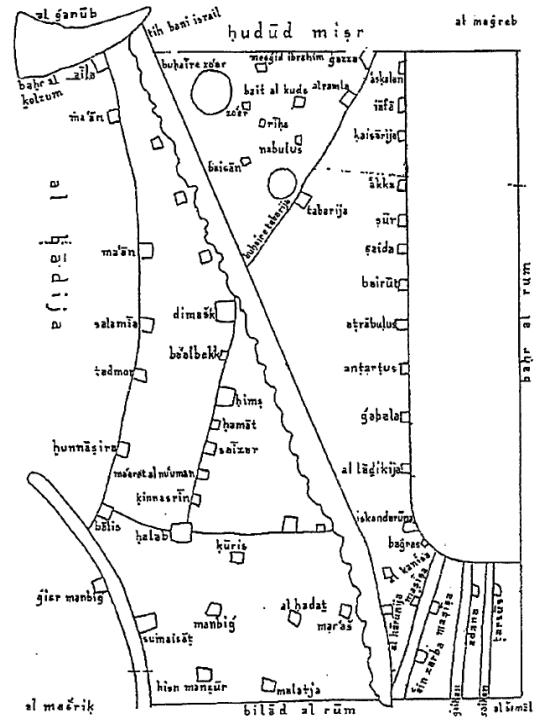


Fig. 3-9. Sketch of Al-Istakhrī's map of Syria, with the cardinal points inverted, with the Dead Sea on the left and the Levant coast to the Mediterranean Sea on the right. Notably, all towns are located along coastlines, roads and rivers, which courses are highly abstracted (Kedar 2006, fig. 9.2).

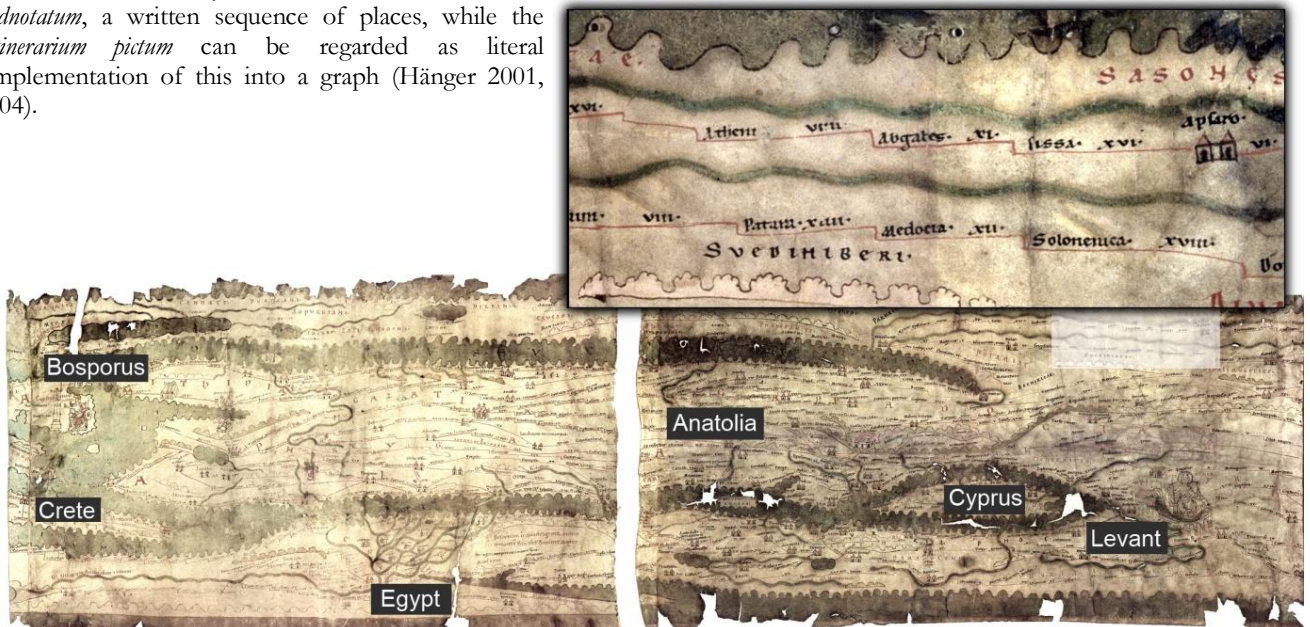


Fig. 3-10. Two of eleven tablets of the *Tabula Peutingeriana*, showing the eastern Mediterranean. This medieval copy of a Roman road map extended from Britain to India. The written template to such map would be an *itineraria adnotata* similar to 'King Valdemar's Itinerary'. To provide an example, the transcribed lower route in zoomed-in excerpt would read: Item Patara XVIII, item medocia XII, item Solonenica XVIII etc (Source: ÖNB Bildarchiv Wien, Cod. 324, edited by author).

In late Antiquity, such itineraries were regarded essential in warfare, as Vegetius describes in his *De Re Militari* (III, 6) where also distances between the camps were described. The lack of conventional indications required for orientation can be explained by the practise of following an already predefined route for making incursions (Hänger 2001, 96). *De Re Militari* was still omnipresent in Europe up to the Reformation (Allmand 2011, 139). Therefore the consolidation of royal power was deeply connected with the development of a road-system. An army-road also existed in Denmark since the Viking Age and it is probably not incidental that – as Saxo Grammaticus notes – King Valdemar I took great interest in a network of evenly spaced signposts covered in miraculous letters of an unknown language in the (now Swedish) province of Blekinge, the easternmost extent of the Danish heartland: *Verum apud Blekingiam apta meantibus rupes mirandis litterarum notis interstincta conspicitur* (GD 0.2.5.2). The signs were worn off by the use of the road, hollowed out and washed away by water and mud. Saxo's description clearly suggests that he referred to an ancient road network, rather than runestones. It is certainly no coincidence that King Valdemar took great interest in this route, but probably not due to an archaeological interest, but rather in terms of army logistics. Significantly, Blekinge is also the starting point of the Valdemarian Itinerary from the province's southeasternmost tip – the island of Utlångan. The province of Scania – to the west of Blekinge – appears to have also played a central role in the maritime logistics. In the struggle for the crown of Denmark between Harald III and (since 1080) his successor Canute IV, the Scanians ostentatiously demonstrated their loyalty to Canute, and created fires along the coast to guide the way for his fleet. It is assumed that Canute was perceived as protector by the Scanians, as he has already lead many war campaigns against the Slavs and Balts (Hoffmann 1976, 42).

### 3.2.2. Communication monopolies: Controlling geographical knowledge

Army roads as depicted in the *Tabula Peutingeriana* or as is partially preserved in the Danish *Hærvej* were the arteries of state power, but few of these routes – especially waterways – are still preserved in the physical landscape. Nonetheless, the absence of physical remains does not mean the absence of routes. The development of transport corridors can not only be achieved by built structures such as roads, inns or strongholds, but also by building up a knowledge base on geographical realities and mechanisms to protect this knowledge.

There are several indications that there were well-established sea-routes strung along such trajectories that were essentially not dissimilar to land routes, as described in *itineraria adnotata*. This is highlighted by

an episode described in the chronicles of Henry of Livonia, when the Danish king attempted in 1221 to extent his rule over Livonia and sent out a knight named Gottschalk to take over the magistracy of Riga. According to Henry, everyone — Livonians, Letts and Germans — opposed him and (here's the decisive hint!) the merchants denied him a pilot for his ship to come either from Gotland to Livonia or from Livonia to Gotland so that he was almost lost at sea, driven off course by contrary winds, as Henry put it (HCL XXV.2). His need for a pilot is very significant, as it highlights that the spread of geographical knowledge was intentionally restricted, and mariners foreign to a land often required the assistance of pilots. The hiring of pilots for sea voyages, not just near harbour navigation, was a common practise in Europe at that time, as the 13<sup>th</sup> century regulations of the Rôles d'Oléron demonstrate (Sauer 1992, 254). The excerpt emphasizes that not everyone had access to all sea regions, even when he was backed by royal authority. It seems paradoxical that King Valdemar II was able to land with 1500 ships in Estonia — a great maritime logistical feat — but did hardly manage to send his messenger to the neighboring Livonia, only some 200 km further south. This very much indicates that people moved along pre-defined trajectories with little knowledge of how these places were otherwise interlinked, highlighting the importance of controlling certain 'nodes', as transport and warfare occurred along these trajectories. These were often secured by castle building or by anchoring warships at important estuaries to control strategic "bottlenecks" of transport. In this case, Gotland seemed to be such a node for the Gotlandic and German merchant community, and the German crusading movement in the Baltics. Their pilot community had evidently a key role in deciding who had access to Livonia and it had evidently an interest in thwarting the hegemonic interests of King Valdemar II in the Baltic region, by denying the Danish knight a pilot. There are indications for close collaborations between the Gotlandic merchant community and the German crusading movement: Gotlandic masons were hired for the construction of the first stone castle at Ikšķile (German: *Uexküll*) — the first German colony in Livonia — on a Daugava river island in 1196 (HCL I.6).

The important mediating role of the seafaring merchant community on Gotland may even be reflected in the first town seal of Lübeck from 1223 (Fig. 3-11). The hitherto widely accepted interpretation was that this was a depiction of a *coniuratio* scene between two equals; often even over-interpreted as a Frisian mariner and a Westphalian merchant underpinning the underlying — stereotypical — idea of Hanseatic cooperation (e.g. Ellmers 1986, 61). However, a more recent interpretation puts emphasis on the subtle — yet important — hand-gesture made by the *stýrimaðr* — the skipper — which appears to be an *evce* gesture,

marking him to be in higher hierarchy to the *farþegi* — the guest, whose admittance on board was granted by the skipper through this gesture (Jahnke 2008, 20ff.).



Fig. 3-11. First seal of Lübeck around 1223 (after Jahnke 2008, fig. 1).

While this re-interpretation favours a merchant as most likely embodied *farþegi*, another re-interpretation suggested that this could have been a pilgrim or crusader (Paulsen 2010, 93ff.). In both cases, however, the key role of the mariner is emphasized, if one is willing to accept the premise of an *ecce*-gesture. So the seafaring merchant community may be represented by the *stýrimadr*, reflecting their influence and power. This is also reflected by the special

protection the Gotlandic merchants enjoyed in the Bishopric of Livonia, whose role was perceived of vital importance for the mission and crusading movement in the Baltics (Kattinger 2001, 22), most probably because they provided the ships for Bishop Albert's annual crusading contingents embarking from Lübeck and arriving in Riga via Visby.

The seafaring community may have had an own hierarchical organisation, which is not yet well understood. At the siege of Silves in 1189, other crusaders observed the absence of noblemen on part of Danish and Frisian crusading contingent, whose skippers were apparently bound together in a formal association to arrive at important decisions and maintain discipline (cf. *Narratio de Itinere Navali Peregrinorum Hierosolymam Tendentium et Silviam Capientium*, Nørøxe 2009, 82). The absence of any high-ranking noblemen in the Danish-Frisian crusading fleet was explained by the likely preference of such noblemen to travel on horseback across land, while the sea-route would have been the choice of the poor, who could not afford to travel on horseback (Nørøxe 2009, 84). This puts emphasis on the notion that seafarers often formed fairly autonomous communities, which did not fit into the conventional hierarchical order on land. Does this help to explain the influence of the Gotlander merchant community in allowing access to the Baltic?

This may at least explain the attempt to tap the source of information and by drawing out an itinerary without the interference of middlemen, as the following section will suggest.

### 3.3. King Valdemar's Itinerary revisited

In the following, the Latin route description colloquially known as 'King Valdemar's Itinerary' (Swedish: *Kung Valdemars segelled*) is discussed. The itinerary is an *itinerarium adnotatum* and describes a sequence of places along the coastline of Sweden and Finland, connecting the island of Utlängan, at the south-eastern tip of the province of Blekinge — a part of medieval Denmark — with Tallinn, the capital of Estonia. The latter fell under the rule of King Valdemar II in 1219.

The term 'itinerary' has already a historiographic connotation in that it is used for travelling often in relation to a pilgrimage or *peregrinatio* (Constable 2008, 349). As shall be demonstrated in the following, this is quite an adequate transcription and therefore the colloquial use is endorsed here, despite there is little evidence that the itinerary can be specifically linked to King Valdemar II. It has been nevertheless implied, however, as its original composition is likely to fall into his reign — from 1202 to 1241. The codex

included also a papal list ending with Pope Gregory IX, who died in the same year as King Valdemar II — in 1241 (Varenius 1995, 193). The problem with this is, that the census in which the itinerary was included was a heterogenic compilation without one publishing year.

As a matter of fact, *periplus* — as the maritime equivalent to an *itinerarium* — would be perhaps a more adequate term to refer to this route description, but not necessarily, as the use of the term *itinerarium* is also applied — at least in the historiographic tradition — for pilgrim and crusading voyages across the sea like the *Itinerarium Peregrinorum et Gesta Regis Ricardi*, describing the seaborne voyage of King Richard I of England in 1189. The *Narratio itineris navalis ad Terram sanctam* — describing the navigation route of Lower German and Flemish crusaders in 1189 to Marseille with the Holy Land as ultimate destination (Chroust 1928, 179ff.) — is a title given by the historian himself (Chroust 1928, C) but may have been also

chosen by a contemporary writer due to the apparent connotation of *itineraria* with pilgrim or crusading voyages, as pointed out in section 1.2.3. A primary association of *itineraria* was arguably that of itinerant kingship, rather than pilgrimage in its own right. As the case may be, the generic term of ‘itinerary’ is kept here, not only for simplicity, but also for comparative reasons, keeping the problematic etymological deduction in mind.

Just like medieval *mappae mundi* and Roman road maps, this itinerary has been given little credit for utilitarian use, simply because the Latin transcription would make little sense in the brawny hands of an illiterate mariner. Although this is certainly true, a present-day bias of how geographic information is communicated has led to the underestimation of this uncommon source.

The next two sub-sections will shed light on the research history, and how the source was underestimated in the context of the compilation, while a new interpretation is offered in the following.

### 3.3.1. Rediscovery and research history

The itinerary from Utlängan to Tallinn was originally part of the Danish Census Book (*Liber Census Daniae*) which was mostly compiled in King Valdemar II's reign. It is however not a book in the conventional sense, but a compilation of different — primarily administrative — documents, which were written down at a time spanning mainly between 1215 and 1265 (Breide 2006, 26).

A palaeographic analysis has suggested that the writing can be associated to that of a monk who has lived in the Sorø Monastery — on the Danish Island of Zealand — around 1300, although this can be a copy of an even older original (Modéer 1937, 90). In the wake of the Reformation, the monastery's library was dissolved and its works became disseminated. In an attempt to seek “*göthiske monumenter*” to shed light on early Swedish history, the Swedish nobleman Johan Gabriel Sparwenfeldt acquired the transcript collection from Sorø Monastery in 1682 and — on request of his friend Gripenhielm, director of the *Läntmäteriet* (Swedish Survey Agency) — sent him a part of the collection. Upon receiving it back, he forgot to unite both parts of the collection and donated the now separated part to the *Antikvitetsarkiv* (Swedish Antiquities Archive) in Stockholm. In 1783, the itinerary was filed under the historicist Latinised title *Navigatio ex Dania per mare Balticum ad Estoniam* (Langebek 1783, 622). Only in the latter half of the 18<sup>th</sup> century one became aware that the document collection has become separated and that it must have been — in its entirety — the *Jordebog* or the *Liber Census Daniae* — often colloquially referred to as King

Valdemar's Earth Book (Danish: *Kong Valdemars Jordebog*).

The nature of the itinerary cannot be understood in isolation to the other documents compiled in the census book. The latter contains a census of Denmark's overseas provinces, Halland, Scania and Blekinge in Sweden, as well as Reval, Harju (German: *Harrien*), and Virumaa (German: *Wierland*) in Estonia. Both parts are connected by this itinerary, and the latter three Estonian provinces are registered in the *Estlandliste* (“Estonia list”) written down in 1230, which can be perceived as a terrestrial continuation of this itinerary. The sequence of the places named here was interpreted as marching route of priests through Reval, Harju and Virumaa, who baptised the local pagan population between 1219 and 1220 (Johansen 1933). Moreover, the lands were estimated for taxation. This list was taken as basis for a revision in 1241 for Danish land tenure, after the Order of Swordbrothers withdrew on behest of papal intervention after having *de facto* occupied Danish-Estonia in the wake of suppressing the pagan uprisings (Riis 2003, 67ff.). Without a doubt, the most interesting addendum is another itinerary. It describes the route from the Danish town of Ribe to Acre in the Holy Land. An identical version of the Ribe-to-Acre itinerary is also found in Adam von Bremen's *Gesta Hammaburgensis ecclesiae pontificum* and Albert of Stade's *Annales Stadenses*. A similar route was taken by Frisian and Flemish crusaders in 1189.

The *Liber Census Daniae* has never been coherently studied by historians (Carsten Jahnke, pers. comm.) and therefore the itinerary cannot be evaluated in its full context. Nonetheless, enough circumstantial knowledge can be inferred from the itinerary and the general knowledge of what kind of documents were compiled in the *Liber Census Daniae*. Given the contextual information, it seems strange that the Valdemarian Itinerary has been frequently dismissed as important source. It was argued — for instance — that the itinerary merely presented an alternative “save route” in times of political instability, as it presented a detour (Breide 1998, 47ff., Ilves 2012, 98). Others have argued that the route description from Utlängan to Tallinn cannot be seen within the context of the Baltic crusades, because the route from Ribe to Acre cannot be associated to a crusade either, because the latter was compiled in Adam's *Gesta* who died in the early 1080's, thus antedating the First Crusade of 1095 by more than a decade (cf. Morcken 1983, 127; Varenius 1995, 192; Ventegodt 1982, 71; Westerdahl 1995a, 25.). This however, is based on two false premises, the first being that crusades were essentially seen in the tradition of pilgrimages (cf. section 1.2.3). What is more, the route description from Ribe to Acre is in verity a recording made by a Danish crusader dating around 1200 and 1230, which was posthumously added to Adam's *Gesta* (cf. Sauer 1996, 66; Schmeidler 1917, 228). Thus the objection is rendered obsolete and an earlier association with

the crusades made by Christer Westerdahl (1978) can be endorsed. In the following, both itineraries are evaluated in the medieval cosmographic context.

### 3.3.2. Two routes — one doctrine?

We probably owe the existence of the Ribe-Acre itinerary King Valdemar's II pledge towards the end of his reign to go on a crusade to the Holy Land. Although he did not fulfill his pledge, he may have prepared a voyage by having this route recorded (Ventegodt 1982, 58f.). Thus, both itineraries should be seen within the context of the crusades (Fig. 3-12).

This raises the question why King Valdemar II concentrated his crusading activities on Estonia

rather than the Holy Land? Was Estonia a gain for the Danish crown?

The crusades in the north were evidently used to pursue also economic interests. Although a basis for taxation was laid down with the *Estlandlisten* — the 'Estonia lists' (cf. Johansen 1933), it can be doubted that Estonia itself was a real economic gain for the Danish crown, as its new provincial capital Tallinn was not situated at an important river, a vital artery of trade into the Russian hinterland. Moreover, the costs involved in pacifying the Estonian territories must have been considerably higher. This was quite different in Riga, founded in 1201 by Bishop Albert von Buxhoeveden near the estuary of the Daugava River.



Fig. 3-12. The two itineraries of the *Liber Census Daniæ* in the context of medieval Denmark and the three major fronts of Catholic occidental Europe. The old Varangian routes on the Russian rivers into Black Sea and Caspian Sea are shown in green (Graph: Daniel Zwick).

Even the Livonian Rhymed Chronicles — where no opportunity was missed to glorify the deeds of the Teutonic Knights — roundly admitted with disarming honesty that the incentive for the Christian colonization of the Daugava river valley were rooted in mercantile interests and that trade was conducted with the pagans (Meyer 1848, 7). It is apparent that

even an organisation like the Teutonic Order, whose primary mission was to convert pagans, if needed with the sword, recognised the positive economic side-effect of a “pacified” land. The coalition of *ecclesia* and *mercatura* in Riga and the Daugava River valley is historically well documented (Blomkvist 2005, 524ff.). But what was the incentive for the

foundation of Tallinn? Tallinn too was located at a strategic location, a location from which the trade with Russia via the Narva River could be controlled. However, the fortificatory interest seemed to prevail, as the erection of the large fortress — *Castrum Danorum* — right after the victory at Lyndanisse in 1219 was of pre-eminent importance, serving as

bridge-head for further conquests in the region (Riis 2003, 67). What made this region so interesting?

A possible — but highly hypothetical — explanation can be inferred by applying the *orbis terrarum* concept. It is notable that T-O maps tend to depict the Baltic region in the immediate vicinity of the Tanais River (Fig. 3-13).

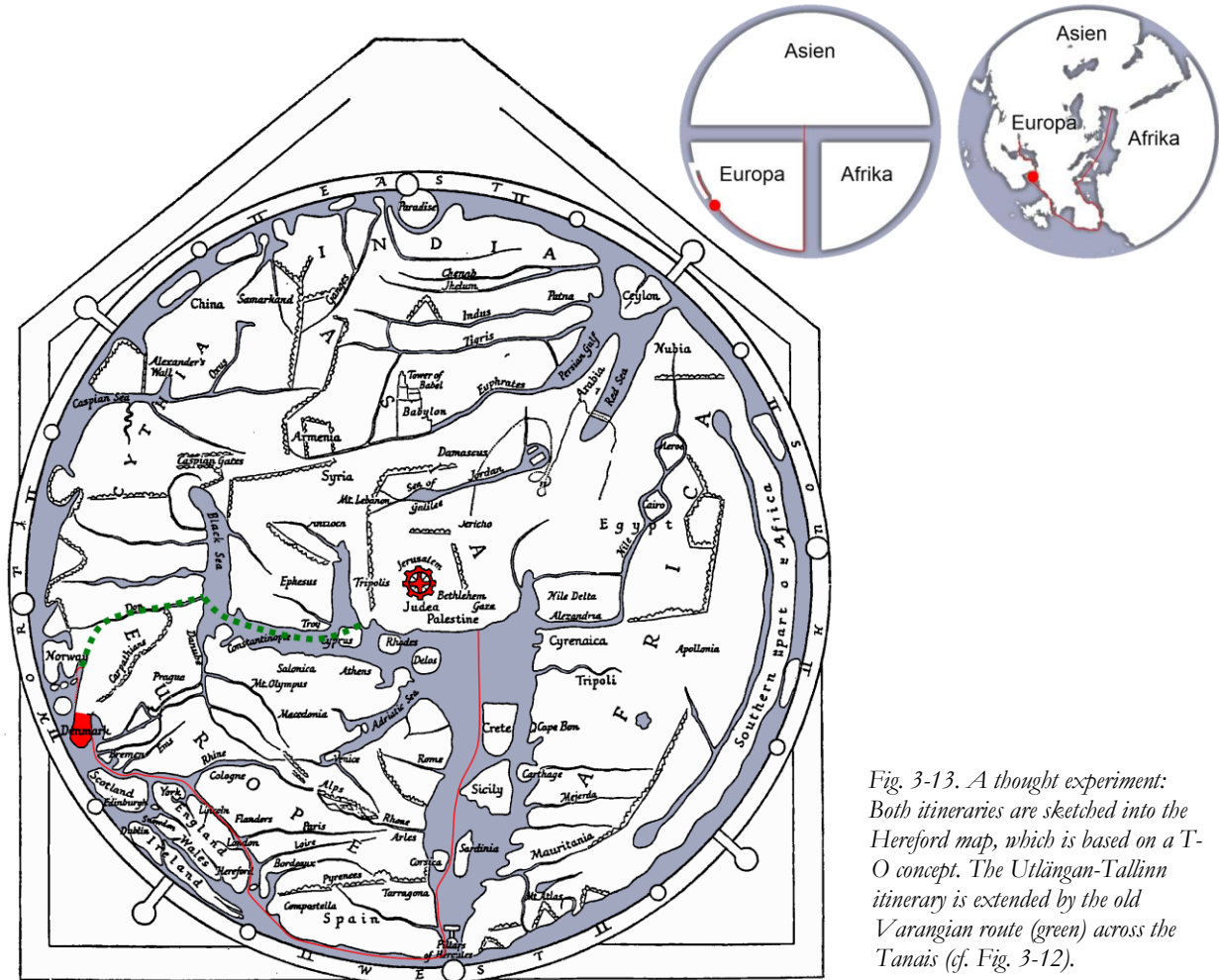


Fig. 3-13. A thought experiment: Both itineraries are sketched into the Hereford map, which is based on a T-O concept. The Utlängen-Tallinn itinerary is extended by the old Varangian route (green) across the Tanais (cf. Fig. 3-12).

Although the above T-O map is of English provenance, there is also indirect evidence that the Danes were likewise acquainted with such T-O maps, as indicated by indirect evidence: A now lost *mappa mundi* was compiled in the Codex Resenianus and copied on behalf of the Icelander Arni Magnússon in 1728. Its detailed nature is reflected in Arni's reference to "Drasnes, so sem þad i því gamla landcorte a pergament, sem eg um gat, stendur, er promonotrium Celticum i Spanien strax vid það nes, sem skípsfolk kallar Cabo d'Ortegál, enn hvört það kemur saman vid Orkneiasögu deur ei, hef eg ei stunder ad sia affier, þar bokinn er allareidu bia Worm" (Kálund 1916, 33 acc. to Simek 1990, 61). The old map on pergament depicted recognisable places like Cape Ortegal in Spain. Although Iceland was ruled by Norwegian kings at the time when the

Valdemarian Itinerary was written, the copy of the *mappa mundi* was made when Iceland was part of the Danish realm, so the original might have come from a Danish source. There can be no doubt, however, that the contemporary Danish perception of the world was in line with the common medieval belief of a tripartite world encircled by an ocean (GD 0.2.1.1-3, cf. section 2.3).

Was Estonia really meant as final destination of Danish expansionary policy? On the basis of the T-O concept, both itineraries can be conceived as being essentially eastwards bound — to *oriens*. This abstract notion is corroborated by the fact that the Tanais is the Greek term for the River Don, which together with the Volga and Dnjepr belonged to the extensive



Russian river system used by the Varangians to trade with the Orient. The Varangian trade route to Constantinople never really ceased to exist and did not end before 1204 and the route was known in the early 13<sup>th</sup> century, as Saxo Grammaticus referred to Erik Ejegod's visit in Constantinople (Lind 2009, 32ff.). With the conquest of Kiev in 1240 and other lands in the eastern Russian river plains by the Mongols, parts of the trade network and access to Oriental merchandise collapsed (cf. Hammel-Kiesow 2015, 34). Were the Danish conquests in the Baltic meant to establish a base for an alternative route to the rich and holy lands of the East? This question has to remain hypothetical, but in the context of medieval cosmography it would not be too far fetched.

### 3.3.3. Initiator

Justifiably, there is a general consensus that the itinerary did neither serve as practical guide on board of ships — as the Hanseatic Sea Book — nor documents an actual voyage — like that of Othere and Wulfstan. The Latin transcription in itself should be proof enough that this was not a document designed for the brawny hands of an illiterate sailor. The origin appears to be the Cistercian monastery of Sorø (Breide 2006, 74). Although a palaeographical analysis indicates that this particular transcriptoon was made by a Sorø monk who lived around 1300, it could be a copy of an even earlier original (Modér 1937, 90). However, it was doubted by one scholar that this document was drafted in Sorø, attributing it instead to the Franciscan Order which was more active in terms of travelling and establishing new monasteries in this area (Gallén 1993, 28ff.). This objection has to be seen as little convincing, as it is based on the wrong premise that monasteries made clerical work on their own behalf. Monks belonged to a literate class when this was not a matter of course, and thus had a key position in the communication and the drafting of privileges, often on behalf of the king. This is reflected in the way how the Livonian crusading movement was coordinated, which was very much dependent on the foundation of Cistercian monasteries for creating an

information network (Tamm 2009, 341 ff.). This is also reflected in the volume of papal replies to — no longer preserved — correspondence received from the Baltics, indicating that a great volume of information reached Rome from the periphery (Jensen *et al.* 2001, 8 ff.). This is also reflected in the case of the *vmlandsfara* privilege, where the crown commissioned a monastery with the drafting for a privilege: Issued in 1251 by King Abel and drafted by the Franciscan Order for the protection of merchants sailing between Flanders and Scania. A copy of this privilege was kept in the monastery of Utrecht (Flanders) and Lund (Scania) (Ventegodt 1982, 60f.). A similar constellation of a royal client and a monastic writer could be also assumed in the case of the itinerary from Ütlangan to Tallinn. However — as will be stressed in section 3.3.5. — the writer must have relied on the experiences of the seafaring population, which used to communicate geographical knowledge orally. Thus, this itinerary is a unique source, as a kind of knowledge was tapped, that was normally considered too profane to be recorded.

### 3.3.4. A maritime equivalent to a marching route?

The document consists of a laconic sequence of place names, of which most were already identified by their modern names (Härlin 1942). Most place-names did not relate to settlements, but geographical places like islands, sounds, capes and bays. Compared to other itineraries it was common that the place-names were not hierarchical and did not differentiate between topographical features and settlements (Harwood 2006, 37). ‘King Valdemar’s Itinerary’ mentioned only three urban centres: Kalmar, Stockholm and Tallinn. At Bråviken (*Brawik*) the route is divided into two parallel routes — one inner and outer — and at Mallsten (*Mæthelsten*) the outer route is divided again into an middle and outer route. Most intervals were defined in *ukasio*-units. To provide an example for a segment, the inner route from Bråviken to Stockholm (Fig. 3-14) reads:

*Et ultra bravik usque fimersund II. Inde usque örsebac, usque rugø I er per rugø I. Inde usque stendor sund. Inde usque siuia sund I. Inde usque basø I. Inde usque fjfång I. Inde usque swether sund I. Inde usque ekibholm I. Inde usque oslåsund I et per oslåsund I. Inde usque ikernsund I. Inde usque gardø I. Inde usque dalernsund I. Inde usque bariestic I. Inde usque litle swethiutha I. Inde usque stokholm I* (Transcription: Härlin 1942).

*And across Bråviken to Femöresund 2. From there to Örsbaken, to Rågø 1 and past Rågø 1. From there to Stendorren. From there to Sävsundet 1. From there to Håfö 1. From there to Fjifång 1. From there to Svårdsund 1. From there to Ekholmén 1. From there to Yxlösund 1 and through Yxlösund 1. From there to Vitgarnssund 1. From there to Gålö 1. From there to Dararörsund 1. From there to Baggensstaket 1. From there to Sveriges Holme 1. From there to Stockholm 1* (own translation).

The description is very laconic and if converted into a graph it would look very similar to the *Tabula Peutingeriana* (section 3.2), where places are put in a sequential order in a pearl-necklace-like manner in total isolation from cardinal points. No notable

geographical formations or landmarks are described, just place-names, not unlike the plan of the London Underground. Answers can be only found in comparison to sources which illuminate army logistics.

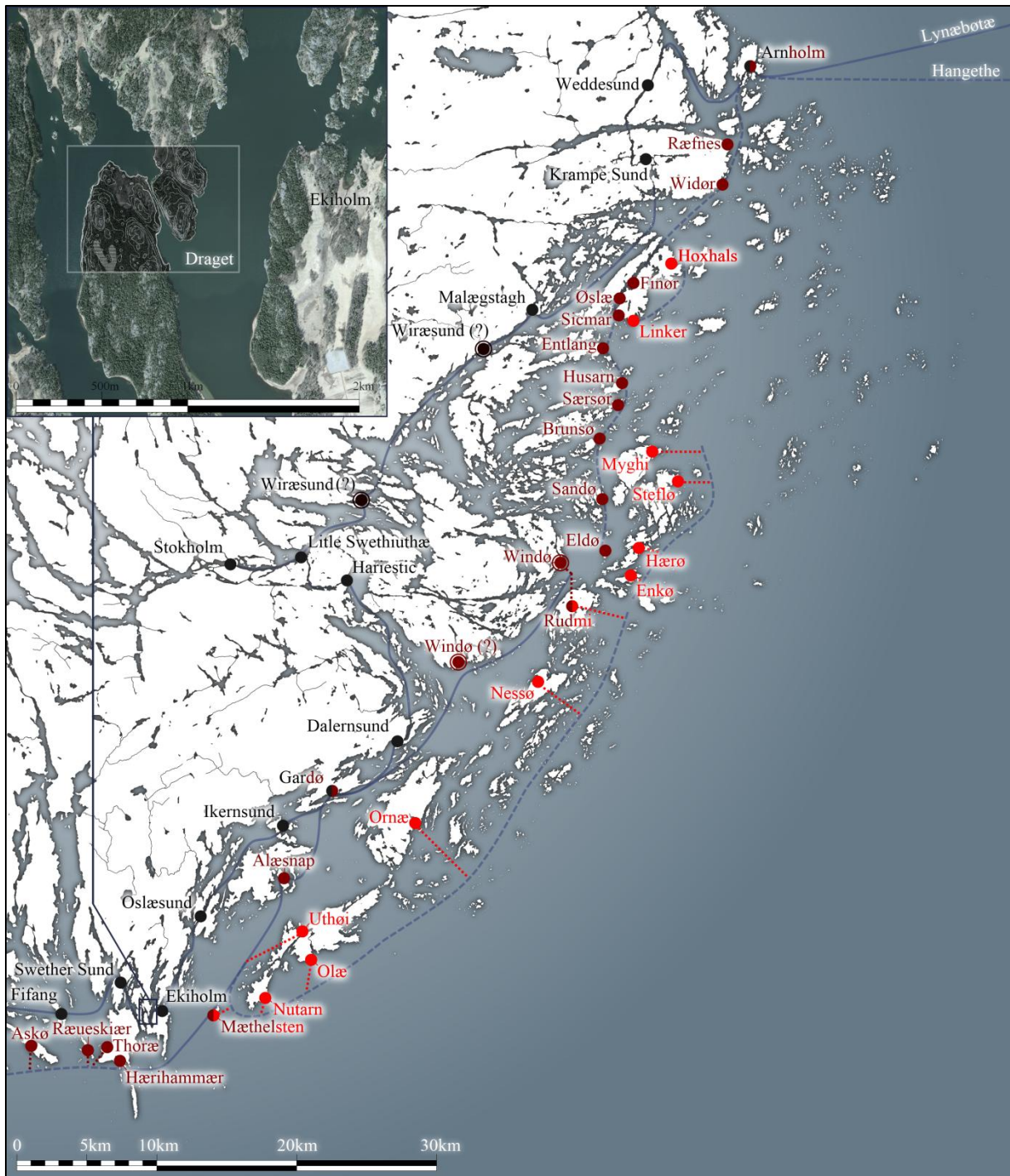


Fig. 3-14. This map represents the zoomed-in part of Fig. 3-1. It shows how the route splits up in several parallel segments in the Stockholm Archipelago. The segments where ukæσιο-units were provided are represented as continuous line, and where just a sequence of names was provided as dotted lines. It is striking that only for the inner (black dots) and partially the middle route (dark red dots) ukæσιο intervals are indicated, but omitted for the outer route (red dots). This could indicate that the outer route may have had another function. Given the exposed location, these islands were probably not directly headed for, but may have served as landmarks for taking bearings, as is suggested in this graph. The place-name identification is based on Härlin (1942) who almost completely managed to associate the names mentioned in the itinerary with modern places, with the exception of Wiræsund or Windø which remain ambivalent (Graph: Daniel Zwick).

And an apt comparison can be drawn to the 'Litauische Wegeberichte', i.e. Lithuanian travel routes. These represent a compilation of reports commissioned by the Teutonic Order between 1384

and 1402, carried out by scouts in the area literally called 'Great Wilderness' in a depopulated area marking the borderlands between the Teutonic Order and the Grand Duchy of Lithuania. These

information were gathered to plan incursions (Hirsch 1863, 663ff.). Similar to the Stockholm Archipelago, this was a peripheral area with no road network. The route was chosen in relation to places important for army logistics, e.g. taking into account possibilities to replenish provisions, setting up camps for the night, and where likewise distances between these places were noted (Striegler 2012, 212). The scouts were normally Lithuanians acquainted with the localities, as indicated by the names used, often referring to homesteads named after the owner. Thus the place-names were very subjective and referred to knowledge that would have been impossible to acquire for strangers to the land.

Therefore the Lithuanian scouts were also accompanying the Teutonic knights on their war campaigns, as the recorded place-names would not have sufficiently served the orientation of nonlocals (Striegler 2012, 212). Thus the place-names were very subjective and referred to knowledge that would have been impossible to acquire for strangers to the land. Therefore the Lithuanian scouts were also accompanying the Teutonic knights on their war campaigns, as the recorded place-names would not have sufficiently served the orientation of nonlocals (Striegler 2012, 212).

Similar conclusions can be drawn for King Valdemar's Itinerary, where most place-names referred to small local sites, like islands, bays or inlets that could have been only recognised by the local population well acquainted with the localities and place-names. To deepen the analogy further, certain places in the Lithuanian travel routes were recommended for setting up the camp. The maritime equivalent would be sheltered anchorages, and just that seems to be indicated in the Valdemarian Itinerary: An important anchorage in the itinerary was used up to the early modern period and is situated on the itinerary's middle route, called *Älvesnabben* (*Alasnab*). It was pointed out that in its northern extent the Danish toponym *Jutnabben* is documented, which appears to be a clear indication of the Danish presence in this region (Ankarberg 1995, 105). Was the division into three parallel routes owed to the itinerary's genesis, involving several route descriptions merged into one, or were different routes purposefully included? The splitted up routes converged again at Gälö (*Gardo*) und Arholma (*Arnholm*). If this was intentional, it could be hypothesised that a part of the fleet was meant to replenish provisions by following the inner route, which was leading to Stockholm, and re-join the fleet at an appointed node, such as Arholma. Only the inner route is continuously divided into *ukasio*-units, on which the total distance from Utlången to Tallinn would sum up to 113 *ukasio*-units. Which purpose did this information in its Latinised form serve? As mentioned earlier, such a list would have certainly been misplaced in the brawny hands of an illiterate sailor, thus it can be ruled out that it was a practical

navigation guide. Besides, the itinerary could not be used independently. Pilots with a knowledge of the local waters would have been still needed to identify the place-names, since there is no description thereof in the itinerary itself.

In order to answer this question, a closer look needs to be taken of the *ukasio*. This does not seem to be a unit of length, but rather a distance-per-time unit, which roughly corresponds to 4,2 nautical miles (Breide 2006, 181), although there is no indication within which time-frame this distance was to be covered. Its etymological origin was the Norse term *vika* (*sig*) and refers to the change of rowing-crews (Heide 2008, 26; Prenzlau-Enander 2003, 180). This is a highly subjective measure. On a sailing expedition in 2010, carried out in the author's firearing, one *ukasio* was covered on a day sailing from Ekholmen to Yxlösund. A much greater distance — possibly 3-4 *ukasio* — could have been covered, if my crew would have risen earlier, abstained making a stop-in-between in Nynäshamn, and if there was a suitable wind. As there was a calm, most of this leg was covered under oars. Although it is hard to say what the average distance was covered by a 12<sup>th</sup> century fleet, it is fair to suggest that it could have been used as guideline of how many *ukasio* could be covered in a day. As such, it could be arguably seen as equivalent to army logistics on land: In Denmark of the late 14<sup>th</sup> century, royal inns were set up along the *Hærvej* — the army road — at an interval of 30 km, which corresponds to a day's march (Westerdahl 2006a, 62ff.). Does the *ukasio*-system likewise imply what distance could be covered within a day at sea?

It is notable that *ukasio*-distances were only provided for the inner and partially middle route, but not for the outer route. This may reflect the etymological origin of *ukasio* as being a system primarily geared towards rowing-crews (Heide 2008, 26; Prenzlau-Enander 2003, 180) and thus primarily applicable to the inner archipelago. The importance of the class of watercraft with regards to the environment in which it is operated is reflected in Roger of Hoveden's account of a northern European crusading fleet in the Third Crusade in 1191 in the Mediterranean made up of oared vessels had to remain close to land, as they could be swamped easily in the open sea, which Richard Unger associated to English *esneves* (Unger 2006, 265), although it may also have referred to Danish *snekker*, the typical longship of the leding. In 1187, the Danish King Canute VI had ordered explicitly *snekker* for the impending crusade (Bill *et al.* 1997, 111), but the problems described by Roger of Hoveden may have led to a rethinking process, when in 1224 King Valdemar II of Denmark pledged to join the crusades to the Holy Land with *snekker* and — for the first time — *kogger* (cogs) as well (DRB 1.6.16). So the inner route described in the itinerary may have been a designated route specifically for oared vessels like *snekker*, ships of the leding-system, and the itinerary took this into account by

continuously including *ukasio* units. The reliance on both cogs and longships may have been a common strategy for fleets to penetrate deep into the coastal areas with the latter, which would have been inaccessible ships which were propelled only by sails like the cogs. This practise is also testified elsewhere, where the town of Wismar provided in 1311 a *kogge* and a *snicka* (HUB II, 201). The etymological link

between *snicka* and *snekker* does not leave any doubt that the same class of vessel is referred to. The importance of having smaller and more agile oared craft in the fleet which could penetrate coastal areas more difficult to navigate is also supported by toponymic evidence, as highlighted in section 3.3.8. (Fig. 3-15).



Fig. 3-15. A 14<sup>th</sup> century mural from Skamstrup Church, Denmark, shows the legendary race for the Norwegian crown between the two brothers Olav in his winning cog (left) and Harald in his longship (right). The legend implies that it was unlikely for a cog to sail faster than a longship and that King Olav won against all odds (Source: Crumlin-Pedersen 2010, fig. 3.42).

### 3.3.5. Successive genesis of a formalised route

The mediation of sailing routes often followed — what has been termed — a “*successive genesis*” with regard to the Hanseatic Sea Book, which surviving manuscript was compiled around 1470, but based on earlier information dated between 1300 and 1346 (Sauer 1996, 50ff.). The same book may have even been based on templates also used for the Valdemarian itinerary in the Liber Censur Danica. This is indicated by the use of *weke ses* starting at Falsterbo, replacing the — for the Hanseatic Sea Book — much more common unit of *kennyng*. Like toponyms, measuring units are also indicative of function and origin, and the *kennyng* unit seems to have originated at the Frisian coast near the Rhine estuary and based on the visibility range, a measure that made sense in the context of the English Canal with the opposite shores not far away. The first mention of *kennyng* in the Lübeck Ship Rights Act of 1299 was within this context, in which it was

stipulated that passengers had to pay only the full freight charge when the ship has moved one *kennyng* seawards, which is taken as synonym for out of land sight (Sauer 1996, 145). While this reflects the influence of Frisian seafarers in Lübeck, route transects containing *weke ses* units are indicative of a Scandinavian origin. The etymological similarity to *vika sig* and thus *ukasio* is unmistakable. This unit was so ingrained that even in the year 1612 the salary of pilots was calculated by the *veckesjö eller mil* (Härlin 1942). Not only such units of measurements, but the sailing routes had a long ‘tradition of usage’, as Westerdahl (1992) expressed it, and such anomalies as a different unit-system may indicate the advancement into a different transport zone, which boundary is not necessarily a feature in the physical landscape, but probably more so in the cognitive landscape, often dividing different culture zones. Such anomalies also exist in ‘King Valdemar’s Itinerary’, which reveal its heterogenic character. While the route description along the Swedish coast was mostly laconic, a more detailed instruction is provided along the Åland and Finnish coast:

*Et notandum est quod de arnholm usque lynabote itur medio inter orientem et aquilonem et si prosper est uentus ab occidente potest uelificari directa linea de arnholm usque hangethe et de hangethe que finnice dicitur cumiupe (...). Pretera notandum est quod si placet potest uelificari de hangethe usque bothensholm cum uento aquilonis uersus australem plagam et orientalem. Atque ibi habet mare VIII ukasio (Breide 2006, 29).*

*Note , that the course from Arnholm to Lemböte follows a northeasterly direction, and one may, if there is a favourable wind from a westerly direction, sail on a direct line from Arnholma to Hangö, which is called Cumiupe in Finnish (...). Note, that one could — if one desires — saild from Hangö to Odensholm with a northern wind to the southeast. And these are 8 ukasio at sea (own free translation).*

This excerpt describes the precondition for a direct landfall, in Hangö (*Hangethe*) and Odensholm (*Hothensholm*), respectively. The right conditions for making such a landfall were emphasised, revealing that the author recognised the significance which suggest that he was a mariner and well acquainted with this region. In terrestrial navigation it was highly important to keep within the sight of known landmarks, and sailing across a wider stretch of water whereby all landmarks came out of sight, bore the risk of being driven off course and landing on shores unknown.

Aside from reflecting the tacit knowledge of a sailor, the route description from Sweden to Finland is altogether distinctive to the rest. This can be seen as indication that the itinerary was merged together from at least two different descriptions. Was the Swedish-Finnish already used on the crusades under Eric IX against the pagan Finns? The Finnish Crusades as described in the Eric Legend are little understood and it is questioned whether these crusades actually took place, or could be defined as such. There are, however, slight indications that the Eric Legend was near-contemporary, written as early as the 1160's and therefore may contain some factual events (cf. Bengtsson & Lovén 2012). A more tangible manifestation of Swedish discovery and development of a maritime infrastructure in this region is suggested by some written sources: Several Swedish enclaves in Finland were freed from taxation in exchange for pilot-service (Westerdahl 1995b, 270). Often the requirement for a reliable pilot-system appears to be the main incentive for the establishment of Swedish enclaves along the Finnish and Estonian coast in order to safeguard the control over sailing routes: A Swedish colonization of the Estonian island of Odensholm/Osmussaar (Itinerary: *Hothensholm*) is documented since — at least — the 14<sup>th</sup> century (Peil 1999, 6), and in the year 1341 the Bishop of Courland permitted the apparently Swedish-populated island of Runö/Ruhnu to practise Swedish Law (Rußwurm 1855, 189). It can be conjectured that the colonization of these islands started well before the presence of a Swedish population was noted in recorded history.

The cesura in the itinerary from the laconic sequence along the Swedish coast, and the annotated description along the Ålandic and Finnish coast from Arholma (*Arnholm*), suggest that this segment was described by a set of different people — perhaps emmigrated Swedes. The Danes understood to tap this regional knowledge and its transcription may reflect a similar purpose, as that of the Swedes more than half a century before.

### 3.3.6. Links to the leding-organisation

The use of the *ukasio*-system may have been owed to a superordinate incentive. It provided a basis for

estimating travel time. This would have not only been important for fleet logistics, but also important for the knowledge with what delay messages and be sent and received from the Estonian overseas enclaves. This would have been of preeminent importance even after the victory at Lyndanisse of 1219, as the aftermath was characterised by several rebellions, which needed to be quelled in led to a discord with the Order of the Swordbrothers — the military arm of the Bishopric of Livonia — which assisted the Danes in defeating the rebelling Estonians, but refused to vacate their new-found positions of power once they gained *de facto* rule over the Danish possessions in Estonia. At a meeting probably held in Vordingborg in the year 1237 with King Valdemar II, the papal legate and a German delegation of the Swordbrothers — now united under the banner of the Teutonic Order —, the Danish king is said to have hinted to let action speak if his claim on Estonia is not respected, by showing off with his fleet as a blatant threat directed to the German delegation (Skyum-Nielsen 1981, 112). And this was certainly impressive, given the maritime capabilities of the Danish crown at that time. The calculation basis of the itinerary's *ukasio*-system would have enabled him to time an attack fairly exactly, and another calculation basis, which was also part of the compilation of the *Liber Census Daniae*, referred to the geographical division of his provinces into *havne* and *skipaer*.

The latter included 42 of the first, and correspond to a leding-ship with 42 crew-members and a *styraesmaend* — literally steersman, but synonymous to skipper. The Danish leding was not only a system for naval conscription for coastal defence, but also also in offensive combat since the Wendish Crusades of 1147 (Hoffmann 1976, 25; Lund 1997, 195). Interestingly the leding — or *lething* — was the vernacular term for the Latin *expeditio*, which was used by Saxo Grammaticus almost exclusively for naval campaigns from 1130 onwards, i.e. 80 of 93 times (Jensen 2009, 149). In his *Gesta Danorum* Saxo Grammaticus covers Danish history from the dawn of times, presenting it as a continuous national epic. Yet, the prominence of the term *expeditio* in — from Saxo's perspective — the recent past could mark a consciously perceived shift in the way warfare was conducted. On the basis of the interchangeability of the terms *expeditio* and *lething*, Kurt Villads Jensen argues that the latter — despite being primarily seen as defensive in nature — can be synonymous with the crusade, as defence could also refer to a pre-emptive attack, just as the promoter of a perpetual crusade could be perceived as pacifier (cf. section 1.2.2).

Thus, with the *leding* organisation the king disposed over data on the anticipated fleet size, and once the leding was mobilised and summoned, he could time almost exactly an attack on opposite shores by using the calculation basis of the itinerary's *ukasio*-system: a powerful instrument for ruling over the Baltic Sea.

### 3.3.7. The significance of a detour

It is noticeable that the Valdemarian itinerary would have presented a detour. On the basis of that, it was concluded by some authors that its ordinary use could be ruled out and only kept as backup option for safe navigation (Breide 1998, 47ff; Ilves 2012, 98). However, the detour can be explained by the requirements of fleet logistics as outlined in the preceding section.

Another possible explanation can be based on a strategic factor: The route — especially the inner one — was sheltered by a chain of islands. Was this a route to conceal fleet movements to Oselian pirates — Estonians from the Island of Ösel/Saaremaa — to sail undetected to hostile shores and launch a surprise attack? As a historical event in 1215 suggests, the Oselians were able to summon within a very short time a considerable fleet, when nine German cogs were trapped in an anchorage (HCL XIX 5) (section 11.2). In previous years, the Danes launched three seaborne but unsuccessful attempts to conquer Ösel/Saaremaa, indicating that the Oselians were considered a respected foe. Given the strong maritime resistance, it is perhaps no surprise that the island could be only taken by an army crossing the frozen sound in winter (HCL XIX, 9). Although there is hitherto no archaeological evidence for shipwrecks which can be associated to *pyraticeae*, as they are described in the sources, these were probably open boats, large enough to transport booty and slaves, but which freeboard was considerably lower than that of cogs (cf. section 4.1). However, they could be apparently trimmed in a way that their prow could project above the skiffs of the crusaders — the *navicula* (Heinsius 1986, 53). Ösel/Saaremaa was already exposed to seaborne attacks before the Viking Age, as demonstrated by the recent spectacular find of a boat grave from around 750 A.D near Salme with 40 Scandinavian warriors (Peets 2013). Given the long history of seaward threat, it is not a surprise that the Oselians were renowned seafarers and feared pirates, whose vessels may have matched the longships of the Danish leding.

A reference in Henry of Livonia's Chronicles may be key to understand the Oselian naval system, which appears to have a similar standardisation as the Danish leding. In 1203 a fleet of German crusaders intercepted an Oselian fleet of 16 ships off Gotland, boarded two of them and killed their crews of 60 men. One of the crusaders even boarded single-handedly a third ship and managed to kill 22 of the Oselians with his double-handed sword, but was eventually captured and killed when the remaining 8 crew members managed to set sail and close up with the rest of the fleet. This does not only indicate that each Oselian pirate ship carried 30 men, but that 8 men were not really enough to crew this ship, for which reason it was abandoned and burned (HCL VII 2-3).

Of further interest are archaeological finds on Ösel/Saaremaa, which indicate a close cultural contact to Gotland, indicating that it may have had a similarly egalitarian society like the “peasant republic” of Gotland (Mägi 2011, 331). When the papal legate William of Modena called the Gotlanders in 1226 to wage war against the Oselians, they refused (HCL XXX.1). Was there an informal friendship between the populations of both islands? And was this the reason why Estonian ships laden with booty and Danish slaves thought it safe to sail under the Gotlandic coast, as mentioned in the previous excerpt? This seems to be confirmed in the chronicles of Henry of Livonia, who notes that the Gotland merchants and citizens sought to maintain peace with the Oselians, which was considered disgraceful by the German crusaders (HCL VII 1). If there was an informal friendship, the Oselians could have been warned early about Danish fleet gatherings. Although a route via Gotland would have been shorter in terms of travelling distance, this may indeed serve as an explanation why the route along the Swedish and Finnish coast was chosen in the itinerary.

### 3.3.8. Toponyms as manifestations of real and imagined associations

As stressed in section 3.1, place names that make objectively little sense may have had a deeper meaning that could be only unlocked by pursuing an ethnological approach in combination with the awareness of biblical and mythical themes, like the “amazons” of Fennoscandinavia. Christer Westerdahl (1978, 39) has suggested that the study of toponyms in interesting transects of the route may reveal more about the itinerary's nature — an advice that will be followed here.

The itinerary's first node is the island of Utlängan in the province of Blekinge. Blekinge literally translates as “great calm waters” and there are many ship-toponyms in its archipelago (Stenholm 2009, 61ff.).

This might be a reflection of the fact that the archipelago offered good anchorage grounds in sheltered and calm waters. The island of Utlängan arguably served primarily as bearing point, being the archipelago's most offshore south-easterly island. Although the island itself offered an anchorage in an inlet called Kuggen, most ships would have probably anchored in the archipelago beyond, in which many different ship-types have become fossilised as toponyms, always composed of a ship-type — i.e. *busse*-, *draka*-, *knarr*-, *kugg(a)*-, *snäck*-, *snick*-, combined with a geographical entity — i.e. *-holmen*-, *-skär*-, *-vik(en)*-, *-nyk* (Fig. 3-16).

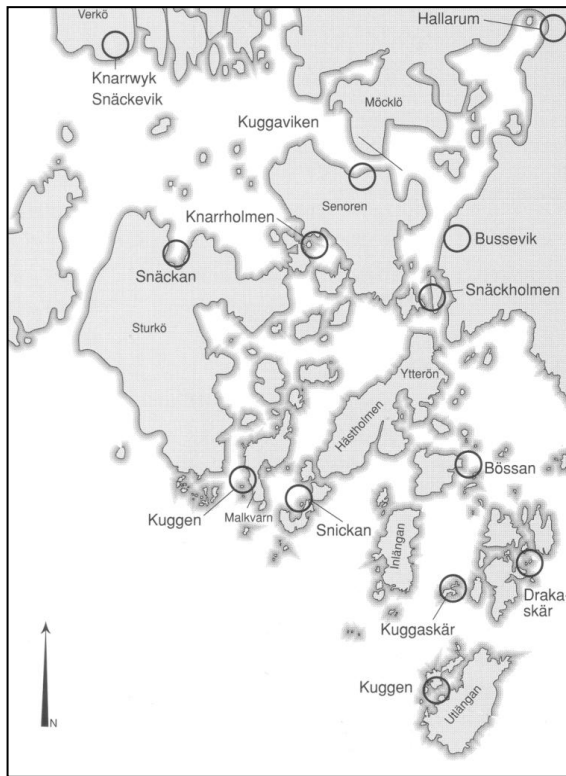


Fig. 3-16. Distribution of Viking Age and medieval toponyms in the eastern archipelago of Blekinge (Graph: Stenholm 1995, 57).

For instance, *Kuggaviken* could be translated as “Cog Bay”, although the *kugg*-toponyms cannot be safely associated with cogs, but could also refer to hills. Although this goes against the grain of scholars interested in maritime studies, this is arguably the more likely interpretation, as *kugg*-toponyms have been so far only dated to the early post-medieval period when cogs were no longer present in the sources (Westerdahl 1992, 10f.). *Kuggaviken* interpreted as “Bay of the Hills” would make sense nonetheless, as hill formations were landmarks, serving the mariner as orientation.

Even though not all toponyms are necessarily connected to ship-types, some definitely are, like *busse*-, *knarr*- and *snäck*- names. These names marked the points of levy fleet organisation, i.e. a gathering point for leding fleets, and may even date back to the Viking Age (Westerdahl 1992, 10).

The spatial clustering is suggestive of a pattern, which may reflect the different seagoing capabilities of vessels. It is notable that the *kugg*- names can be found only in the outer reaches, or the wide open bays. If the “cog” is denominated by the *kugg*, which is still a possibility, this would reflect the limited maneuverability of a heavy sea-going vessel not able to access the inner archipelago (cf. section 4.1), and if it referred to “hill”, it would reflect the first impression of an undulated landscape from an approaching distance. Other ship-toponyms are found in the inner

archipelago and may point to their capabilities to operate under oars. This explanation is of course highly hypothetical, as other interpretations are possible too. Different classes of ship-types might have gathered at separate places, even when they were part of the same fleet. For instance the cargo-ships — i.e. *knarrs* — might have gathered at a predefined point to take over additional supplies. Thus, from a utilitarian perspective, it would make sense, as the local supplier would know exactly where he has to deliver provisions. These toponyms may well be reflections of what Christer Westerdahl defined as harbour sites of a ‘ritual landscape of the seabord’, where names are associated with a function (Westerdahl 2011, 261ff.).

Another function is ingrained in the toponym *Draget*. While *Draget* itself is not mentioned in the itinerary, it is an isthmus directly located between Svärdsund (*Swether Sund*) and Ekholmen (*Ekholm*), which are both mentioned in the itinerary. Today, this isthmus can be crossed through a canal, which had to be deepened in the mid 19<sup>th</sup> and in the course of the 20<sup>th</sup> century due to post-glacial landrise (Fredholm 2006, 7 f.). Vessels following the itinerary’s inner route had to cross this isthmus, as it was the only passageway between Svärdsund and Ekholm. In medieval times there will not have been a canal here,<sup>13</sup> but the land would have been much lower in relation to the water-level due to post-glacial landrise. For this region the land-rise was reconstructed with 3.5 mm per year (Ågren & Svensson 2007, fig. 5.1). Despite of this estimate, an exact reconstruction of the historical coastline has not been made yet, as the water-level depends also on a number of other factors. But to get a rough impression, an annual rise of 3.5 mm extrapolated over 800 years would result in a difference of 2.8 m. The author crossed this channel with his fireæring on a sailing expedition in 2010 and from an own estimate of the canal-wall height this would not have been sufficient for the isthmus to become inundated (Figs. 3-14, 3-17).

<sup>13</sup> The construction of canals in the rock was probably solely facilitated by the invention of dynamite. At least in the early 17<sup>th</sup> century an attempt by Norwegians and English to cut a canal through an isthmus near Spangereid was aborted immediately, when they hit rock (Westerdahl 2006b, 15 ff.).



Fig. 3-17. Crossing *Dragefskanal* — a modern canal — in the author's *fireåring* (Photo: Daniel Zwick).



Fig. 3-18. The author's *fireåring* moored in *Eckbolmen* (Photo: Alexis McEntyre).

This impression is corroborated by the contour lines (Fig. 3-14). A possible explanation for this navigational bottleneck can be inferred from the toponym: *Draget* is a common toponym in the Scandinavian world, which is composed of *drag* — the same meaning as in English — and *e(i)d* — which is an isthmus. Both terms in combination denote

portages, i.e. sites where ships were “dragged” or hauled over land (Westerdahl 2006b, 78). The central importance of this site may be reflected by the cluster of *drag*-toponyms in the direct vicinity, like *Dragsund* and *Dragbergen*. Naturally, such portages could be only crossed by relatively light vessels, as could the itinerary's inner route in the maze-like inner



archipelago only be navigated by easily maneuverable vessels that could also operate under oars.

This environment may have abetted the development of a distinctive class of water-craft, moderately sized vessels, small enough for traversing portages and suited to navigating in these narrow waters under oars and sails, perhaps similar to the Helgeandsholmen V wreck from around 1300, which is very slender with a high length-to-beam ratio and built in a way to suggest that oars were the main propulsion (cf. Varenius 1989, 38ff.). A great number of rowers would have been also required to haul the vessel across a portage. The interdependence between a certain type of craft or propulsion and its “habitat” was taken up in terms of an evolutionary analogy (paper B, 55), to allude to an “ecological niche” and the way it affects evolutionary convergence, i.e. appropriations or technical responses to a certain environment throughout time and space that appear similar in analogy, but do not necessarily belong to a some homologueous tradition. 400 years later, an emphasis was still on oared craft in the Swedish archipelago fleet. But ship-construction may not have been the only environmentally-conditioned appropriation, but it may have been also taken into account in the itinerary itself by only including the *ukasio*-distances for the inner route; the route that was supposed to be rowed, as argued above.

Apart from Draget, there is archaeological evidence for a landing site and a tar-pit in the nearby Ekholm (Ekholm) (Fredholm 2006, 8) (Fig. 3-18). Although tar was also used for land constructions, the vicinity to the water is very suggestive: May the local tar-production been geared to supply bypassing ships with this product, which was required for maintenance works of the hull and rigging? Tar was a typical Swedish export products, like other forest products as pitch, potash, but also osemund iron and copper, which were part of the cargo assemblage of two 15th century wrecks near Danzig/Gdańsk (Ossowski 2014) and Skaftö (von Arbin 2012, 67). Not far away on the island of Utö (*Uthö*), but on the outer route, iron was mined since the 1100s (Byström 1996, 13 ff.; Norman 2006, 91). The Danish itinerary adapted mostly the local Swedish and Finnish place-names, with rare

exceptions. One exception is a Finnish island which was referred to with the Danish place-name *Hestö* – meaning “horse island”. The excerpt in question reflects particularly well the conveyance of geographical knowledge, expressed in the otherwise laconic document thus *inde Horinsaræ quod danice dicitur Hestö* — i.e. “*then Horinsaræ, which is called by the Danes Hestö*”. This emphasizes that the writer acknowledged that the Danes knew already these places already well enough to give them own names. This corroborates the interpretation in section 3.3.3 that the route description should not necessarily be seen in direct relation to King Waldemar’s II campaigns in Estonia, but that it may have been written later as guide to estimate travel time to the new Danish territories in Estonia after the conquests have been largely completed.

Aside from this notion, the toponym is very interesting in itself. Although a transcendent explanation for horse-toponyms in the northern maritime context was offered by Christer Westerdahl (2009, 315) — who pointed out that they could have marked dangerous localities for navigation in allegory to precipitous rocks where lame horses were rushed over to perish — there is also much to be said for a utilitarian background. Many toponyms reveal a subjectively perceived association and this island must have been deemed important enough by the Danes in terms of horses that they used their own toponym instead of the Finnish one. Was this a place where horses were bred and acquired for their Estonian war campaigns? This seems possible, as islands were ideal grazing grounds for horses and other animals due to their isolated nature, obviating the construction of fences.

Even in the 16<sup>th</sup> century there are many other horse-related toponyms in this region, also on the Estonian side of the Gulf of Finland, as testified by the Swedish toponym *Hesting* (probably originating from *bäst-äng*, i.e. horse meadow) or *Hestholm* (horse island) (Rußwurm 1855, 74). As will be stressed in section 4.3., there may be indirect archaeological evidence for the transport of horses along the Swedish coast of this route, which might have served for the establishment of horse breeder colonies along the coast or for warfare in the Baltics.

### 3.4. The significance of the re-interpretation

Having illuminated the medieval context – or at least some aspects of it – in which itineraries and rutters were drafted, embedded it into the mental landscape of the 13<sup>th</sup> century influenced by both cosmographic beliefs as much as reports of actually travelled routes, and finally, set up hypotheses based on practical aspects reflected in the itinerary, this author arrives at a significant different interpretation of the Valdemarian Itinerary than previous authors, who

doubted that it was an actually frequented route, interpreting it as an alternative “save route” in times of political instability (Breide 1998, 47ff., Ilves 2012, 98) and dismissed the claim that it could have been connected to the Baltic Crusades on the basis of an anachronism (cf. Morcken 1983, 127; Varenius 1995, 192; Ventegodt 1982, 71; Westerdahl 1995a, 25., cf. section 3.3.1).

Although not all aspects of the itinerary's compilation history within the *Liber Census Daniae* is known, its importance becomes immediately apparent through the general geo-historical context as much as by the nature of the source. Before Denmark gained a permanent foothold in Estonia after the battle of Lyndanisse in 1219, a number of attacks have already taken place beforehand on Estonia in the years 1194, 1196, 1197 and 1206 on Saaremaa, and even in Finland in 1191 and 1202 (Reisnert 2009, 54). The crusades against Finland may have even ultimately served the purpose to gain a bridgehead from where to conquer Estonia (Lind *et al.* 2006, 151). In this context, the detour (as compared to the more direct route of the Hanseatic Sea Book) of the itinerary makes sense, as much as the abovementioned Danish toponym Hestø at the Finnish coast.

An important distinction has to be made between King Valdemar's Itinerary and the Hanseatic Sea Book, the first being an *itinerarium adnotatum* and the second a rutter. Although they could be effortlessly compared in a graph (Fig. 3-19) and seem to adhere to the same principles, they are fundamentally different in the purpose for which they were made. While the Hanseatic Sea Book was for practical use on board of ships, the itinerary remained in the *scriptorium* or library of a monastic or royal institution, as already anticipated in section 3.3.3. This does not mean that a rutter following the same route did not exist. In fact, it is very likely, as the itinerary from Sweden to Finland is "contaminated" with navigational notes, which made little sense in a

conventional itinerary and must have been copied from a rutter or – at least – from an oral route description. Although the possibility that ships may have actually followed this route is alluded to in the following chapter, the principal purpose of the Valdemarian Itinerary should not be lost out of sight.

It represents the intellectual component of a communication network, which made it possible to exert central royal authority in dispersed and peripheral areas. This is nowhere as well reflected as in an incident described by Henry of Livonia, which illustrates that not only people, but also information were subject to travel time. When a German crusader fleet encountered an Oselian pirate fleet off the coast of southern Scania near Listerby, laden with plunder and prisoners from an earlier raid on a Danish coast, the crusaders were disposed to avenge the losses of their Danish fellow Christians. But they did not attack, as the Oselians managed to convince them that Riga (where the crusaders were heading to) has made peace with them in the meantime. This however, proved to be a lie, and the crusaders were thoroughly outsmarted (HCL VII, 1, cf. Bauer 1975, 25). This perfectly illustrates that manpower, weapons, resources and ships were not enough to win wars, but that information was essential to exert state power as not to lose oversight in the complicated patchwork of medieval diplomacy. As anticipated already in section 3.3.6, the itinerary would have made it possible to calculate travel time for fleets, and has to be seen in the context of the *leding* organisation.

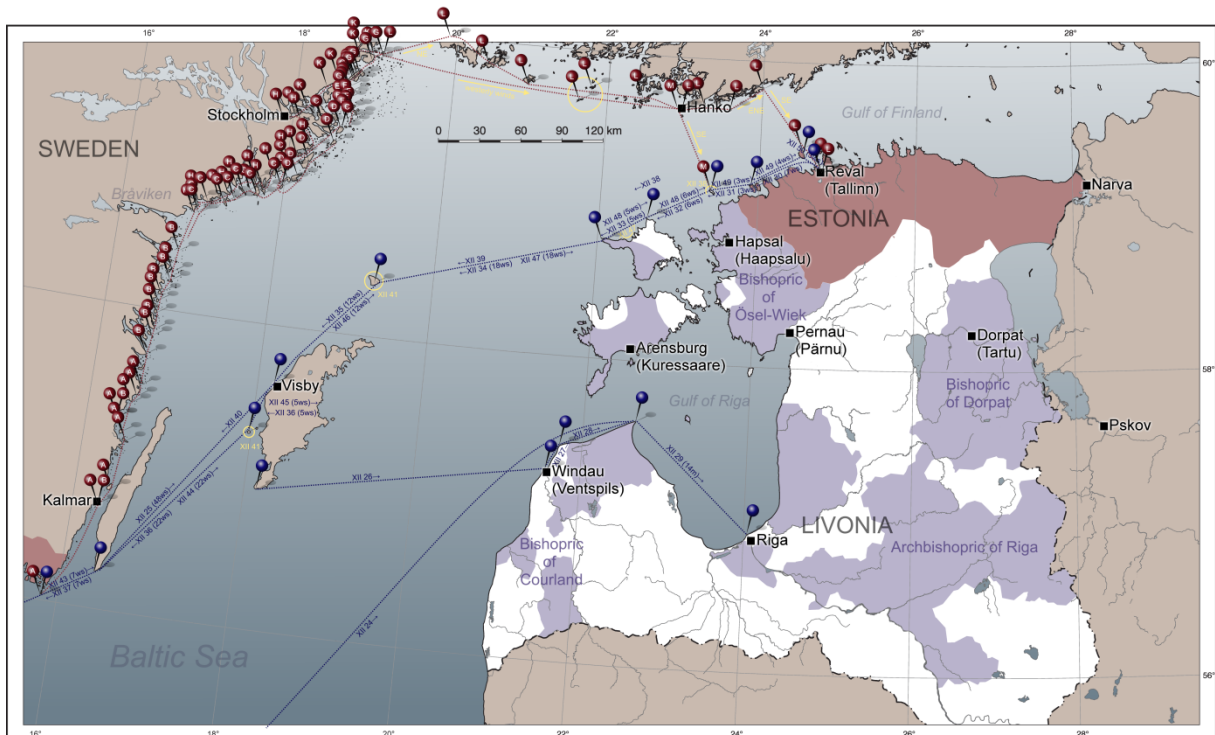


Fig. 3-19. King Valdemar's Itinerary (red pins) in comparison to the route description of the Hanseatic Sea Book (blue pins), and the territories held by Denmark (red) since the second quarter of the 13<sup>th</sup> century and Livonia, subdivided by holdings of the Swordbrother Order (white) and the bishops (purple). Navigational notes regarding course directions, minimum depths etc. – as typical for rutters – are marked in yellow (Graph: Daniel Zwick).

Another aspect – not yet addressed – could be legitimacy. The Danish king, the archbishop of Riga and the Swordbrothers were often engaged in disputes amongst each other for the stewardship of the lands conquered in God's name. All sides were making an effort – more or less successfully – to appeal to the popes for support of their respective territorial claims. This underlying conflict amongst the crusading factions has escalated in 1220, when King Valdemar II claimed Livonia, which was resisted by Bishop Albert of Riga, who conversely claimed that Riga has established a Christian mission in Estonia several years before the arrival of the Danes (DD 1.5, nr. 165; Reinsert 2009, 57). In this

conflict, the pope sent William of Modena to mediate and settle these conflicting territorial disputes. It could be anticipated that a Latinised itinerary from Denmark to Estonia in combination with the *Estlandlisten*, showing the marching routes of the priests who baptised the local population, would have credibly documented the missionary efforts of the Danish crown. This may have ultimately underpinned the Danish territorial claims in the eyes of the papal legate. Although there is no evidence to this author's knowledge that the itinerary was drafted for this purpose, it is a distinct possibility with regard to the historical context.

## 4. SHIPS IN FRONTIER ZONES OF THE NORTH-EASTERN BALTIC RIM (13<sup>TH</sup> CENTURY)

In this section several ship-finds are revisited, which seem to have played a role in the transport network of the northeastern part of the Baltic Sea, where new trading posts as well as colonies in the wake of the crusades emerged. As such, it forms a counterpart to chapter 2, which examined the evidence from the

ports of departure as well as access points into the Baltic Sea. In this chapter, the 'arrivals' are examined, and of course the 'non-arrivals', i.e. ships that were abandoned or lost in waters far from their crews' homelands.

### 4.1. The Riga 3 ship and its port

To this date, three medieval wrecks have been discovered in Riga's earliest harbour in the Rīģe River (German: *Rising* / Latvian: *Ridzene*), which probably all date into the 13<sup>th</sup> century: The first discovery was already made in 1554 and was described in the alderman book of the great guild of Riga as being located at the former waterfront between the sand and lime gates. No further information is provided in the source (Caune 1994, 482). The second wreck was unearthed during archaeological excavations in 1938, about which little is known, except that it was heavily built with treenails measuring 5 cm in diameter and – as an *in situ* sketch indicates – a stempost notched to the keel in a sharp angle, and that it probably fell victim to a fire, as indicated by scorch marks (Caune 1994, 484). Henry of Livonia describes frequent attacks on Riga and ships moored in the Riga River outside the town wall could have become a vulnerable target. Only the third discovery of a ship – Riga 3 – was in a relatively well-preserved state and for the standards of a 1939 excavation well documented. The wreck was carefully disassembled and prepared for preservation and further study, but fell victim to a fire through artillery bombardment during WWII and was lost. Fortunately, many details can be still inferred from the *in situ* documentation and shall be evaluated. But before looking at the ship-remains, the location and early harbour development shall be addressed, as these factors are not incidental for the interpretation of the ship.

#### 4.1.1. Foundation and fortification

After Lübeck was founded in 1143/1158, Riga is the second German town foundation in the Baltic Sea area, established in 1201. This is remarkable, as it is located on the opposite shores of the Baltic Sea and predates even the town foundations in the Wendish

Quarter, i.e. of Wismar, Rostock, Stralsund and Greifswald. This is even more remarkable in respect of the presumed shortage of ships in Lübeck (cf. section 2.3.4). An explanation for this paradox has been offered with regard to the pivotal role of the Gotlandic merchant community whose economic mainstay was maritime long-distance trade. The foundation of Riga (Fig. 4-1) was preceded by merchant activities in the Daugava River valley, in which the Germans may have been involved since 1161 (Benninghoven 1961, 28).

The economic motive for settling in this area is even acknowledged in the late 13<sup>th</sup>-century Livonian Rhymed Chronicle, a source predominantly concerned with portraying the deeds of the Teutonic knights in a heroic light with reference to a higher celestial mission, rather than mundane trading activities. Nonetheless, no pretence was made for the primarily economic interests, which laid the foundation for German colonization in Livonia:

*"Established merchants, rich and prominent in honour and wealth, had decided to seek profit from trade, as many still do today. God led them to employ a man who knew of foreign lands and straightaway he brought them by ship to the Baltic Sea. (...) The Daugava is the name of the river which flows out of Russia. (...) They went home and returned again often to Livonia in large numbers. Whenever the natives observed their arrival, they were received as welcome guests, and they spent many days buying and selling. So well did it go that they travelled thirty miles into the interior where many heathens lived with whom they could trade, and they remained there long enough to build a settlement. With native permission they built a worthy place on a mountain by the Daugava, a castle so large that these traders could remain there in peace and conduct trade for protracted periods of time. It was named Üxkiüll and stands even today in Livonia"* (Smith & Urban 1977, 3f.).

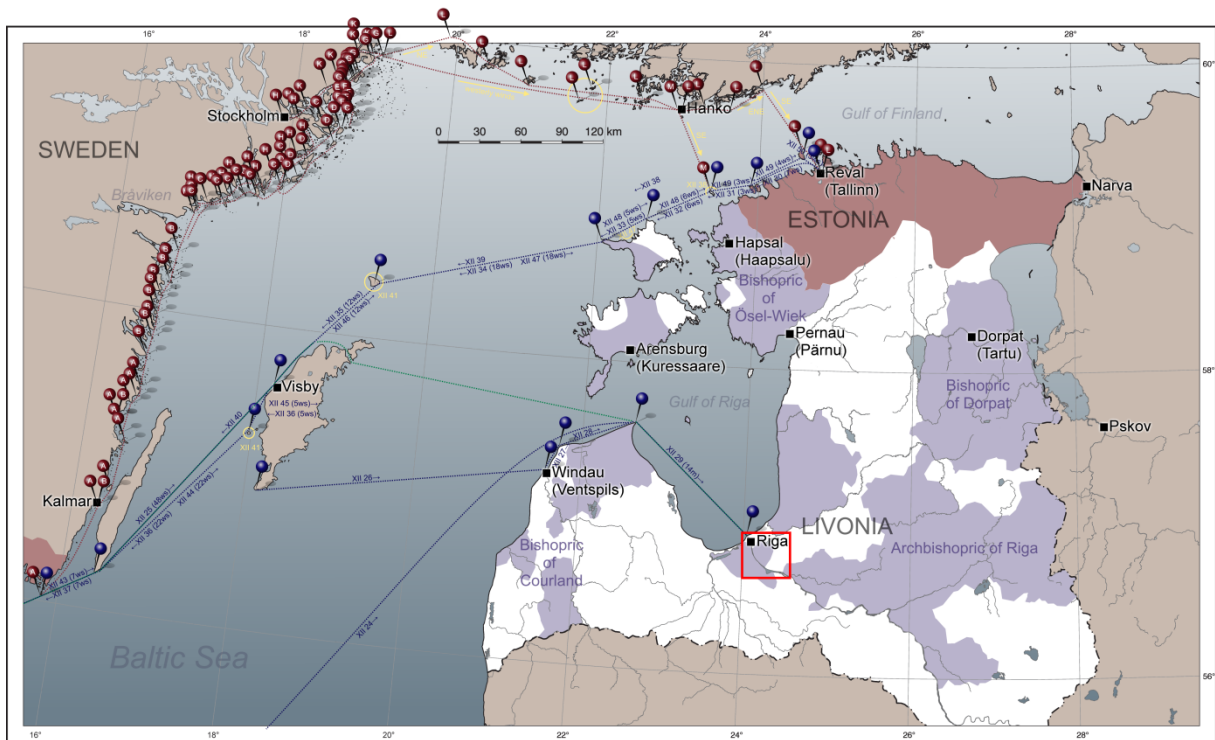


Fig. 4-1. The location of Riga in the context of territorial rule (not yet established in this form in the foundation phase in 1201) and sea routes. A hypothetical route (dotted green line) is added, which was probably used by the German crusaders who sailed via Visby. The municipal area around Riga (red square) is magnified in fig. 4-4 (Graph: Daniel Znick).

Although Henry of Livonia ascribes the foundation efforts mainly to the mission activities of Meinhard, the first Bishop of Livonia, this can be doubted on the grounds of the shares of the merchant community in the financing and building the castle. It is one of the few instances when Henry's otherwise trustworthy and sober reporting may have been tinted by his bias as member of the clergy (cf. paper A, 358). The castle of Üxküll (Latvian: *Iksķīle*) was the first stone castle in the Baltics, founded in 1188, and situated near a Livonian village at a river bank, which articulated with an important north-south road, connecting the interior with the coastal regions (Lind *et al.* 2006, 165) (Fig. 4-2). Significantly, the most crucial logistical support was made by the Gotlanders, who not only provided ships but also the stonemasons to erect the castle (HCL I, 6).

However, Üxküll became redundant as headquarters of the episcopal see, when a direct bridgehead was required for arriving crusaders. Seagoing ships could not reach the castle due to rapids, which could be only traversed with small river-craft. This led to problems in landing the crusader contingents in 1198 and 1200, which had to disembark at the Daugava estuary several kilometres downstream from the castle (Benninghoven 1961, 22f.). Thus, a new site for the episcopal see and capital of the Livonian crusader movement had to be found. As Henry of Livonia notes, it was chosen with the possibility for a *portus* (HCL IV, 5 and V, 1) and in 1201, Riga was founded as the second German city with access to the Baltic Sea. However, the city was not founded at the

main stream – the Daugava River – but its side-arm called Rīge River, which served as first harbour and in which also the three ships were discovered. The community of *mercatores Guttenses* – i.e. Gotlandic merchants – had a vested interest in settling in the city, thus changing their status from a travelling (*frequentates*) to a residential (*manentes*) merchant, and claiming far-reaching autonomy within the city in 1211 (Benninghoven 1961, 37).

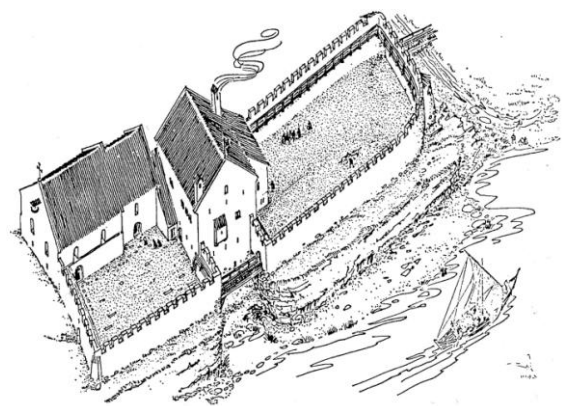


Fig. 4-2. Artist's impression of Üxküll Castle and its enclosed church on the basis of the archaeologically excavated foundation walls (Source: Caune 1996b, fig. 1b).

The joint commitment and mutual benefit between *ecclesia* and *mercatura* is well documented for the Daugava River valley, where merchants facilitated maritime logistics with their ships, provided transport and supplies, pilotage and know-how, while the clergy

offered protection by unleashing the crusading movement in this region, in which new territories and resources became accessible and markets could be established in the baptised and "pacified" lands (cf. Blomkvist 2005, 529f.).

The 13<sup>th</sup> century is marked by numerous building activities of both stone castles and fortified watermills; the latter being strategic points not only because of their economic value, but also because watermill sites were often combined with bridges, which to control was of eminent importance to safeguard access to the city and its hinterland. The

castles of this period were built with large courtyards (Caune 1996, 19), probably to offer protection and a camp space for the new arrivals. Not all castles were of stone, however. In order to protect trade against Osilian and Courish raids – and arguably the estuarine islands, which seem to have had some economic value as they were enfeoffed in 1211 (Benninghoven 1961, 20) – Bishop Albert founded the fortified Cistercian monastery of Dünamünde in 1205 (Caune 1996, 24). Additionally, a cog was anchored in the Daugava (also known as Dvina) estuary in 1216 to safeguard access to the river, described by Henry of Livonia as follows:

*“Et audientes, qui erant in Riga de familia episcopi et fratres milicie, consilia Estonum, emerunt cogonem, munientes eum in circuitu tamquam castrum et locantes in eo viros quinquaginta cum balistis et armis, statuentes eum in ore fluminis Dune ad custodiendum portus introitum, ne venientes Osilienses obstruerent sicut ante.”* (HCL XIX.11, ed. Bauer 1975, 200).

*“The members of the bishop’s household and the Brothers of the Militia who were in Riga heard of the Estonians’ design and bought a cog and strengthened it all about, like a fort. They put fifty men in it with ballistas and armour and they stationed it at the mouth of the Dvina River to guard the entrance of the harbor, lest the Osilians come and block it up as before”* (Brundage 2003, 184f.).

One may question whether this "strengthening all about" refers to the crenellated superstructure, as seen in several seal-depictions (Fig. 4-3) from the new German towns founded along the southern Baltic coast?

These would have offered raised fighting platforms for the *balistarii* — the crossbowmen — who have played a vital role as marksmen and in defensive combat on land and at sea (cf. Mäesalu 2011, 267ff.). It is often implied that these superstructures became a permanent feature on the ships in the wake of trade wars (cf. Ellmers 1986, 65f.). But this seems impractical, as they would have decreased the sailing capabilities considerably, offering such a massive wind-cover that they would have dramatically increased the leeway and reduced the hydrostatic stability due to top-heaviness. Henry of Livonia’s description of a cog converted into a floating castle should be considered a decisive hint, at least with regard to the development of early for- and aftercastles.



Fig. 4-3. Oldest seal of Danzig/Gdańsk with the earliest known example from a 1299 document (Source: Ewe 1972, fig. 51).

For Detlev Ellmers, ship-depictions on Hanseatic seals symbolise two major aspects: The cross on the mast-top marks them as merchant vessel and the vessels themselves emblemise the most important mode of transport (cf. Ellmers 2005, 416). If, however, ship-depictions with elaborate castle-structures are interpreted as floating fortresses to protect a *portus*, the meaning varies slightly in that the ship itself was not a merchant vessel but a ship to protect the safe conduct of trade, which could have been advertised in the seal. This would have been a particularly important aspect in the Baltics and Prussia, which were not pacified. Besides, the monastery of Dünamünde fulfilled also the role as a waypoint where ships could anchor to wait for favourable winds (Benninghoven 1961, 23). The fortified cog could have protected an anchoring merchant fleet from seaside attacks.

Riga's waterfront revetment at the Rīge River was probably built shortly after the foundation in the first decade of the 13<sup>th</sup> century. The revetment had multiple purposes: It was an erosion cover, extended far enough into the river that ships with a greater

draught could be moored (Fig. 4-4) for a more convenient unloading and disembarkation, and by backfilling the former sloping river-bank behind the revetment wall, new land was created onto which storehouses could be built (Zunde 2015, 150).



Fig. 4-4. A Bremen-type reconstruction moored at the revetment quay of the Middelaldercentret near Nykøbing Falster, Denmark. This photo gives a rough idea how the Rīge harbour could have looked like in Riga's foundation phase, except that many of the early buildings and the town wall were constructed in brick-stones from the very outset (Photo: J. Engelbrecht).

An exactly similar – but far more extensive – development occurred in Lübeck between 1210 and 1250, where the land reclamation advanced about 100 metres into River Trave between 1210 and 1250 (Gläser 2009, 89).

The Rīge harbour still existed hundred years after its foundation (Fig. 4-5). In 1297 the City of Riga intended to build a draw-bridge across the mouth of River Rīge to transport building material faster to the other side, where a revetment was constructed in order protect the town wall from being undercut by ice-drift. The opening was to measure 33 foot, i.e. 9,46 metres, so that – as the correspondence explicitly states – not only other ships like prams and *pyratīcae* could pass through, but also *liburnae* (Benninghoven 1993, 242), which is a term synonymously used to

cogs (cf. Heinsius 1986, 92; Paulsen 2016, 132f.), indicating that after almost a century after the city's foundation, the Rīge harbour was still in use for large ships. It would have arguably also offered better protection against the ice-drift. This is reflected in the addendum to Riga's municipal statutes of 1300, which stipulate that a fourth of the ship's worth has to be relinquished for towing assistance into the Rīge when the ship is rendered disabled by adverse ice-drift (Benninghoven 1993, 243). In 1304, a dispute was settled, after a complaint was made by the Teutonic Order that it cannot reach its estate – St. George Court – at the Rīge River bank by ship, upon which the City of Riga had to grant free passage also to small and large ships of the Order brothers: *naves dictorum magistrī et fratrum parvae et magnae* (Benninghoven 1993, 246).

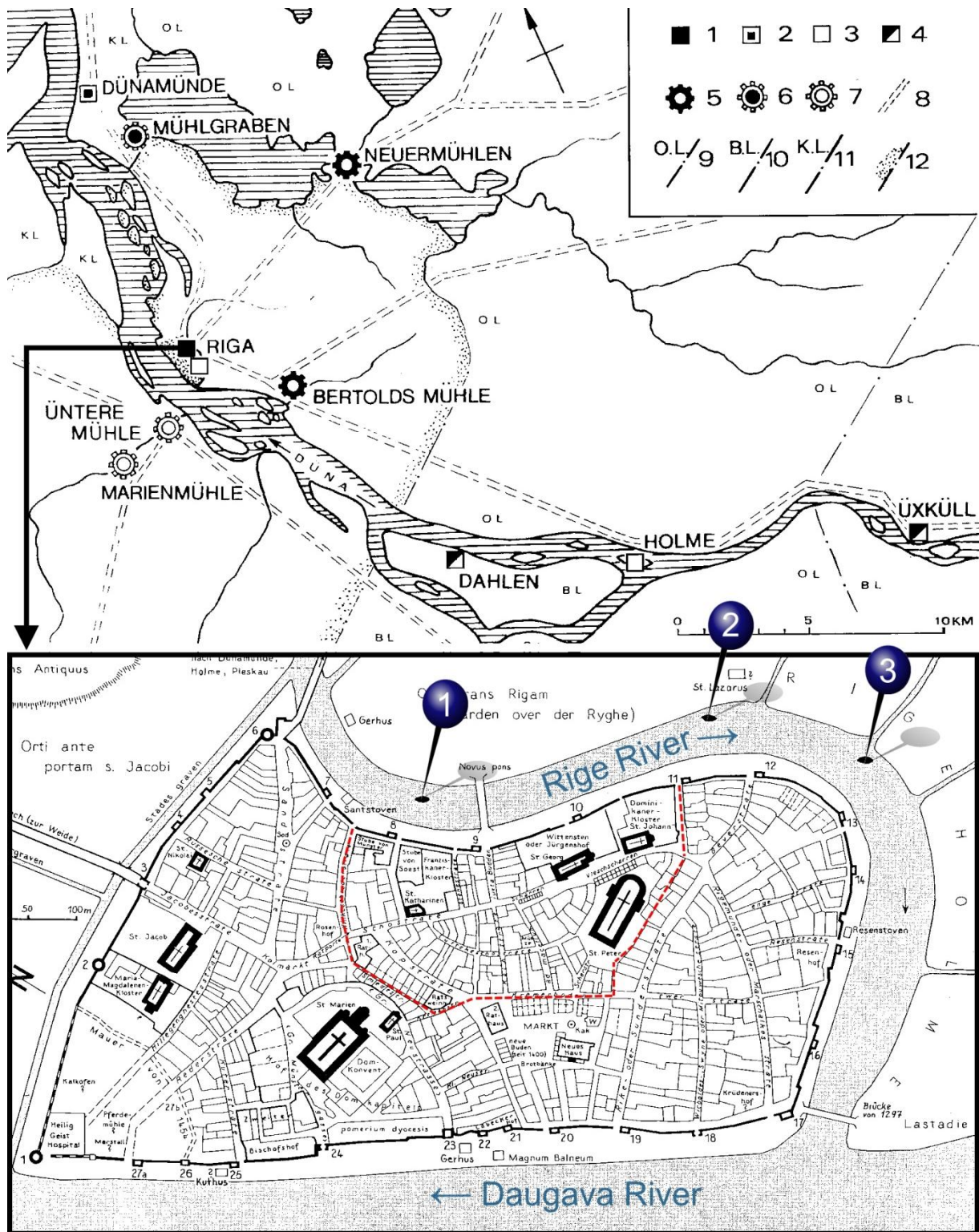


Fig. 4-5. Top: The Daugava estuary region in 1226, showing Riga (est. 1201) in relation to Üxküll (1188). Key: (1) Castle of the Swordbrother Order, (2) Monastery, (3) Bishop's Castle, (4) Vassal Castle, (5-7) fortified watermills, (8) roads, (9-11) boundaries of the Order's, bishop's and municipal areas (Source: Caune 1996, fig. 3), Bottom: The City of Riga 1230-1330; the area marked in red corresponds to the city's foundation phase until 1210. The three ship-finds referred to in the text are indicated by the blue pins. The bridge (built 1297) at the mouth of the Rige River was built as draw-bridge (Source: Benninghoven 1993, 241; cf. also Benninghoven 1961, map 6, modified by the author).



### 4.1.2. The Riga 3 wreck

The wreck was dated stratigraphically into the 13<sup>th</sup> century and was excavated in a 7 m deep pit beneath a 15<sup>th</sup>/16<sup>th</sup> century waterfront revetment (Caune 1994, 485f.) (Fig. 4-6). A number of associated finds corroborate this date; one of them being a hollow bronze arrowhead with three holes – possibly for inserting burning matter – thus indicating a possible use as flaming arrow (Caune 1994, 492). Scorch marks in the Riga ship 2 and 3 indicate that these ships may have fallen prey to one of the many attacks launched against the city, particularly in the early phase. For instance, in 1210 the Cours launched an attack and in 1297 the line of dispute even ran right

through the city itself, when the citizens of Riga rebelled against the Order of the Swordbrothers and destroyed their castle within the city precincts.

The wreck was tilted to its starboard side – i.e. the largest surviving portion – with 12 surviving strakes on the starboard side and only 4 on the port side (Caune 1994, 485f.). The original dimensions are based on a reconstruction, according to which the ship was 14.3 m in total length, with a beam of 4.9 m and a height of 2.4 m amidship and 2.8m at the bow, thus indicating a sheerline (Caune 1994, 488). As such, it would have been a medium-sized vessel. On the basis of the stem-shape, Andris Caune (1994, 493) associates the Riga 3 wreck to the cog-group (sic!) according to Ole Crumlin-Pedersen's typology (1983).

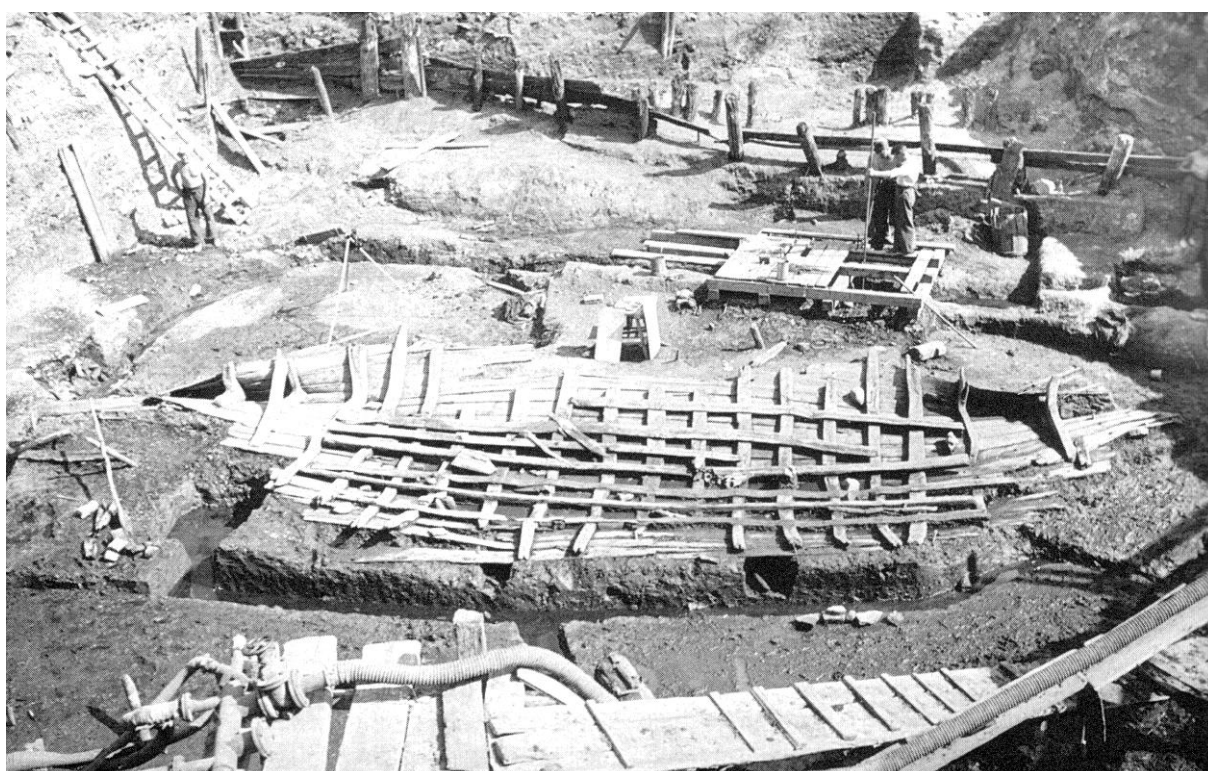


Fig. 4-6. Riga 3 wreck during its excavation in 1939 (Photo: Caune 1994, fig. 2).

These characteristics are basically the characteristics of the Bremen-type, of which the Riga 3 wreck had the following (after Caune 1994):

- hook-scarfs connecting keel and stem and sternpost at sharp angles, 120° (stem) and 110° (sternpost) respectively, joined with iron bolts
- greater sided (12-17cm) than moulded (8-9cm) height of the floor-timbers
- great plank widths (34-45 cm) and thickness (2.5-3 cm) indicating tangential conversion

Characteristics non-specific to a building tradition include:

- assembled frames joined to planks with wedged treenails of 3cm diameter
- stringers, or probably rather ceiling planks (widths 11-18 cm, thickness 2.5 cm)
- T-shaped keel, with a length of 9.19 m, height of 15 cm and an upper width of 20 cm amidships, tapering to 11 cm towards both ends

And, finally, characteristics that can be brought in connection with a Scandinavian tradition – although not exclusively – include:

- use of clinker-nails
- animal hair treated with tar, as well as cords and cloth

The ship was entirely constructed of oak, with the exceptions of several repairs made with pine and birch (Caune 1994, 488). These makeshift repairs are characteristic for ships travelling into the far north where oak was not readily available. Andris Caune also notes that the tool-marks indicate that all works were carried out with the axe, with no indications whatsoever for the use of a saw or a plane. This is not surprising, as the earliest ship in the Baltic Sea featuring sawn planks is the Gedesby ship of 1320 (Bill 1997).

The stem and stern posts are preserved to a height of 1.58m and 1.95m, with rabbets for 8 and 9 hood-ends, respectively. The stem and stern posts must have been prolonged by additional pieces, as there were at least 12 strakes (Caune 1994, 488). Thus, there is no way of knowing whether all hood-ends were rabbeted into the stem and sternposts, or – as in the case of the Kollerup ship – only the planks below the water-line.

Considering that the Latvian archaeologist Andris Caune wrote his article on the Riga 3 in German – not his native language – and submitted it to a journal not specialised in maritime affairs, the use of terminology is in one section ambivalent, although most descriptions make sense for this author and could be translated effortlessly. One aspect in particular is interesting: Caune (1994, 490) writes that the oak planks were *geschlissen* (stripped?) and smoothed with an axe, while the 'sides' and 'ends' were clinker-fastened. Does this mean, that some portions of the midship section were not clinker-fastened, but rather – like in bottom-based constructions – had flush-laid planks? Neither the reconstruction drawing of the cross-section nor the photos indicate this. But why were specifically the 'sides' and 'ends' mentioned as being clinker-fastened, when indeed the entire ship's planking ought to be fastened this way? This detail was lost in translation, but it would be save to assume that the ocular evidence – the photos and the drawing – should be the determining factor in classifying this wreck as a "pure" clinker-construction.

In the excavations no gudgeons for a stern-rudder were discovered, so the excavator concluded that the ship must have had a side-rudder. Andris Caune rightly pointed out that neither a fitting for a side-rudder was detected and that possible traces for gudgeons may have been detected in a later investigation (1994, 492). This reminds of the

Kollerup case, where initially also no traces of a stern-rudder were found (Khortz Andersen 1983), but iron concretions were detected many years later (Hocker & Daly 2006, 192f.).

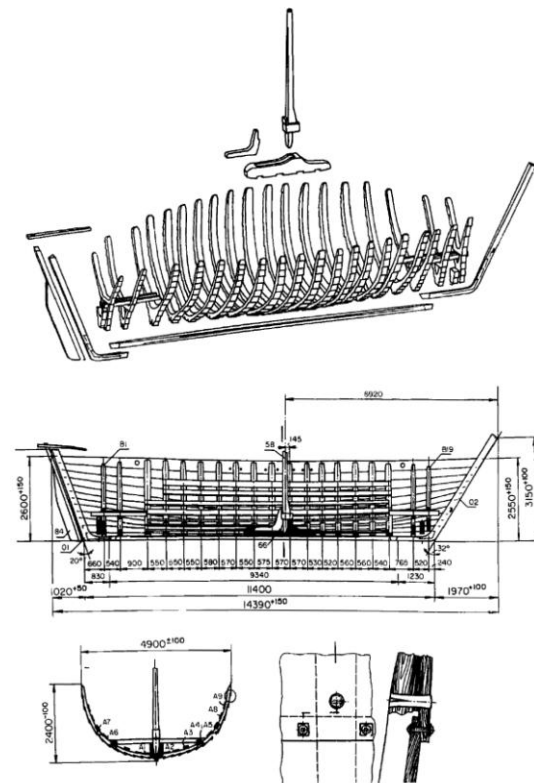


Fig. 4-7. Reconstruction drawing of Riga 3 (Drawing: A. Zalsters in Mäss 1991, 314)

#### 4.1.3. Hybrid, intermediate form or variant in its own right?

The mixed constructional features bring us back to an old question: Which criteria are crucial for determining the principal influence? In a case like the Karschau ship, where only a later repair was carried out in a technique from a different shipbuilding tradition, it is obviously still addressed as a Scandinavian construction. In a case like the Bossholmen ship, which has all Bremen-type features except for the untypical beam-keel, one would still feel inclined to see it as part of the Bremen-type. This has been the case even with the Kollerup ship, despite having many deviating features, for which reason it was suggested to refer to the wider tradition as Kollerup-Bremen type, as suggested by Anton Englert (Englert 2000, 46). This, however, implies a pre-determined line of development from the mid 12<sup>th</sup> to the late 14<sup>th</sup> century, which may not do justice to other vessels with Bremen-type features, but which development might have taken an entirely different trajectory. As such, the Kronholm wreck from the first half of the 13<sup>th</sup> century can be seen, which likewise displays an amalgamation of features,

interpreted as mixed Scandinavian and German influences by the excavator: Bremen-type or "German" features include the flush-laid bottom planking and the characteristic straight stem, while the slenderness of the framing system built of pine was thought to be reminiscent of a Scandinavian influence (Rönby 1996, 70). The Kyholmen wreck from the early 13<sup>th</sup> century presents a similar case, but the other way round (cf. Crumlin-Pedersen 1980): Here the Scandinavian features prevail and only the straight stem might be referred to as a feature analogous to the Bremen-type. In fact, all Bremen-type features have been referred to as cog-features by most of the above authors, which brings us back to the way the "cog" was mis-appropriated for the use in archaeological typologies. Its definition is solely based on the ship depiction on the Stralsund seal of 1329, which was referenced in a 1483 document as "*unser Stad Sigel ghenomed den kogghen*" (our seal reproduced from the cog) (e.g. Fliedner & Pohl-Weber 1968, 24) (Fig. 4-8).



Fig. 4-8. Stralsund seal of 1329 (Source: Ewe 1972).

As pointed out earlier (paper B, 61), the deduction and inference of further criteria was biased by the sequence of discoveries. Although the Riga 3 wreck was excavated in 1939, well before the "Bremen Cog" excavated in 1962, the "identification" of the Bremen wreck as "cog" through Siegfried Fliedner (1964) was based on Paul Heinsius' groundbreaking study first published in 1956, which tentatively associated ship-depictions with ship-types (cf. Heinsius 1986).

The pre-occupation with idealised historical type labels obscure real links. If we only take the characteristics of the Riga 3 ship alone, one will find a striking semblance to a type of fishing craft, which was built until the turn of the 20<sup>th</sup> century in the Vistula lagoon (Fig. 4-9). These type of crafts also had straight stems, proper keels, stern-rudders and were amongst the last traditional square-rigged working boats in Europe (Celarek 1991, 47). The Riga 3 ship would have also matched the visible criteria of the Stralsund seal and had it been associated first to this ship-depiction, instead of the so-called "Bremen Cog", the "cog-typology" (*sic!*) would have been defined in a much different way.

The observations on which the "cog-typology" is based are not wrong in itself, as they describe a consistent set of features frequently observed as "cluster". But these are not necessarily relating to a historical type, but a shipbuilding tradition. For this very reason, it makes more sense to replace the term "cog" in the archaeological usage with Bremen-type, as has been practised throughout this work.

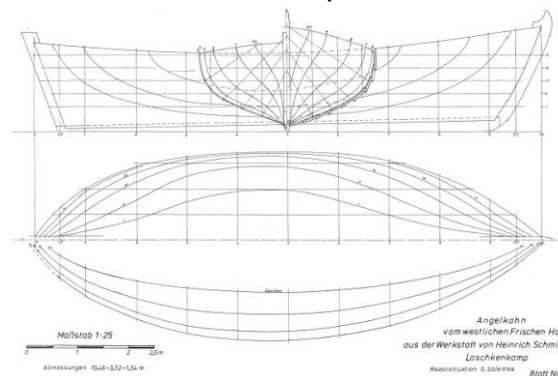


Fig. 4-9. An early 20<sup>th</sup> century fishing boat from the Vistula Lagoon with 'inherited' medieval characteristics (Drawing: Gerhard Salemke).

This does not mean that Bremen-type ships or the Riga 3 ship might not have been referred to as cogs by contemporaries. It is even very likely that most Bremen-type vessels were called cogs, as Bremen-type vessels tend to be comparatively large. Although the historical sources are mute on constructional details, they overwhelmingly indicate that cogs were large vessels (cf. Jahnke 2011; Jahnke & Englert 2015, 37; Paulsen 2010).

## 4.2. The Matsalu ship-timbers

Several ship-timbers were recovered in the Matsalu Bay in Lääne County, Estonia (Fig. 4-10). This is historically an interesting region and the ship-timbers may be a small piece in the puzzle to illuminate the

history of conflict. Maili Roio kindly made available the recordings and agreed to send some dendrological samples to Dr. Aoife Daly, who was commissioned with the analysis by this author.

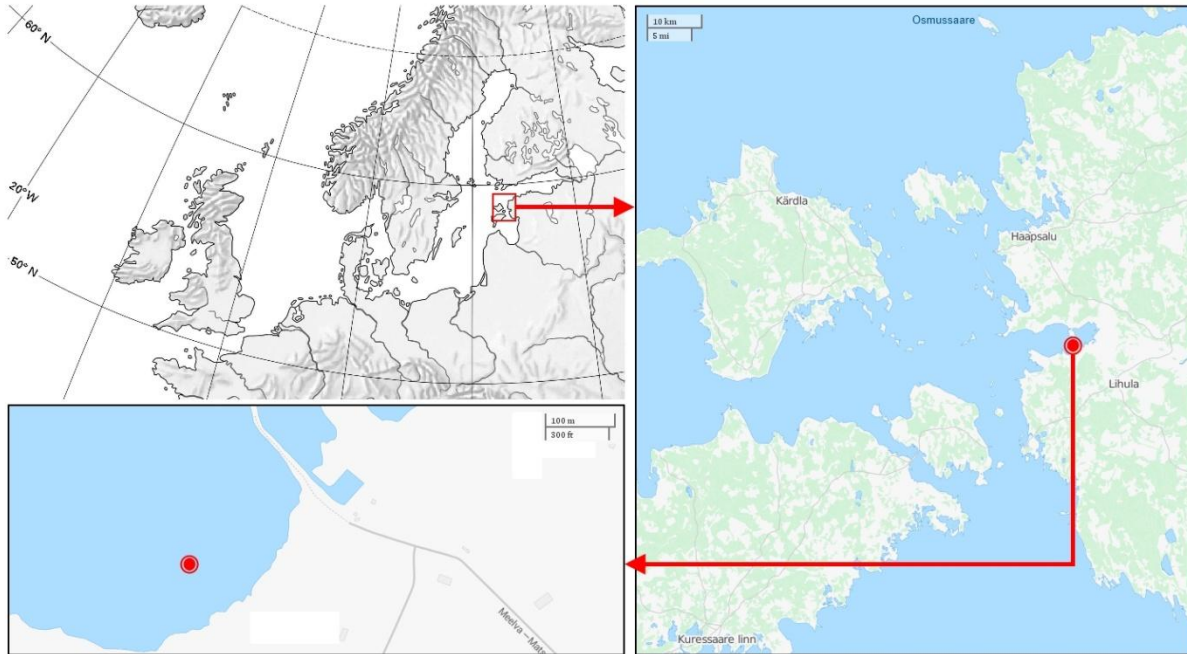


Fig. 4-10. The location in Matsalu Bay where the ship-timbers were found (Basis data: Openstreetmap, modified by author).

### 4.2.1. Date and provenance

Five samples from the Matsalu timbers were analysed by Dr. Aoife Daly, all of oak (*quercus* sp.), and it was possible to date three of them. Only the heartwood is preserved, thus the actual felling date could be considerably later than the last tree-ring (Fig. 4-11). In terms of provenance, the highest correlation occurs

with the South Jutland region, Denmark, with a t-value of 8.14 to the accumulated group of the Kollerup, Kollund and Skagen wrecks from the 2<sup>nd</sup> half of the 12<sup>th</sup> century (Daly 2013, 2). Both, the date and the Danish provenance, are striking and may testify early expeditions from southern Jutland to this region. In the following section the constructional features shall be evaluated in the light of shipwrecks from that time.

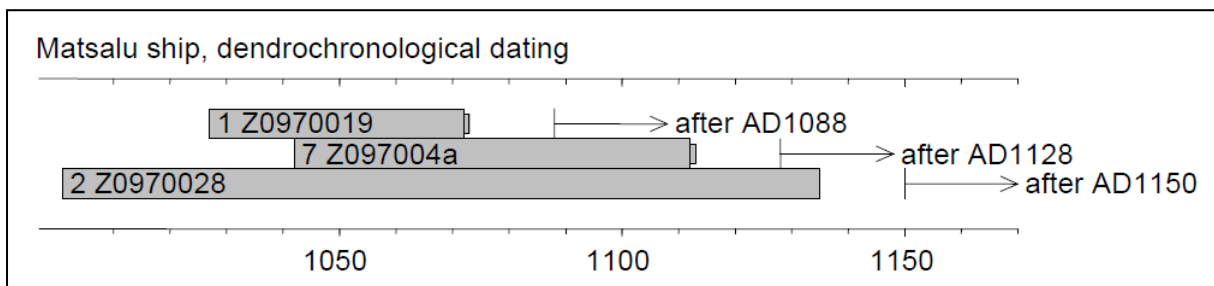


Fig. 4-11. Three samples from the Matsalu ship-timbers (Daly 2013, fig. 1)

### 4.2.2. Construction

The ship-timbers are hitherto unpublished and only recordings have been made and included uncommented in a catalogue (Ratas & Ratas 2012). On the basis on the recordings alone, however, it is possible to infer some constructional principles (all

interpretations by the present author). Most elements have only survived in fragmented form. The most heavily fragmented pieces from which no details can be deduced are omitted here.

All frame fragments consistently indicate that the moulded width is about half of the sided width (cf. timbers 1, 2, 3 6, 8, 9, 10, 11), with moulded

dimensions of about 15-20 cm and sided measures of about 35 cm. Most of these timbers feature a joggled side, which indicates lapstrake planking. Judging from the distance of the joggles and allowing for lands (overlapping planks), the plank would have had a width of approximately 35-40 cm. Each strake would have been fastened by two treenails to the frame, which are diagonally arranged. Timber 1 shows how the frame was scarfed, i.e. diagonally, measuring ca. 40 cm and held by three treenails, two of which will have arguably also protruded a strake.

A very fragmented piece of a frame — timber 2 — features a recess with an iron oxide layer (Fig. 4-13.), which appears to be a limber hole. The high iron oxide content in the bilge-water can be explained by the corrosion of iron nails or even caulking cramps (sintels), which however are not present in the archaeological assemblage.

Timber 10 appears to have only one recess for a lapstrake at its upper edge (Fig. 4-14), and the remaining face smoothed as to accommodate flush-laid planks. There is even a slight bend at the position where the seam of the two flush-laid planks would have been. This almost definitely points to a bottom-based construction, as already indicated by the floor-timbers, unless the edges have deteriorated or were adzed off, or belonged to a frame of an extended dugout, like the Schlachte wreck from 1170 (cf. Zwick 2012). However, the latter possibility is diminished by the fact that the timbers appear to come from one find context and the presence of a V-shaped frame element clearly indicates that this must have been a vessel that was entirely planked.

Such V-shaped frames were located at the tapering ends of the hull, either at the stem or stern section. Unfortunately, this frame appears to be too fragmented to infer further details. Another

interesting element is a slightly curved beam, slightly trapezoidal, with a maximum width of ca. 17 cm and a thickness in a range of 9 to 12 cm (Fig. 4-15). Judging from the curvature, this is likely to be a stringer, a longitudinal reinforcement. The curvature more likely represents the ship's tapering sides rather than its sheer. The 9 holes — arguably treenail-holes — are arranged in an alternating fashion: The first and last three holes are horizontal and the three remaining holes in the central part are vertical. Thus, only the ends must have been notched to the frames, whereas the vertical treenails in the central could have been notched to cross-beams. They are spaced at an interval of about 110 cm (not counting the gap, where evidently a cut section was cut out as sample). The stringer features a recess on both ends, which possibly served as scarf for the elongation of the stringer.

Another possible interpretation of timber 7 is that of a channel, with the three vertical holes representing the points through which the shrouds were redirected. This would have kept the shrouds clear of the gunwale by merely redirecting — not bearing — the tensile force, which would explain why the timber was only fastened at both ends to the hull. A further fragmented element — timber 5 — can be identified as a knee, which would have been most likely positioned on a cross-beam or thwart and reinforced the upper side planking (Fig. 4-16).

A rough estimate on the vessel's size can be based on timber 7, measuring almost 5 m in length. Judging its moderate curvature, this could have been part of a very large vessel in the above 20 m length range. The impression is corroborated by the large dimensions of the frames. The significance of such a large vessel in this remote bay can be arguably explained in historical terms, as shall be attempted in the following section.



Fig. 4-12. Matsalu timber 1: joggled frame with futtock-scarf (Ratas & Ratas 2012, tab. 1)

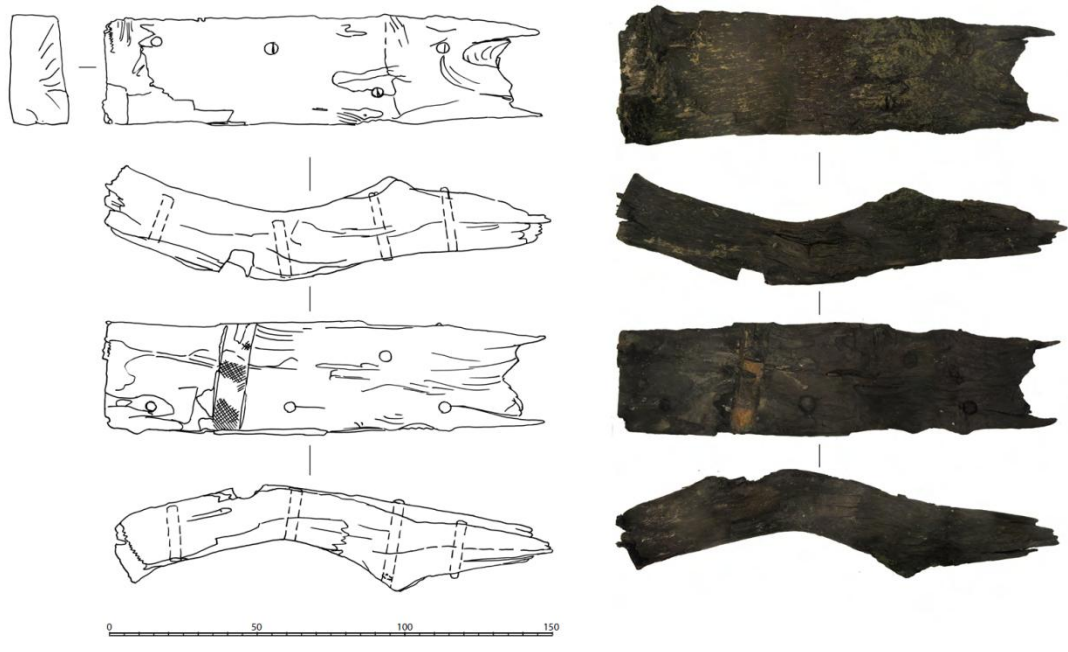


Fig. 4-13. Matsalu timber 2: floor-timber fragment with limber hole (Ratas & Ratas 2012, tab. 2)

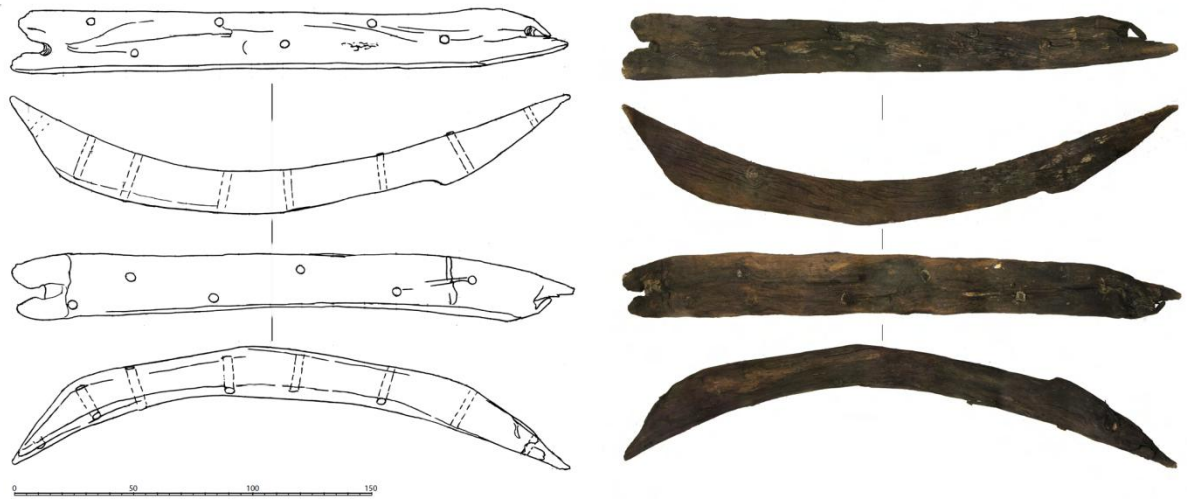


Fig. 4-14. Matsalu timber 10: frame element (Ratas & Ratas 2012, tab. 10)

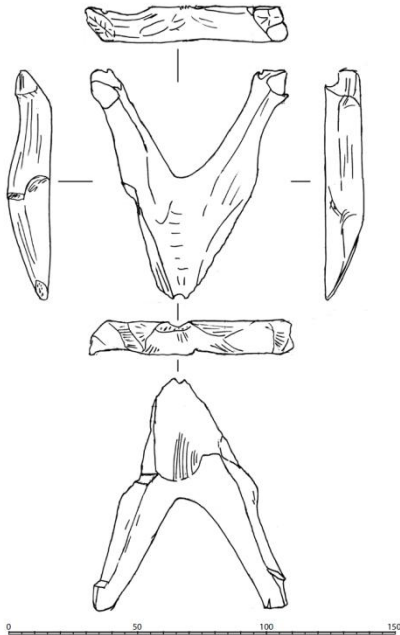


Fig. 4-15. Matsalu timber 4: V-shaped knee (Ratas & Ratas 2012, tab. 4)

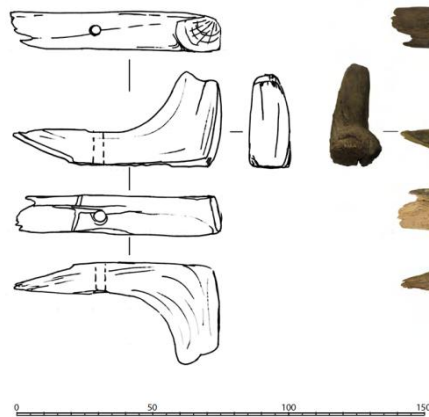


Fig. 4-17. Matsalu timber 5: knee (Ratas & Ratas 2012, tab. 5)



Fig. 4-16. Matsalu timber 7: beam / stringer (Ratas & Ratas 2012, tab. 7)



### 4.2.3. Floor-timber dimensions as diagnostic feature?

Due to the fragmentary state of the Matsalu wreckside, the possibilities for comparison are limited. The most notable feature is that the sided widths of the frames are almost twice the ratio to the moulded depth; a feature well apparent in heavy timbered early Bremen-type constructions. Timber 10 with its partially joggled outline for both flush-laid and lapstrake planks could indeed be the decisive cue to categorise the Matsalu timbers as Bremen-type construction. This is corroborated by all frame dimensions and — to a lesser extent — the high iron content in the bilge water — as evidenced by the iron oxide at the limber hole — which could be an indicator for the presence of caulking clamps in the interior part of the hull, unless one is willing to accept that the high iron content stems from the iron nails alone.

The timbers are comparable to the earliest ship of this type — the Kollerup ship of 1150, which similarly has a Jutlandic provenance. The latter's maximum frame dimensions are about 40 cm as sided width and 20 cm as moulded depth (cf. Khortz Andersen 1983, pl. 2), thus very similar to the Matsalu frames. On the basis of the shared Jutlandic origin, it has been hypothesised that the Kollerup (ca. 1150) and the Kolding wreck (1188/89) (Fig. 4-18) may have even been built in the same shipyard, as the strikingly similar construction of their stern hooks suggests (Hocker & Daly 2006, 192f.).

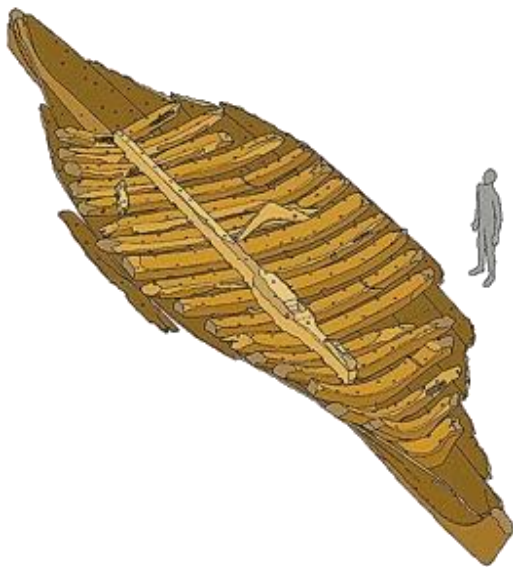


Fig. 4-18. This graph shows the state of preservation of the Kolding wreck (1189), which was generated on the basis of Faro-Arm data processed with Rhinoceros 3-D software. Its frames with the characteristically greater sided than moulded widths are of similar dimensions as the Matsalu frames (Graph: Fred Hocker).

With the Matsalu wreck, there is yet another potential find that features similarities to this group of Bremen-type finds. The comparability of ship-timbers is of course limited, but frame dimensions can be a diagnostic feature. In the following table, quantitative characteristics of the Matsalu timbers are compared to corresponding features of major vessels from this period and the entire Baltic Sea region. As the dimensions vary greatly — e.g. the frame and plank widths towards the hood-ends — only maximum dimensions of floor-timbers, futtocks and planks for the amidships section are provided in order to assure comparability.

What can be concluded from the table is that “flat” frames — i.e. where the sided width surpasses the moulded depth — occur only in bottom-based or Bremen-type constructions. Moreover, the greater plank width is characteristic for these constructions. As could be inferred from the frame's joggled outline, the plank width of ca. 35-40 cm would be consistent with this finding.

While the Haderslev Ship built around 1220 bears no similarities to the Matsalu Ship, a loose heavy V-shaped floor timber typical for Bremen-type constructions was found on top of the wreck: Timber 1 with 27 cm sided width and 15 cm moulded depth. Unlike the Haderslev Ship, where all frames were connected to each strake with one treenail, this floor-timber was held by a double row. It dates to after 1188 and appears to be of local origin at the Møllestrømmen site near Haderslev (Englert 2015, 239). Haderslev is also the presumed site where the oak timber for the Kollerup, Kolding and Skagen ships were cut in the second half of the 12<sup>th</sup> century (cf. Hocker & Daly 2006). It is indeed striking that all early Bremen-type constructions — now including the Matsalu ship-timbers — share a Jutlandic origin. This implication will be discussed further in this chapter's conclusion.

What seems important for the time being, is that the finding location in the Matsalu Bay at a small distance of only 5 km to the historical town of Lihula (German: *Leal*) could be significant with regard to the wreck's interpretation, not least because it is situated at the mouth of a creek leading to Lihula. This might have been navigable for smaller vessels in medieval times. Given the absence of sapwood, the Matsalu timbers could be also considerably later in date than the *terminus post quem* of 1150 suggests, possibly in the range of decades rather than years. With this assertion, the Matsalu timbers date right into the “Theatre of War” when the province of Lääne was a highly contested zone of conflict between Danes, Germans, Swedes and Estonians at the end of the 12<sup>th</sup> and the early 13<sup>th</sup> century.

Wreck	Date	Provenance	L/B (m)	Floor		Futtock		Frame	Plank	Reference
				M	S	M	S	spac.	width	
Eltang	1138+	W-Jutland	18 / 5	9	7	9	12	48	20-30	Englert 2015, 77ff.
Lynæs I	1140+	Västergötland	25	20	13	-	-	69	24-29	Englert 2015, 1151ff.
Karschau	1145	Little Belt / Fyn	26 / 7	25	10	-	-	66	20-30	Englert 2015, 191ff.
Skånör	1148									Hörberg 1995, 125
Kollerup	1150		21 / 5	20	40			57		Khortz Andersen 1983; Daly 2015, 367
Matsalu	1150+	Jutland	-	20	35	-	-	-	35-40	this section
Schleswig M	1169	SW Sweden								Daly 2015, 358, 367f.
Erritsø	1180+	S Jutland								Daly 2015, 364
Roskilde 2	1185+	SW-Sweden								Daly 2015, 368f.
Kolding	1189							59		Daly 2015, 358, 369
Skagen	1190+	S-Jutland	18	20	30	-	-	55	40	Bill 1997, 192, Daly 2015, 358, 369
Korsholm 3	1201+	N-Jutland								Daly 2015, 358, 369
Kuggmaren	1215	N-Jutland	15+ / 8+	20	30	-	-	c.45	60	Adams & Rönnby 2002
Kyholm	1201+		13+					65		Crumlin-Pedersen 1980
Haderslev	1220	S-Jutland / SH	12+ / 5	21	18	14	13	43	25-45	Englert 2015, 229ff.
Kronholm	1223+	-	15+ / 5	10	20	-	-	40	40	Rönnby & Zerpe 1995

Tab. 4-1. Comparison of frame and plank dimensions (L = length / B= beam / M = moulded / S = sided). The Matsalu timbers are highlighted in dark blue and Bremen-type constructions in light blue. Maximum average values are certainly not representative, but should be only regarded as approximate values. Dates indicated with a “+” show that no sapwood is preserved and that the felling date can be considerably later. Some “spikes” in the maximum dimension — which may occur at the heavy rudder-frame or a scarfed section for instance — have been omitted. All values are rounded and in cm, unless otherwise stated.

While an attempt to link the Matsalu timbers to specific historical events that occurred in this region would be too speculative and unwarranted in the absence of an exact date, the timbers should nonetheless be seen in the context of other Bremen-

type constructions presented in this chapter, which can be linked to long-distance routes into the eastern Baltic region from the Danish and German heartlands.

### 4.3. Revisiting the Kuggmaren Ship in the Stockholm Archipelago

The early 13<sup>th</sup>-century Kuggmaren wreck is situated in a lagoonal inlet of the Jungfruskär (Fig. 4-19), an offshore island to Nämdö, listed in the Itinerary as *nessö*. It is situated at a distance of 40 km to Stockholm as the crow flies.

The wreck is well visible from the surface, as it is only at a depth of 1.5 m (Adams & Rönnby 2002, 174) (Fig.4-20), which would correspond to a depth of approximately 4.7 m in the early 13<sup>th</sup>-century, if the post-glacial land rise is taken into account. According to the Swedish land survey of 2003 with the RH 2000 system, the post-glacial land rise amounts to 4 mm in this region; extrapolated to 800 years this would be 3.2 m (Ågren & Svensson 2007, Fig. 5.1).

That is not to say that the land rise occurred equably, but approximation by extrapolation is the closest

estimate and demonstrates how much the hydrological conditions have changed over the centuries. The site was investigated in 1998 and it was described as the earliest “cog-find” in Swedish waters (Adams & Rönnby 2002).

While the term “cog” is avoided here for reasons expounded in section 2.3., the implication of being perceived as ‘foreign’ vessel in Swedish waters remains.

Upon considering the finding location, the dendrological analysis and construction, a possible connection of this ship with the Valdemarian Itinerary and the Northern Crusades was suggested during the initial investigation (Adams & Rönnby 2002, 179). This connection shall be explored further in this section on the basis of new research data.



Fig. 4-19. The location of the Kuggmaren wreck (Basis data: Openstreetmap, modified by author).



Fig.4-20. The Kuggmaren wreck in situ in a sheltered inlet of the Jungfruskär (Photo: Karin Romdahl).

Macrobotanical samples retrieved from the bilge as well as caulking material were kindly made available by Prof. Dr. Johan Rönby (Södertörns University)

and analysed by the author under the guidance of Prof. Dr. Wiebke Kierleis and Dr. Helmut Kroll (University of Kiel).

### 4.3.1. Date and provenance

Initially, three dendrological samples (group 1) were taken from the planks and analysed by Olafur Eggertsson at the University of Lund. As the samples included no sapwood, it was only possible to date the wood roughly into the early 13<sup>th</sup> century with the highest correlation for Jutland, Denmark (Adams & Rönnby 2002, 176). Two additional samples (group 2) were taken from the frames and corroborated the earlier finding to the extent that the highest

correlation occurred with Danish master chronologies. The analysis provided also a precise felling date — i.e. spring/summer 1215 — as the sample contained sapwood (Daly 2007a, 88). However, the analysed samples were quantitatively not representative enough to infer an exact regionally specific provenance (Fig. 4-21). The relatively low t-values are due to the few samples taken, rather than the remote possibility that the wood originated from far outside the periphery of the dataset (Daly 2007a, 90).

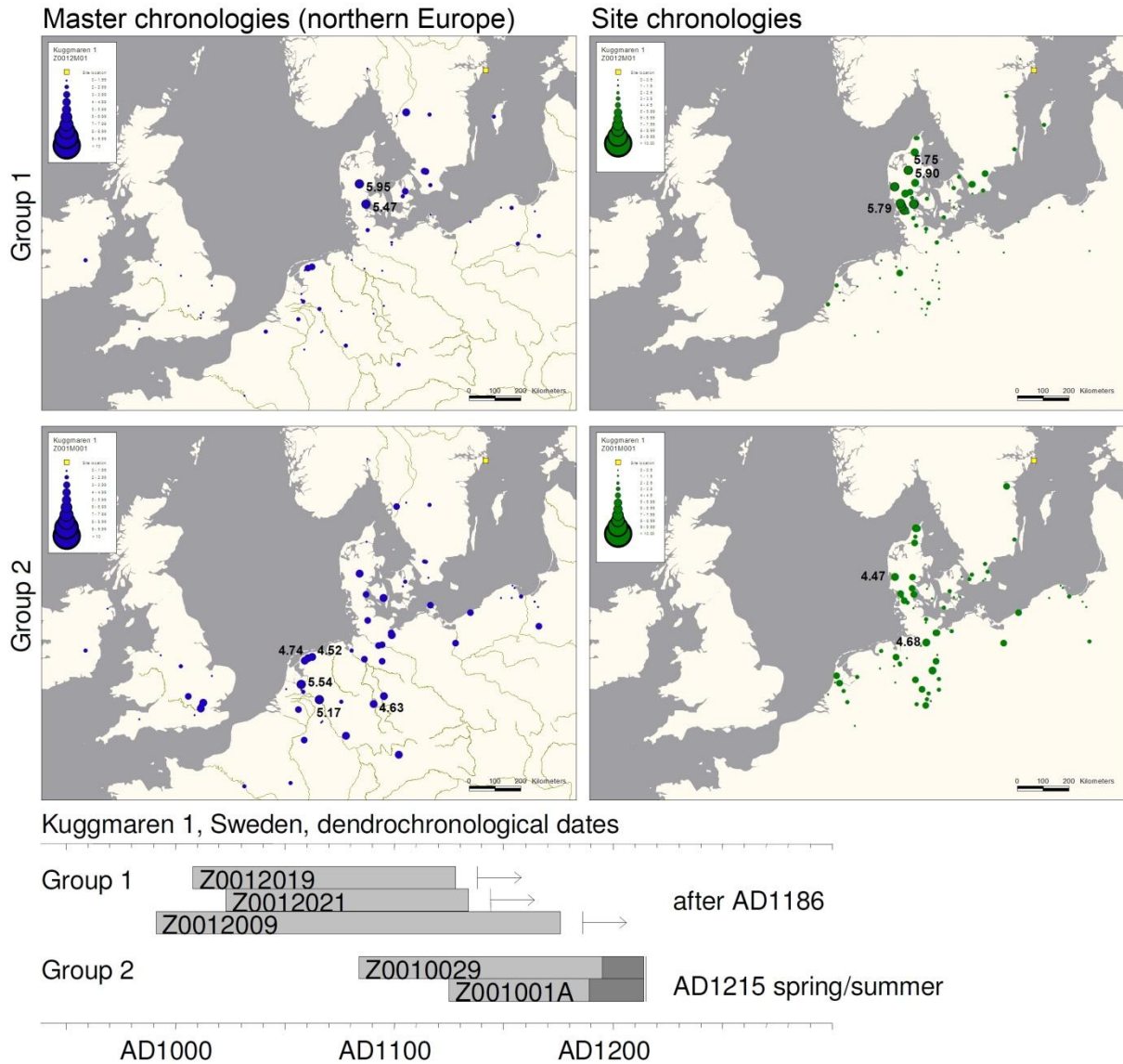


Fig. 4-21. Distribution of correlation values between the mean values for the Kuggmaren I samples and master (blue) / site (green) chronologies from northern Europe (Daly 2007a, figs. 71-73, 76-77).

The fact that the t-values of group 2 are the highest for master chronologies from the Netherlands, rather than Denmark, reflects that the provenance determination of the Kuggmaren wreck cannot be regarded as entirely resolved. The disparity could be explained in terms of separate sources for the framing and the planking (Daly 2007a, 92). As crooked frame

elements were usually cut locally (Daly 2007a, 195), this would imply early timber export from Denmark, but unlike in later centuries (paper D), there appears to be no historical evidence for significant timber export at that early time, especially from Denmark. There seems to be a greater disparity overall in group 2 if compared to singular measurements (Fig. 4-22).

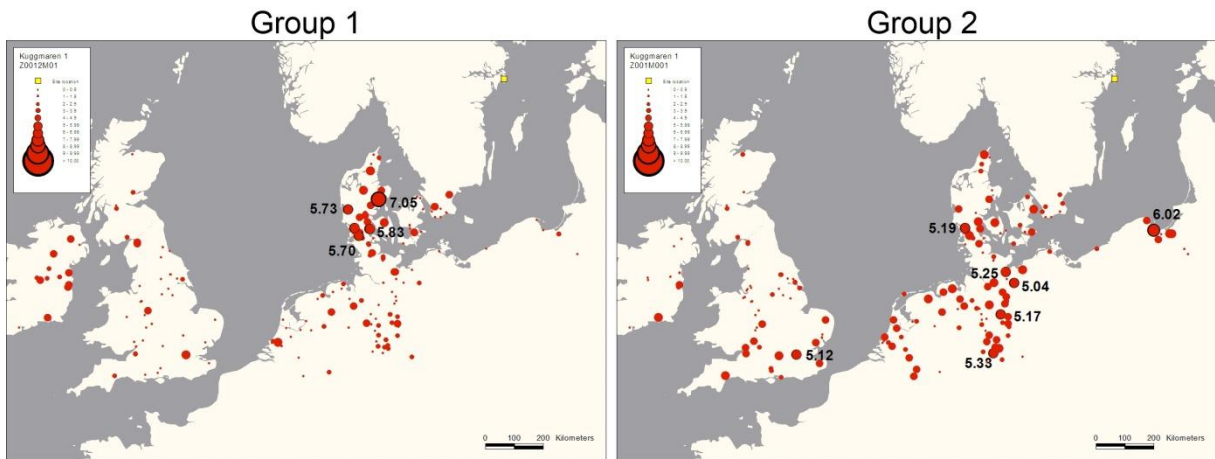
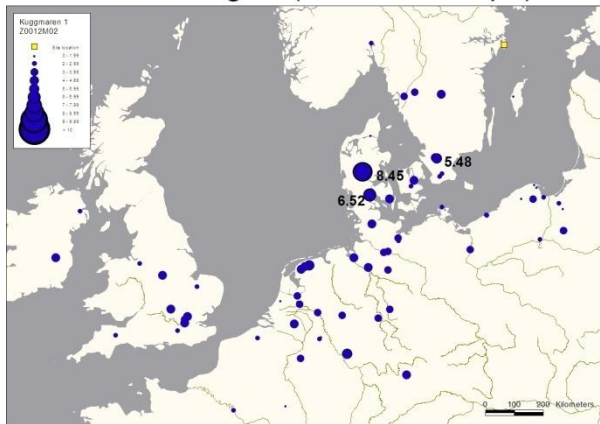


Fig. 4-22. Distribution of correlation values of Kuggmaren group 1 and 2 to single tree-ring measurements (Daly 2007a, figs. 74, 78).

Aoife Daly notes that one of the reasons for the greater variability in group 2 could be also conditioned by the pith inclusion, which naturally has a higher variability. This alone could explain the disparity as has become manifest in group 2. Thus, it does not seem unreasonable to “blend out” the Dutch maximum t-values from the master chronology comparison for group 2 and one could assume — for the sake of experiment — that both

groups originated from the same region. By treating both groups as one group — and by the fact that the rings of the younger tree cannot be compared, as the group 1 samples contained no pith — the correlations as expressed by the t-value are actually somewhat higher (max. 8.45), which strengthens the earlier finding that the timber originated from Jutland (Daly 2007a, 94) (Fig. 4-23).

#### Master chronologies (northern Europe)



#### Site chronologies

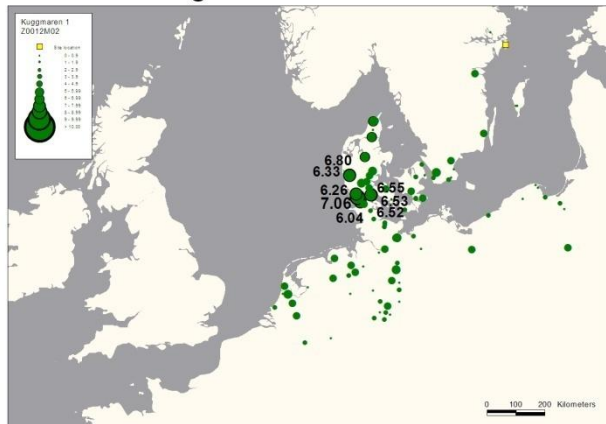


Fig. 4-23. Distribution of correlation values of all Kuggmaren groups to master (blue) / site (green) chronologies (Daly 2007a, figs. 79, 81).

Although the provenance determination would benefit from the analysis of further samples, the probability of localisation was increased by Aoife Daly’s re-analysis, which encompassed not only new samples, but also a statistical approach in which the limitation of dendrological data was duly taken into account.

#### 4.3.2. Grain residues

The grain samples kindly made available to the author by Prof. Dr. Johan Rönby were analysed in November 2011 and yielded the following result:

Taxon	Category	English	German	Quantity
<i>Hordeum vulgare</i>	fruit / pericarp	barley	Gerste	main mass
<i>H. vulgare</i>	rachis	barley	Gerste	11
<i>Avena sativa</i>	husk	oat seeds	Saathafer	7
<i>Stellaria media</i>	seed	chickweed	Vogelmiere	4
<i>Anthemis arvensis</i>	fruit	corn chamomile	Acker-Hundskamille	3
<i>Atriplex patula</i>	fruit	halberdleaf orache	Rutenmelde	3
<i>Avena sativa</i>	fruit	oat seeds	Saathafer	2
<i>Conium maculatum</i>	mericarp	poison hemlock	Gefleckter Schierling	2
<i>Arctium</i>	fruit	burr	Klette	1
<i>Atriplex hastata</i>	fruit	spear-leaved orache	Spießmelde	1
<i>Cenopodium album</i>	fruit	white goosefoot	Weißer Gänsefuß	1
<i>Corylus avellana</i>	pericarp	hazel	Haselnuss	1
<i>Fallopia convolvulus</i>	fruit	black bindweed	Windenknöterich	1
<i>Fumaria</i>	mericarp	fumitory	Erdrauch	1
<i>Galeopsis bifida/ G. tetrahit</i>	mericarp	hemp-nettle	Hohlzahn	1
<i>Lapsana communis</i>	fruit	nipplewort	Rainkohl	1
<i>Poaceae</i> (rezent)	fruit	sweet grass	Süßgras	1
<i>Ranunculus</i>	fruit	crowfoot	Hahnenfuß	1
<i>Torilis japonica</i>	mericarp	common hedge parsley	Gewöhl. Klettenkerbel	1
<i>Viola</i>	seed	viola	Veilchen	1

Tab. 4-2. Macrobotanical analysis of a grain sample from the Kuggmaren wreck.

The main mass consisted of barley fruits and pericarps, which indicates that it must have been pre-cleaned. The cleaning procedures conform to the main product — barley — while oat husks are relatively frequent as side product. The most weeds were relatively heavy seeds and fruits which cannot be easily separated from the harvest (Helmut Kroll and Wiebke Kierleis, pers. comm.).

Quantitative estimates on whether this was part of the cargo or provisions is of course not possible, as only the bottom of the wreck survived and most of its cargo has dispersed, except for some residues that have fallen into the bilge and covered by sediments. It is also not possible to determine whether the grain was shipped on the vessel's last and final voyage, or from an earlier shipment.

It was argued that grain-carrying vessels ought to have a ceiling, as for instance displayed on the depiction of the Brösen wreck near Danzig from the first half of the 13<sup>th</sup> century<sup>14</sup>, in order to separate the cargo from the bilge-water, implying that grain was transported as bulk good (Heinsius 1986, 132). While there is little evidence for ceiling planking, the wide sided frame dimensions of Bremen-type constructions would have made it possible to insert temporary *de facto* ceiling planks laid across the heavy timbered frames.

<sup>14</sup> The ceiling planking in the drawing of the Brösen wreck might have been included as 19<sup>th</sup> century bias of how ships were constructed. One should not forget that the Brösen wreck was never properly recorded, and the sketch could have been amended by further details after the wreck was broken up.

### 4.3.2. Grain and horse transports along the Swedish coast: a hypothesis

Although there are still many unknown parameters, it is already possible to make a preliminary attempt to interpret the find assemblage. In order to do this, the – yet unproven – premise is set, that the grain in the Kuggmaren samples originated from the last voyage's shipment. It needs to be kept in mind, that the following conjecture stands and falls with this premise.

A possible use of the grain could have been for beer-brewers. But the pre-cleaning usually takes place after the transport and shortly before the malting process and requires dry storage for a period of dormancy (Guido & Moreira 2014, 52). Would it have made sense to pre-clean the barley before transporting it in the humid conditions of a ship's hold? While this question has to remain unanswered, an interesting comparison can be made: About 240 km further south as the crow flies is another 13<sup>th</sup> century shipwreck with a similar cargo: The Bossholmen wreck near Oskarshamn likewise carried barley, but mainly rye. Some of the seeds also contained hops and juniper, which might indicate that this was shipped as commodity for beer-brewers in the north (Lemdahl *et al.*, 1995, 170).

The barley, however, could have also served as fodder for transported animals. Amongst the insects found in the Bossholmen samples were also carrion beetles that could be found in horse dung (Lemdahl *et al.*, 1995, 171). This is indeed a strong indicator for the transport of horses, at least at one point in the ship's transport history. There are several contemporary references, which confirm that barley

was used as horse-fodder on sea voyages. According to the chronicler Albert von Aachen, participants of the First Crusade from Cologne carried barley as horse fodder (Glasheen 2006, 122). Also Mediterranean ships bound to the Holy Land were laden with barley as *en route* horse fodder, which consumption rate for seaborne voyages is detailed in documents from Venice for 1268, from Naples for 1278-80 and from Marseilles for 1318 (Pryor 2006, 16f.). Historical sources from the later half of the 13<sup>th</sup> century reveal that the estates of the Hospitaller brothers in southern Italy actively supported the crusader logistics to Acre with wheat, barley, legumes and horse shipments (Bronstein 2005, 98). A similar case could be also made for the Northern Crusades.

*“Igitur omissis amici rebus propriis curam iniecit, contractaque aduersum Rugiam classe, quo gnauius bella conficeret, maritime Danorum expeditioni primus equos adiecit, quaternos singulis nauigiis mandans, eumque morem diligens posteritatis cura seruauit. Classis eius numero digesta mille et centum nauigiis frequens repta est.”* (Gesta Danorum 14.1.6, Friis-Jensen/Zeeberg 2005, 142f.).

Of particular interest is Saxo's notion that it has become common practise that each ship carried four horses, which in “*posterity*” was “*carefully followed*”. Since his book was written in the beginning of the 13<sup>th</sup> century, Saxo thus indirectly emphasises how important horse transport must have been considered at his time, and that it must have continued to play an important role. As shown above (section 3.3.8.), the itinerary also included a toponym *Hesto* — literally: horse island — which must have been somehow connected to maritime horse-transport, possibly as grazing ground. Its location on the opposite side of the Gulf of Finland nearby the Danish possessions in Estonia is certainly not irrelevant. Horses will have undoubtedly been shipped across the Baltic Sea, as much of Valdemar II's army relied on horseback warriors. In 1234 the castle's arsenal of Reval/Tallinn listed 250 warhorses and 200 riding horses (DD 1:6, 199; Reisnert 2009, 61), i.e. only 15 years after the Danes had gained a victory at Lyndanisse and laid the foundation of Danish sovereignty in Estonia with the construction of a stone castle. These horses could not have been bred from a small stock within this short time span, so it can be assumed that the great majority of these horses were shipped to Estonia. On Saxo Grammaticus' premise that 4 horses could be transported in one ship, this would mean that at least 113 horse shipments must have taken place in the 15 years after the Battle of Lyndanisse — between 1219 and 1234 — for the Reval/Tallinn arsenal alone. Since this was not the only Danish castle and arsenal in Estonia, the shipments would have been even more. From this period there are also several other written sources indicating horse-transport, often in connection with the Northern Crusades. In 1226 a possible horse transport occurred when the papal

Both grain and horses were also exported from Denmark since the 11<sup>th</sup> century (Riis 2010, 43f.). In his characterisation of the Danes, Arnold of Lübeck noted in the year 1183 that Denmark is not only renowned for its naval warfare, but also for its horseback warriors and horse-breeding, made possible by its fertile meadows (ACS III.5). War horses were not only bred by knightly orders, but also by ecclesiastic institutions like the Cistercians since the second half of the 12<sup>th</sup> century, specifically for the Baltic Crusades (Jensen 2011, 256). This implies that horses must have been transported across the sea at this time. This is confirmed by the Danish chronicler Saxo Grammaticus, who retrospectively noted that the Danes transported in the year 1136 for the first time horses on board of their vessels:

*“So he forgot the troubles of his friend and attended his own. He assembled a fleet against Rugen, and in order to conduct a brisker campaign, became the first to embark horses on a seaborne Danish expedition. He made every ship carry four, and posterity has carefully followed this practise. When the fleet had taken this complement aboard, it numbered eleven hundred ships.”* (translation: Christiansen 1981, 352).

legate called for a crusade against the pagan Osilians, which — as Henry of Livonia emphasised — was not followed by the Gotlanders and not heard by the Danes, but only the German merchants who acquired horses and came to Riga (HCL XXX.I) (cf. Johansen 1933, 111). Since the German merchants and crusaders operated via Visby, it is possible that they acquired their horses on Gotland and shipped them to Riga. However, the Gotlanders engaged in horse trade on their own, but also with the other side. In 1229 Pope Gregory IX sent a message to the Bishop of Linköping, the Cistercian Abbot on Gotland and the provost of Visby, in which he recited a complaint by the Bishop of Finland who discovered that Gotlanders were supporting the pagans with horses and demanded to prevent the merchants from trading with them (HUB I. 230). In the light of the overwhelming circumstantial evidence one may ponder about the probability that the Bossholmen ship — and perhaps even the Kuggmaren ship — may have played a role in this vast logistical enterprise of horse-transport to Estonia. In the Kuggmaren case — especially — it remains to be seen by further sampling, whether the ship carried horses or other animals. Even if it did not, there is a distinct possibility that the barley was destined for a port in the Baltics. Given that Bossholmen and Kuggmaren were most likely Danish vessels, the hypothesis that they might have followed a similar route as described in the Valdemarian Itinerary with Estonia as destination is not too far-fetched, although Stockholm cannot be ruled out entirely: At its location, it would have already been past the southern passageway to Stockholm at Baggenstället — *Hariestic* in the itinerary — which was most likely not used by larger sailing vessels.



Fig. 4-24. The stone door – *porta lapidum* – named Hariestic in the Valdemarian Itinerary (near Baggenstället) viewed from the north. Stockholm is depicted on the right side. Not necessarily owed to perspective, smaller vessels are shown entering the southern passage (here: above) and larger take the passage north (here: below) of Wärdö (from Olaus Magnus Historia - 1555, book II, ch. 28).

Olaus Magnus describes this in 1555 as bight that becomes increasingly narrower and with numerous shoals, leading to the *porta lapidum* (Swedish: *steendor*, English: stone door) (Fig. 4-24) at which thousands of Germans and Danes have lost their lives (Magnus 1555, 90). This notion might be testament that indeed German and Danish mariners not well acquainted with these waters might have tried just that, and met their untimely end here. Larger ships normally chose the save route north of Wärdö (*Windö*), as Magnus added.

If Stockholm was not the destination, a port in the Baltics like Reval/ Tallinn might have been a possible destination.<sup>15</sup> In the case of the Bossholmen wreck there is a cue that it operated on a route that led up north past Stockholm via the Åland Islands: Some moss residues — probably from the dunnage material — originate from a rare moss sub-species only found on the Åland Islands (Lemdahl et al 1995, 171). Grain transports into the Baltics have been previously recorded, when Riga in its first years — shortly after its foundation in 1201 — went through famine in 1206 and needed to be supplied with grain carried by

two cogs (HCL X, 9 and 12). Shortages in provisions will have probably also occurred in the newly conquered Danish part of Estonia after 1219, so a post-conquest supply of grain is plausible. Even long after this period, rye was exported to Tallinn, as in Herman Kolwagen's cog in the year 1382 (Wolf 1986, 110). However, grain was also exported from Estonia, as in 1283/84 to England (Hammel-Kiesow 2002, 71). Even before the arrival of the crusaders, the Estonians had an advanced system of agriculture and grew winter rye in a three-field system (Reisner 2009, 54), so if grain shipments occurred to the Baltics — of which there is barely any evidence — it would be only to overcome temporary shortages.

Having speculated on the destination, there are also some indications which point to possible origins for a grain cargo, as there were not many areas in the Baltic Sea area in the first half of the 13<sup>th</sup> century from where grain could be exported from on a large scale. Before Prussia became the breadbasket of northern Europe from 1280 onwards, grain exports chiefly occurred from the southwestern Baltic Sea coast, i.e. Holstein, Mecklenburg and Ratzburg, traded via Lübeck (Hammel-Kiesow 1999, 89f.) or Rostock, Stralsund and Greifswald. A list from 1275 indicates that rye, wheat and barley were exported via the latter, but mainly to Flanders and England (Hammel-Kiesow 2002, 70f.).

While the dendro-provenance of both wrecks suggests that they have been built somewhere in the

<sup>15</sup> The critical reader might ask why only the major urban centres like Stockholm or Tallinn are considered here. This seems very likely given the size of the vessels on the one hand, which would have not been part of the small-scale coastal trade, and the medieval staple rights on the other hand, which were restricted to major towns.



western part of the Baltic Sea – probably within the Danish realm – the principal grain exporting ports where also located in the western Baltic Sea at this time, i.e. the former Wendish territories in Holstein, Mecklenburg and Pommerania.

Amongst the Kuggmaren samples were also a few ceramic shards of greyware, too fragmentary however, to infer a shape or type. No petrological analysis was conducted, so these fragments can be only assessed in the most generic sense. Greyware was very commonplace after its introduction in the formerly Wendish territories beyond the Elbe River, in the new German populated urban centres at the Baltic Sea. Hard greyware vessels became in fact the most preferred product in north-eastern Germany at that time (Müller 2002, 17). While there is a lack of hard evidence regarding the provenance of the wreck, the grain residues and the pottery fragments, all lightly point in one direction: The south-western Baltic Sea area. Is this just coincidental?

If the Kuggmaren Ship was abandoned in the archipelago not long after it was built (ca. 1215), there is a possibility that it foundered at a time during the *pax valdemariana*, i.e. when Lübeck and other towns along the Mecklenburgian and Pomeranian coast were under the rule of King Valdemar II (cf. section 2.3.4). However, there seem to be no indications (at least to this author's knowledge) that regular grain transports occurred from these towns along the Swedish coast, which could – in this context – either mean that the grain residues in both wrecks are the remnants of a much earlier cargo and had nothing to do with the present find locations, or that grain was transported in another than mercantile context and thus did not enter regular transactions.

Although there are several indications which allow to speculate on probabilities, this question cannot be solved on the basis of the presently available material and therefore has to remain hypothetical.

#### 4.4. The Egelskär Ship in the Finnish Archipelago

The Egelskär wreck (elsewhere also referred to as Nauvo wreck) sunk *en route*, as evidenced by the circumstances of the wrecksite. The cargo is scattered on a precipice at a depth between 4 to 15 m. The ship appears to have capsized and thereby lost much of its cargo, as a bulk of the latter is concentrated at a spot 20 m away from the actual wreck (Wessman 2007,

143). Interestingly, the loss occurred between two islands named in the Valdemarian Itinerary, namely Jurmo (*Iurima*) and Kirkosund on Hitis (*Orsund*). Jurmo is named as the southernmost island of an archipelago, where the open sea begins — *et iurima iacet ultima ab eis versus australem plagam et proxima mari*.

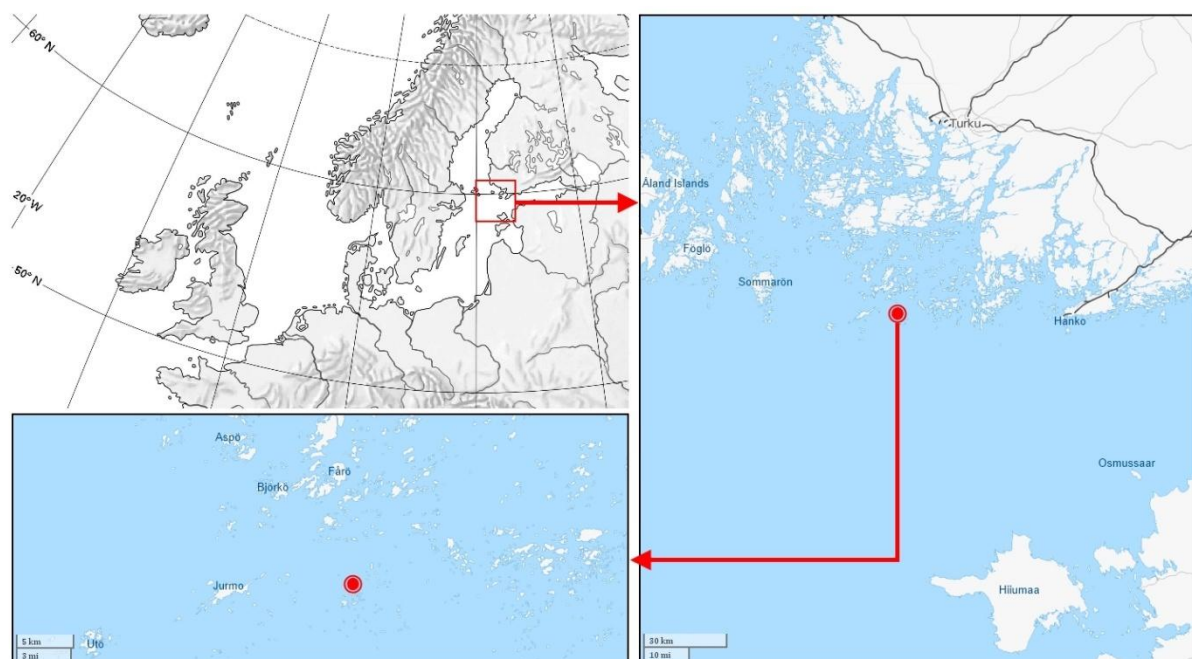


Fig. 4-25. The location of the Egelskär wreck (Basis data: Openstreetmap, modified by author).

#### 4.4.1. Date

As no dendrological analysis was carried out yet, the cargo – particularly the pottery – give the decisive hints on the date and provenance. A preliminary date was established by David Gaimster on the basis of two examples from the stoneware assemblage roughly from the 1310's to the 1330's, with a provenance from Bengerode in Lower Saxony (Wessman 2006, 143). However, a more thorough investigation that included over 500 additional pieces of ceramics lifted in the years between 1996 and 2007 indicates a date in the second half of the 13<sup>th</sup> century, most likely between 1250 and 1270 (Tevali 2010, 9f.).

What is more, the stoneware assemblage's provenance was more precisely identified with the production centre of Fredelsloh-Bengerode in the Solling mountains. They correspond closely with similar stoneware from destruction levels from 1265 in Corvey, from ca. 1271 in Höxter and from ca. 1270 in Nienover in Lower Saxony (Tevali 2010, 10).

The new date refutes an earlier hypothesis made by this author, in that the church bell may have been destined for the rebuilding efforts of monasteries in Estonia (Zwick 2014, 214). These had become the primary target of destruction in the St. George's Night Uprising of 1343-1345, in which the native Estonian rural population renounced Christianity and rebelled against Danish and German rule. Nonetheless, the church bell would be – if indeed the ship was bound for Reval/Tallinn – a testament to church building in the wake of Christianisation which

ensued after the Battle of Lyndanisse in 1219, thus antedating the wreck assemblage by about 30-50 years. Together with the remaining cargo the bell may give interesting clues on the origin of the assemblage and the trade network within which the ship operated, which will be discussed and speculated upon in the following sections.

#### 4.4.2. The ship's cargo and its origins

Aside from the aforementioned bronze church bell, which belongs to the oldest surviving examples in Finland (Alvik & Haggrén 2003, 21) (Fig. 4-26), the ship carried also 3-4 bronze cauldrons (Tevali 2010, 4). The cargo encompassed also about 100 whetstones schists. According to a mineralogical analysis these most likely originated from Norway, but could also come from Germany, France or Scotland (Wessman 2007, 143). The vessel carried also a large amount of limestone, most likely quarried on the Danish island of Sealand, or possibly even on Rügen or Scania (Tevali 2010, 4; Wessman 2007, 143), which chalk cliffs formed part of the same geological formation (cf. section 2.1). The whetstone and limestone was probably loaded as paying ballast, i.e. part of the merchandise, but heavy enough to make the additional loading ballast stones redundant. Other parts of the cargo included a wooden barrel filled with little iron bars. The stonewares formed the greatest quantity of the cargo assemblage, which was imported from Lower Saxony and the Rhineland area. Most wares were from Fredelsloh-Bengerode in Lower Saxony, including 26 globular jugs and 19 cylindrical jugs (Tevali 2010, 60ff.) (Fig. 4-27).



Fig. 4-26. Romanic church bell on the Egeliskär wrecksite (Photo: Kai Enholm).



Fig. 4-27. Three representative objects from the pottery assemblage of the Egelskär wrecksite: 1: Globular drinking jugs (SMM92002:2) 2: Cylindrical jug (SMM92002:6), 3: Beakers (Nierpassbecher) (SMM92002:23) (Photos: Tevali 2010, appendix I. Digitally remastered by the author).

These can be dated confidently, as the production phases of the Fredelsloh-Bengerode workshops are well dated historically and archaeologically, thus the estimate of 1250 – 1270 is fairly reliable. Aside from the Lower Saxon stoneware, a mug and some sherds of Siegburg ware was also discovered (Tevali 2010, 68), i.e. stoneware from the Rhineland. This is a very mixed cargo and beyond any reasonable doubt the Egelskär ship has to be seen in the context of a long-distance trading voyage. It is difficult to ascertain a port of departure on the basis of the cargo due to its heterogeneity. Nevertheless, there are several suggestive characteristics about this ship and its cargo, as shall be discussed in the following section.

#### 4.4.3. Contextualising ship and cargo: Cues on origin and destinations

Although the constructional characteristics of the shipwreck itself has not been studied yet due to the nature of the site, it was confirmed to the author that some of the observed characteristics point to a Bremen-type construction (Stefan Wessman, pers. comm.).

An interesting question is from which port this ship may have departed. The answer could be narrowed down by several exclusive factors. Part of the cargo assemblage had a western Baltic Sea origin – i.e. the limestone – thus a North Sea voyage and the Skagen route can be confidently ruled out, as it would have made little sense to ship this unwieldy commodity out and then in again. In her interpretation of the wreck, Riikka Tevali (2010, 5) seems to imply that all the different cargo items may have been picked up at their respective production centres, i.e. the

whetstones in Norway, the pottery in Germany etc. This may have applied to small-scale bartering trade, but this would be uncharacteristic for long-distance trade, where different commodities were taken aboard at a transshipment point.

What is more, it were largely Hanseatic merchants that were responsible for the distribution of German stoneware to the north (cf. Gaimster 1997, 65), which would suggest that the other commodities from the Scandinavian world were transhipped in a Hanseatic port, where Norwegian whetstone schists and stoneware from the German hinterlands were exported. A possible harbour of departure could be Rostock, which was founded in 1218 and maintained trade with Norway. As opposed to Lübeck, which main Norwegian trade was conducted in Bergen, Rostock merchants visited Norwegian cities in the Skagerrak and Kattegat region, primarily Tønsberg and Oslo. This corresponds to the area where whetstones were quarried, i.e. in the schist mines of Eidsborg, which were distributed via Skien since the Viking Age. This export trade continued throughout the Hanseatic period (Mehler 2009, 100).

Interestingly, another Bremen-type vessel dating between 1298 and 1313 sank with a cargo of Norwegian Eidsborg whetstone schists off the Mecklenburg coast (Förster & Jöns 2003) only about 35 km away from Rostock as the crow flies, which corroborates the assumption that this commodity was transhipped in Rostock. What is more, in the period between 1270 and 1330 stoneware from Siegburg and Lower Saxony dominate the archaeological find assemblage in Rostock (Gaimster 1997, 75). All these factors combined strengthen the hypothesis that the Egelskär ship's port of departure was indeed Rostock.

What could be the possible destination? Late medieval pottery trade in the Baltic is dominated by the competition between stoneware producers in the Rhineland, Lower Saxony and Saxony. The stoneware's robust body enabled it to be transported in bulk over long distances and this ware is often regarded as "*type-fossil*" of 'Hanseatic' urban culture, linking consumers of diverse social strata between London and Reval/Tallinn (Gaimster 2005, 415). Reval/Tallinn was — in fact — the third major importer of stoneware from Lower Saxony, after Visby and Stockholm (Gaimster 1999a, 103, fig. 4). A cross-section of the bulk of imported German stoneware from the 14<sup>th</sup> and 15<sup>th</sup> centuries is presented by the excavated pottery from the Kalmar harbour excavation, of which 67% were Siegburg ware and 21% stoneware from Lower Saxony. Many of these vessels remained intact, which can be associated with wharfside loading operations, thus direct evidence of trade (Gaimster 1999b, 63).

Riika Tevali explores the hypothesis of whether the Egelskär ship's cargo may have been destined for the nearby Finnish town of Turku, but has to soberly admit that German merchants were not present in Turku before the early 14<sup>th</sup> century (Tevali 2010, 41),

although stoneware appeared in Finland in modest quantities since the late 13<sup>th</sup> century (Tevali 2010, 13), with some higher concentrations of Rhenish stoneware in Hanko in the turn of the 14<sup>th</sup> century (Tevali 2010, 16). Hanko is also included in the Valdemarian Itinerary as the first-named location on the Finnish mainland, which was referred to as port by Olaus Magnus. Thus, the higher concentrations of stoneware fragments in this location can be explained by bypassing long-distance merchants, but was probably not a trading destination *per se*.

Given that Reval/Tallinn was not only the destination of the Valdemarian Itinerary, but also the third largest importer of stoneware from Lower Saxony, as well as the fact that the Egelskär wreck has sailed already past the only towns which imported more Lower Saxon stoneware – i.e. Stockholm and Visby – the accumulated circumstantial evidence points to a trade connection between Rostock and Reval/Tallinn. Given the location of the wreck, the ship followed apparently not the route as described in the Hanseatic Sea Book – unless driven off course by adverse weather – but seem to have followed a route transect as described in the Valdemarian Itinerary.

## 5. WOODLAND EXPLOITATION IN THE WAKE OF THE PRUSSIAN AND BALTIC CRUSADES: ASSESSING MARITIME TIMBER TRADE AND ITS IMPACT ON SHIPBUILDING (14<sup>TH</sup> - 15<sup>TH</sup> CENTURY)

This chapter approaches the general theme of maritime logistics from an entirely different angle. It takes a closer look on one of the most important resources of the Baltic Sea region: oak. Its export was an important factor for the economy of the crusader state of the Teutonic Order, for shipping routes, and for shipbuilding – amongst many other uses. Thus, a

range of particular subjects are addressed, which are all critically important for the overall theme of the maritime logistics. As opposed to the previous section, this chapter only examines one ship-fund as case study, while otherwise focussing on the broader trends of timber trade and shipbuilding.

### 5.1. Wood as managed resource

Forests should be considered the most important source for raw materials, as virtually every industry depended on it in some way. Timber was needed for rural and urban settlements, ships, tools and dyke construction, while having also an agricultural use for fences, forest feed and fruits for livestock owners. An essential part was used as energy source, as fuel for charcoal production, which was in growing demand for the metal, glass and brick industry (Paysen 2009, 9). Given the versatile use of this resource, conflicting interests had to be mediated. Since the late 12<sup>th</sup>

century, regulations on woodland use have become increasingly common in Germany and the Netherlands, which most often concern rights for the collection of fire-wood. While softwoods or broken off branches could be collected, construction timber like beeches and oak were off limits (Endres 1888, 36f.; Tossavainen 1994, 17). This reflects that certain tree populations were preserved and that an awareness of the limitations of natural resources was present.



Fig. 5-1. This 18<sup>th</sup> century naval architectural manual exemplifies how to make best use of branches for compass timber. The trees were apparently pruned to control their growth. While these specimens would have been perfect sources for structural timber, most of them would have been very poor choices for planks (Source: Panckoucke et al. 1786, pl. 103).

Although the more densely populated areas of central and western Europe were not depleted of woodlands, they were however managed, e.g. through coppicing. Coppicing refers to a traditional method of woodland management, in which young stems are cut down at ground level to facilitate the growth of multiple branches. This form of woodland management was very common in regions with a high consumption of wood as fuel, such as for making charcoal for iron production, where quantity and not growth patterns were the decisive criteria.

There is, however, evidence for regions where shipbuilding was given the highest priority. Around the year 1300, oak forests in the Basque region within 2 miles from the sea were reserved exclusively for shipbuilders (Loewen & Delhaye 2006, 100). The woodland management is arguably reflected in the framing-style of a late 15<sup>th</sup> century shipwreck of Basque origin, where growth patterns have been apparently ‘trained’ to a specific curvature (Loewen & Delhaye 2006, 102f.). Shipbuilders had an exact notion what kind of timber was required, even long before growth patterns were controlled.

This is also highlighted by a list in which different categories of compass-timber was sketched with rough dimensions provided, for the estimation of

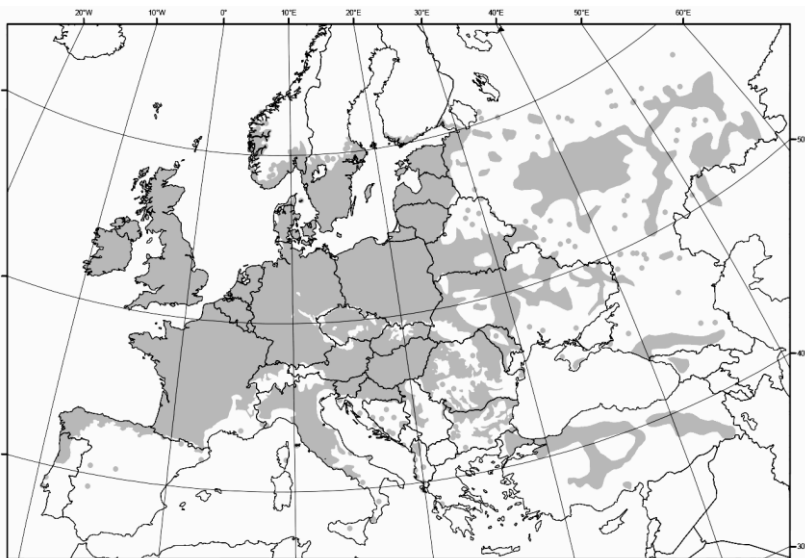
costs for the building of a 16<sup>th</sup> century ship (Olechnowicz 1960, appendix Nr. XLIII). It can be taken for granted that such specifications existed well before that time, even if only as mental templates in the heads of shipbuilders. Naturally, historical recordings on the wood-selection process for shipbuilding are scant, as neither lumbermen nor shipbuilders belonged to a literate class. Thus, an archaeological approach — combined with dendrochronology and other environmental sciences — takes primacy in studying the links between woodland management and shipbuilding deep into historical times.

Ironically, shipbuilders may have become their own fiercest competitors when it came to strategies for woodland management. Trees suited as sources for compass timber — i.e. crooked timber elements suited for the framing — were often not well suited as source for planks (Fig. 5-1). Here the shipbuilders had conflicting interests in the management of woodlands, particularly in densely populated urban regions, where wood was in high demand for other industries. The Baltic region, with its pristine untouched woodlands with long straight-grained trunks and few knots must have been a shipbuilder’s paradise in this respect.

## 5.2. Baltic timber trade

An old English poem from 1430 notes that the Easterlings, Prussians and Germans are shipping osemund iron, copper, staff-wood, steel, wax, pelts, pitch, tar, pine wood and oak boards to Flanders, and also venture into the Bay of Biscay to obtain salt. Yet, he added that they could not do so without permission of the English as the “Masters of the Canal” (Anderson & Bamberger 1773, 136). The precondition for the English to become Masters of the Canal, however, was very much dependent on the

availability of high-quality timber for shipbuilding. Until the mid 13<sup>th</sup> century England imported timber from Scandinavia, but this shifted thereafter to an import of timber from the Baltic region. An obvious reason is that Scandinavia predominantly exported softwoods — suitable for masts and spars — while oak was the main export product of the Baltic region. Another reason was the stark price differential for timber between the Baltic and the West (Jahnke 2015, 223).



*Fig. 5-2. Natural distribution area of pedunculate oak (quercus robur). While western and central Europe has become either largely deforested or covered by managed woodlands, great wildwoods of oak trees were still to be found in the east. This map does not reflect the density, but only the vegetation (Source: EUFORGEN 2009, www.euforgen.org).*

Oak surpasses all other European woods in terms of solidity, strength, elasticity and durability, and can be therefore seen as standard species used in shipbuilding and also many other constructions (Wagner 1984, 132). But it is not only the species that matters, but of similarly high importance for the rigidity is the absence of knots and straight-grained growth. Such qualities could be typically encountered in wildwoods, vast unmanaged woodlands in sparsely populated areas.

Although England could rely on different sources for timber, like Ireland or the Basque region (cf. papers

*Wir brudir Conrad Czolner vom Rotinst[eyn], homeister Dutschis ordens, syn mit unsirn mitgebütgeren eyntrechtlich czu rate wurden, das alle die gene, die durch unsirn willen tun und lassen wellen, ez syn geste adir ynwonere dis landis, von disem tage mee keynerleye gewant adir andir-ware von Engeland czu schiffe adir obir land brengin adir furen lassen, by busze derselbin ware, dy sie brengin; ouch das von disem tage mee keyne assche, pech, teer, meste, knarholtz, waynschos, koggenborte, ywenholtz noch andirs keynerleye holtz us dem lande czur see sullen furen, utgenomen clappirholtz, das mag man czwisschin hy und sentbe Michils tage usfuren und nicht lengir. Wer dis unsir gebot tursticlich und mit freyyl bricht, der sal unsir lande eniglich emperin, und do czu al syn gut han vorloren (HR I.2, 329).*

Most of these items included products used in shipbuilding, like pitch and tar, used for caulking and for the maintenance and preservation of the hull and the rigging. Masts were seperately itemised. Yew — suitable for bows — was also unsurprisingly a major export commodity, given the long tradition of archery in England. The other wood species were regularly — although not exclusively — used in shipbuilding, like wainscot. Can this category be identified in the archaeological record? There is a certain potential that this is possible, as there are several specific indications in the written records. The case study presented in section 5.3 deals with an articulated slab of planking — excavated by this author — which was partially built of Baltic wainscot planks and which sparked the author’s interest to pursue the question of imported timber further. The significance of this finding is twofold, as it reflects not only a choice made by the shipbuilders, but also a maritime trade-network for timber, which reached deep into the hinterlands via the extensive river-systems of the Vistula, Daugava and other streams.

### 5.2.1. Standardised timber products

Amongst the many different timber-standardisations, wainscots are among the most relevant in the context

D and E), one major supplier of timber were said Prussians. At that time, Prussia was a province of the Teutonic Order, and the latter — as only territorial power to be member of the Hanseatic League — had tremendous influence within the same and direct control over its trade deals.

At the peak of the English-Prussian conflict in 1386, the Grandmaster Conrad von Rothenstein enforced a trade ban, which included the export of specifically listed items, of which many were used in shipbuilding:

*We, brother Conrad Czolner von Rothenstein, Grandmaster of the Teutonic Order, have decided in unity with the council, that all those, who are guests or inhabitants of this land, shall of this day, no garment or other good bring, from England by ship or across land, at the peril of forfeiture of the goods which they import. Also from this day, no ash, pitch, tar, masts, knarr-timber, wainscot, cog-boards, yew or other kinds of wood shall be brought outside the land across the sea, apart from clappir-wood, which could be exported until St. Michael’s Day, but not thereafter. Whoever breaks this order with intent and iniquity, shall be expelled from our land in eternity and shall loose all of his possessions. (free own translation)*

of shipbuilding. There are several references to wainscot from 19<sup>th</sup> century sources, a time when timber was still traded in the “medieval” fashion of floating log-rafts down the river. One dictionary defines them as knot-free oak boards (Lübben 1888, 550). In another work of the mid 19<sup>th</sup> century it is similarly defined. In there, wainscots had a length of roughly 3 to 5,5 m and a width of ca. 26 cm. These were taken from logs up to a girth of ca. 80 cm, which was halved or quartered, cut along the grain at a right angle while removing the soft pith (Hirsch 1858, 215; Kapfenberger 2003, 24). This is a sure indicator for radial cleaving (Fig. 5-3).

The author notes, that the English used the term wainscot only to — what was locally known as wainscot-logs — i.e. quartered timber (Hirsch 1858, 215). This would have been a semi-product and the advantage would have been that the customer could customise the timber to his specifications, e.g. by working in ridges. Thus wainscots were less wide than tangentially sawn planks, because their width would have been less than half the diameter of the trunk, as pith and sapwood was removed. Kapfenberger (2003, 24) assumes this description does not apply to timber products before 1700 and bases this on a definition made by Mager (1960, 7), possibly based on the notion of ‘quartered wainscot log’.

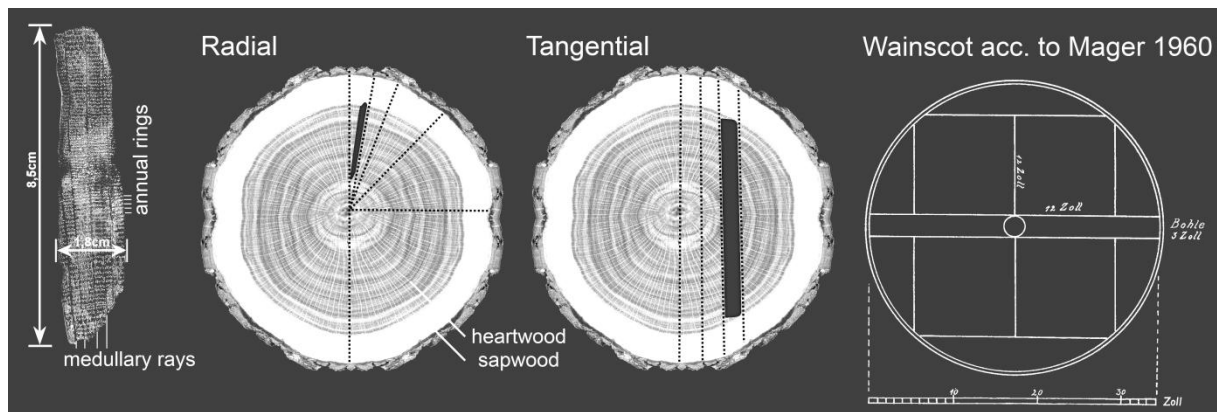


Fig. 5-3. The differences between radially cleft and tangentially sawn timber. On the left side is a cross-section from a plank fragment of the *Beluga Ship*, indicating an orthogonal pattern for medullary rays and annual rings, which is indicative for cleaving. On the right side is a diagram drafted by Mager, which is probably based on a false assumption (Graph: Daniel Zwick).

This, however, appears to be a misinterpretation by Mager, as trunks could be quartered without using a saw, but by using wedges instead to break up the trunk along its grain. Moreover, quartering does not imply working off the curvature of the trunk either. The notion that wainscots were radially cleft oak planks is consistent to the archaeological findings, as will be demonstrated in the following.

The comparative analysis of clinker-built ships from ca. 1300 to 1540 in the extended North Sea area has shown that indeed most wrecks had planks with such modest widths and many were cleft (paper D, table 1). It would be however too early to imply that these were all wainscots, as there are also other categories of wood that may have been radially cleft and used in shipbuilding, such as *knarrholz*, literally knorr-wood (Ellmers 2006, 67). There were also not sufficient information on maximum plank lengths. However, there is by now tangible evidence for wainscots in the cargo holds of shipwrecked vessels. Two groups of timber could be tentatively identified, and one of it is wainscot (paper D, table 2, and an updated table further below, tab. 5-1).

### 5.2.2. Trade patterns emerge

The earliest archaeological evidence for the use of oak in shipbuilding that was imported from the Baltic Sea region for London dates to the early 14<sup>th</sup> century (Marsden 1996, 117, 188) and for Flanders from the late 14<sup>th</sup> century (Haneca *et al* 2005, 262). But written sources suggest that the import of oak started earlier, i.e. right from the outset of the Baltic colonization: Only 5 years after the foundation of Riga, large trunk-rafts called *strues lignorum* – or "strusen" in the German vernacular – were floated down the Daugava River from Lithuania and Belarus since 1206, which carried merchandise while the trunk-rafts were broken up at their destination for further use of the timber. Tree-trunks were also floated down a stream

called Sengaller Aa with Riga as its destination since the later part of the 13<sup>th</sup> century, from where previously only pelts and way was exported (Benninghoven 1961, 35), which may indicate a growing demand for timber-products. Until the mid 13<sup>th</sup> century the Pipe Rolls in England used the Latin word *lambruscata* for timber products, but was replaced around 1250 by *waynescote*, a German-derived term used by the Hanseatic merchants, that was also introduced in the Netherlands with the first Baltic timber imports (Tossavainen 1994, 17). This has to be seen not solely in the context of Baltic oak export, but generally the seizure of a monopoly position on timber export in general. The Hansatic League took advantage of Norway's dependence on annual grain imports and — as supplier of said commodity — forced Norway to cede its timber export market, for its members to become intermediaries (Hammel-Kiesow 2002, 74). In the course of the English-French war, in 1294, vessels from Stavoren and Friesland bound for Flanders were seized in English ports, loaded with Baltic boards, ash and pitch — all Baltic products (Tossavainen 1994, 20).

So it can be noted that some of the typical Baltic forest products were exported to Flanders and England since the mid 13<sup>th</sup> century, strikingly simultaneous with the Baltic and Prussian crusades and the urbanisation process in these regions.

The supply of large and bulky construction timber, as used in house-construction and shipbuilding, was dependent on nearby waterways, where such timber could be more easily transported than on land. Thus, particularly river-valleys became deforested, which led to an increased erosion process and changed fluvial landscapes long-lastingly, but that is another topic (briefly addressed in paper D's last section). On the basis of palynological data, it is assumed that wide parts of the River Vistula valley were deforested already in the early Middle Ages but forests still remained the primary landscape element further upstream (Brown & Pluskowski 2013, 100).



Towards the end of the 14<sup>th</sup> century, Danzig/Gdańsk outstripped Thorn/Toruń as major trading site for wooden products and obtained different wood commodities from the central Vistula region, but also from the Bug River, and Masovia around Warsaw was the most important source of timber and many products were processed locally, when Danzig/Gdańsk merchants entered treaties with Polish saw-mills, determining the desired species and dimensions beforehand (Kapfenberger 2003, 20). But evidently, not all were semi-products, but entire logs — bundled together as rafts called *struges lignorum* — were also floated down the river to Danzig/Gdańsk (Kapfenberger 2003, 20). The felled trees were bundled together and floated down the river to Danzig and other towns, where they were processed. This practise continued until the recent past and evidently these logs were bundled together like make-shift rafts, on which the raftsmen build their temporary dwellings. Photos and depictions suggest a rudimentary steering-oar mounted at the aft ends and some ancillary craft, which task will have been to keep the pack together — like seaborne shepherd dogs. Nonetheless, one could expect that this operation must have been fairly chaotic, as the main method of propulsion was the river current (Fig. 5-4).

The oak logs were probably not floated down the river immediately after they were felled, as the gross density mass of freshly cut oak with bark is about 1180-1270 kg per solid cubic metre.<sup>16</sup> If no bouyancy aids like a lighter softwood species were attached to the bundle, for which there is evidence (Radkau 2012, 39), the logs would have sunk. If air-dried, however, the gross density of oak would be about 870 kg/m<sup>3</sup> and would therefore float.

This is consistent with the photos, which show the logs mostly inundated. An interesting question would be how long these logs were stored to dry, and — when floated down — whether there was a time range in which these logs had to reach their destination before becoming too water-logged to maintain their positive bouyancy. This author is not aware of any historical records from this period to answer this question, but this would be very important for determining when ships were built, which is often — probably inaccurately — equated with the felling date.

Transactors of the Teutonic Order entered in direct trade deals with Polish merchants, typically via Thorn/Toruń — a staple for Polish products and thus perceived as gate to Poland (Kapfenberger 2003, 20). In 1390 the Polish King Władysław II Jagiello granted German merchants the right to buy timber from as far as Cracow (Tossavainen 1994, 28), thus the catchment area of available timber must have been extensive.

And in 1398, the Teutonic Order sealed a deal with the Lithuanian Duke Witowd to open up trade (Kapfenberger 2003, 17). It is striking that the Order itself was engaged in trade deals, often as middleman between Polish logging areas and the Danzig/Gdańsk export trade (Fig. 5-5), even in times of war.

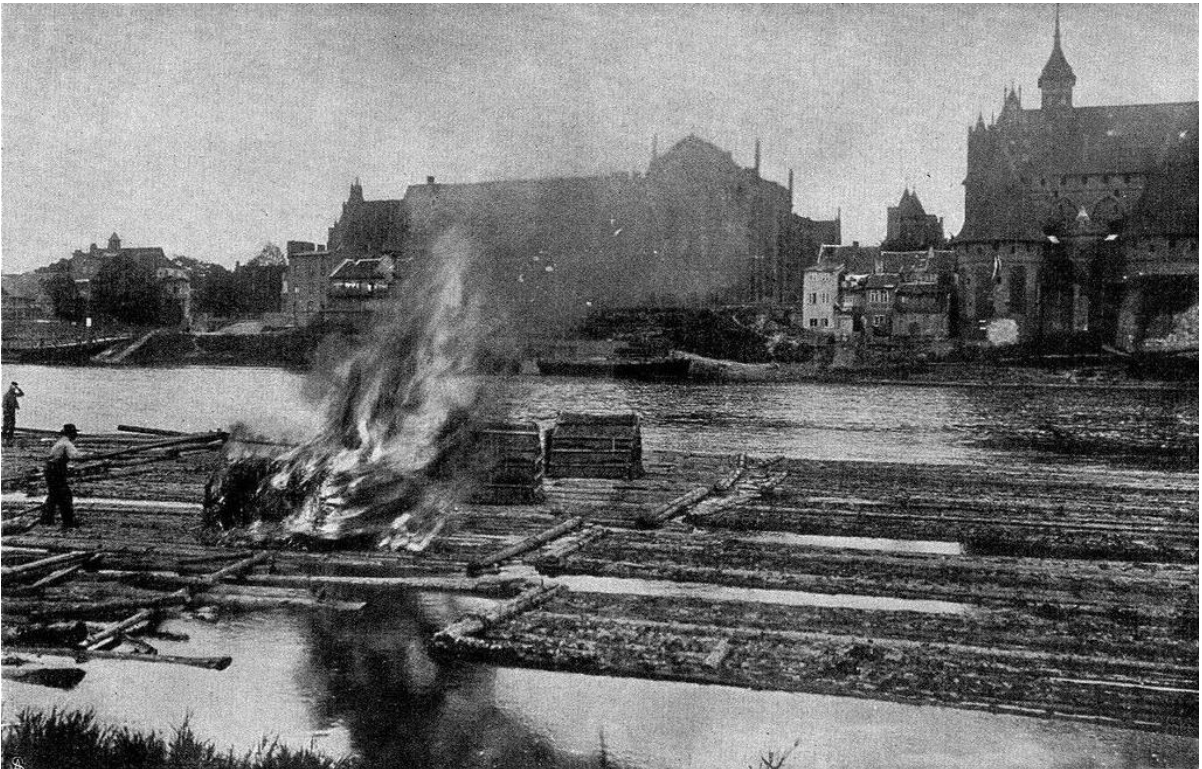
The annual raids of the Teutonic knights into Lithuania came to a halt with the Treaty of Raciąż in 1404, i.e. 6 years after the trade deal with the Lithuanian duke was concluded. As part of this treaty, Samogitia was ceded to the Teutonic Order. In the light of the timber trade of this region, one may assume that the Order used the tool of the crusading ideology as legitimisation to pursue its economic interests and to secure woodland resources.

This has not even changed when Lithuania officially embraced Christianity in 1387 under King Władysław II Jagiello — born a pagan and hitherto referred to as Grand Duke Jogaila of Lithuania — who converted to Catholicism when he was crowned King of Poland in 1386, thus uniting the Kingdom of Poland and the Grand Duchy of Lithuania in a personal union. This was called a heresy by the Teutonic knights, who doubted the sincerity of his baptism and continued the crusades (Rowell 2000, 709ff.). The profitable timber trade in which the Teutonic Order was directly engaged reveal another incentive — aside from the religiously motivated — for the continuation of the war. Shortly thereafter, around 1405, Danzig/Gdańsk obtained the bulk of its wainscot and other timber products from Lithuania, which was pre-processed and inspected in Kaunas and from here it was shipped in river-barges down the Nemunas River, across the Curonian Lagoon, via the Deyma and Pregolya rivers past Königsberg/Kaliningrad, across the Vistula Lagoon and via the Vistula River to Danzig (Hirsch 1858, 161ff.).

Although dendrochronology has advanced in the last decades to narrow down provenances to a regional level, this applies only for regions with sufficient site chronologies. This is the case for northern Poland, but not its southern part, or other countries like Lithuania or Belarus (Haneca *et al* 2005, 264). Some provenances appear blurry and a provenance now quoted as NE-Poland may — after a calibration with new site chronologies — turn out to be Lithuanian. The same problem applies to Daugavean oak, which was obtained from a vast hinterland (Zunde 1998/99).

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<sup>16</sup> German Timber Trade Federation



*Fig. 5-4. Logs floated down the Nogat River — a side arm of the Vistula River. The lower photo shows the burning of a straw hut on one of the log-rafts, as part of a cholera prevention measure. This occurred at a control-station to the foot of the Marienburg (Malbork Castle); the administrative centre of the Teutonic Order (Photos: loose page from a 1905 volume of unknown title).*

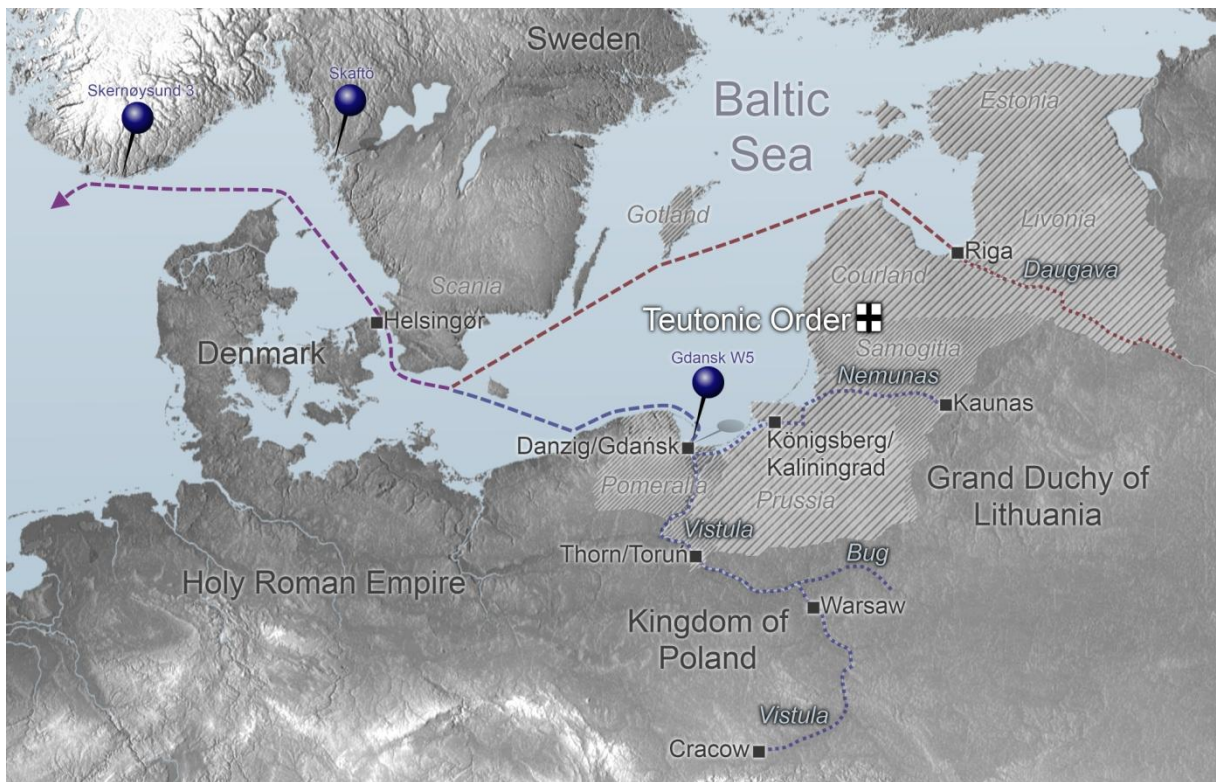


Fig. 5-5. This map shows the arteries of timber trade — via the rivers across the sea — in comparison to the political order. The sea routes correspond to those of the Hanseatic Sea Book of c. 1470 and the blue pins indicate shipwrecks which cargo assemblage included wainscot planks (cf. tab. 5-1). For a long time the Teutonic Order controlled all ports where oak was exported. This changed in the course of the 15<sup>th</sup> century. The lightly hatched areas show the lost territories: Gotland passed already in 1408 under Danish rule, while Pomerania, the City of Danzig/Gdańsk and other parts were ceded to Poland-Lithuania in the Second Peace of Torun in 1466. Moreover, the Duchy of Prussia became a Polish fief. Helsingør is included in the map, as dues on ship-cargoes were levied and recorded here, i.e. in the Sound Toll Registers from the 16<sup>th</sup> century onwards (Graph: Daniel Zwick).



Fig. 5-6. Conserved wainscot planks from the Gdansk W5 wrecksite (Jagielska & Urbański 2014, fig. 8).

shipwreck with the listed timber cargo	date of the timber cargo	quantity	length (cm)	width (cm)	thickness (mm)	provenance	quantity	length (cm)	width (cm)	thickness (mm)	provenance
		group1						group2			
Skjernøysund 3	1394	9(6)	50-83	16 -	20-	N-Poland	13(8)	230	25-30	40-50	N-Poland
Gdansk W5	1403-1408	205	79-85	14.5-16	14-25	NE-Poland	79	250	30	20-45	NE-Poland
Skaftö	1437-1441	3	85	15-17+	20-	N-Poland	4	137+	23-30	30-60	SE-Poland

Tab. 5-1: This table summarises the shipwrecks known to have carried timber as part of their cargo. All timbers were radially cleft. In the case of the Skaftö wreck only few timbers were recovered from the wreck and the data is therefore less representative. In the case of the Skjernøysund wreck many timbers have strongly deteriorated and are not all preserved to their original dimensions, so the number in the brackets represent the uncertain attributions. The data suggests two major formats and in the case of the Skaftö wreck, a possible correlation between timber provenance and dimensions of the prefabricated timber (Sources: Skernøysund 3: Auer & Maarleveld 2013, Gdansk W5: Litwin 1985, 46; Krapiec & Krapiec 2014, 147, Skaftö: von Arbin 2014, 34 (Table: Daniel Zwick).

The preeminent port where wainscot was exported remained Danzig/Gdańsk well into the 16<sup>th</sup> century, with a share of roughly two-thirds at the beginning of the century. This is corroborated by this author's analysis where in fact almost all closely determined dendrochronological results for 'Baltic' timber has a Vistulean provenance (paper D, table 1). Wainscot export trade can be now also archaeologically verified. Three shipwrecks are hitherto known to have carried a cargo of wainscots (Figs. 5-6, Tab. 5-1).

The Sound Toll Register, a register of dues extolled on the merchandise from bypassing ships at Helsingør, indicates that this changed in the course of the 16<sup>th</sup> century, when wainscots were exported increasingly via Königsberg/Kaliningrad — at the mouth of the Pregolya River — and from Courland (Bonde *et al.* 1997, 203; Haneca *et al.* 2005, 262), which arguably included Riga and Vistulean timber.

### 5.2.3. Volume of trade

The Teutonic Order inventory records show that 252,000 pieces of wainscot were ready for shipment in the year 1392, and in 1397, a slightly higher number of ca. 273,000 pieces were stored in Danzig/Gdańsk for export (Mager 1960, 11). If compared to ca. 420,000 pieces of wainscot and 51,000 wainscot-brak — i.e. of slightly lower quality — exported via Danzig 12 years later, as noted in the Pound Toll Register (*Pfundzollbuch*) for the year 1409 (Kapfenberger 2003, 23), the share of the wainscot traded by the Order itself is considerable. The

*Pfundzollbuch* is a register in which commodities are listed in all detail which were exported via Danzig/Gdańsk by ship. Originally introduced in Hanseatic cities in the 1360's to fund the war against the Danish king, it became in 1409 a special tax levied by the Grandmaster of the Teutonic Order to settle the debts of the Hanseatic cities, rather than to safeguard merchant shipping (cf. Jenks 2012).

Half a century later, the volume almost doubled, despite times of political upheaval, war and uncertainty. When in 1454 Danzig/Gdańsk and other Prussian towns united under the banner of the Prussian Confederation to rebel against the rule of the Teutonic Order, and begged to be incorporated into the Kingdom of Poland — an act that was sealed by the Peace Treaty of Toruń in 1466 — the export of timber grew even further in volume. In 1464, exports from Danzig/Gdańsk comprised about 611,000 boards of wainscot (Litwin 2014, 28 acc. to Binerowski 1963). This number may be even an underestimation, as the wainscot pieces were calculated on the basis of the *Großhundert* — grand hundred — à 120 pieces, consequently it would be more in the range of roughly 739,000 wainscots of a total number of 983,000 of wooden export products (Jahnke 2015, 224). Thus, for the year 1464 wainscot was with ca. 75% the far greatest item designated for the timber export market. The profit margin for wainscot was considerable: 100 wainscot boards costing in Danzig/Gdańsk 3.5 Prussian marks achieved in London a price of 20 marks (Litwin 2014, 28).

### 5.3. The case of the Beluga Ship: A Scandinavian wreck, built of Baltic timber and scrapped in a German city?

This author was prompted to explore the question of Baltic timber trade from an archaeological perspective when confronted with the finding of planks of Baltic provenance in the Beluga Ship he excavated in 2007 in the City of Bremen. It is one of the few medieval wrecks built of Daugavian wainscot, and the only within the North Sea within the remit of his study (cf. paper C). This presented an opportunity to explore the Baltic timber trade on the basis of archaeological, historical and dendrological evidence in further detail. This is not to say that the Beluga Ship is singled out as case study because of its representativeness or significance.

#### 5.3.1. Discussing the preliminary results of the Beluga case study

In March 2007 this author excavated a newly discovered clinker-built shipwreck in the City of Bremen — dubbed the ‘Beluga Ship’ (Fig. 5-7). Its construction is reminiscent of Scandinavian shipbuilding and was initially associated with such origin based on the constructional properties alone

(Zwick 2008, cf. paper C). When the dendrological results became available, it confronted the author with an unexpected result: Samples taken from the lower strakes indicated not only a Baltic provenance, but also oak of exceptionally high quality: straight-grained and knot-free. In cross-section, the tree rings and medullary rays form an orthogonal pattern, indicative of radial splitting. Such timber would have been most certainly referred to as ‘wainscot’ (cf. section 5.2.1). This put a whole new dynamic on the question of origin and its implications.

The hypothesis of a Scandinavian vessel was not dismissed, however, but reiterated in different terms. The vessel’s modest dimensions suggested that it was a vessel engaged in coastal local trade. The — not too far — western coast of Denmark was therefore identified as possible origin (Zwick 2010, 68). This would have meant that Danes — or other Scandinavians — imported oak timber from the Baltic. Was this indeed the case, or was the ship even built outside of Scandinavia?



*Fig. 5-7. Photo taken in the construction pit of the Beluga Shipping Company at Teerhof, Bremen, showing the author excavating the Beluga wreck in March 2007 (Photo: Carl-Christian von Fieck †).*

Other western and northern Europeans practised shipbuilding techniques similar to Scandinavians, especially on the British Isles. There is even evidence that this technique may have been practised along the West Frisian coast (Reinders & Aalders 2007), with corresponding finds in Stade and Harburg, but in

very low quantities, which are indicative of visiting ships rather than a locally practised shipbuilding tradition. Although some of these questions were addressed by this author in the two aforementioned German publications, it was felt, that the enigma of the Beluga Ship could not be satisfactory answered in

a regional context. Therefore two papers were presented to an international audience at the 13<sup>th</sup> “*International Symposium on Boat and Ship Archaeology*” in Amsterdam in 2012 and a conference on “*Hanseatic Trade in the North Atlantic*” in Avaldsnes in 2013. One paper focussed on the technicalities of ship-construction (paper C) and the other encompassed a comparative analysis, in which the Beluga Ship was compared to over 50 other late medieval clinker-built ships from the extended North Sea area (paper D). A few repetitions and overlaps between these papers were naturally unavoidable. In the interest of readability, the key aspects are shortly reiterated in the following but do not anticipate the full content of the papers (manuscripts are attached in the appendix), to delve from there into the research question on the relationship between the clinker-method and wainscot imports.

### 5.3.2. Date and provenance

The first dendrochronological samples taken from the fragmentary upper planks yielded a result from the second quarter of the 15<sup>th</sup> century with a provenance from the Weser Lowland (Heußner 2009a). Wood in riverine lowland regions is subject to unique conditions which lead to a distinctive regional annual ring growth by which their provenance could be closely determined. Further samples from the lowermost strakes were analysed and not only antedate the latter by a few decades, but originated from an entirely different region: the Baltic region (Heußner 2009c). None of the samples included any sapwood, so a site-specific margin was added to indicate a *terminus post quem* within the realm of probability (Fig. 5-8). It has to be stressed, however, that this is not a definite date and that the deduced *terminus post quem* could be even antedated if the number of sapwood rings is below average. The term ‘Baltic’ with regards to timber provenance represents a pitfall, as it has been often generically used to describe timber traded from the Baltic Sea area as a whole. This generalisation can be attributed in part to the limited possibilities of making exact provenance determinations in the past. In northern Europe, a refinement of dendro-provenancing occurred only recently, around the turn of the millenium, where finer-grained differences of growth patterns were made comparable by moving away from master chronologies by taking site categories into greater account for the statistical assessment (Daly 2007, 3ff.). In spite of the recent developments, the term ‘Baltic’ still is used in a generic way to include also Poland. In the case of the Beluga Ship, however, the first group of timbers actually have a Baltic origin, meaning the area of what are now the Baltic States. In order to avoid any misunderstandings, it was suggested by this author to use the term “Daugavian” for Baltic timber and “Vistulian” for Polish timber (paper D), while the

term ‘Baltic’ is continued to be used in a generic sense, referring primarily to the southeastern coast of the Baltic Sea. Tree-cutting occurred principally along these two major river-systems — the Daugava and the Vistula — including its numerous side-arms.<sup>17</sup> The logs were floated or rafted down the river as whole or semi-product. The dendrological analysis indicates that the Daugavean timbers were meant as exportable wainscots.

None of the planks contained sapwood, so in neither case an exact felling date could be ascertained, for which reason a margin of 14 years was added<sup>18</sup> for the Daugavian planks and the regular 20 year margin for the locally cut planks, which could have been both considerably greater.<sup>19</sup> Strikingly, the Daugavean planks feature great variations in start-end dates. This could be explained by the way planks were extracted from the parent tree: They might have been considerably dressed along the edges to fashion the planks in uniform widths. If this can serve as viable explanation, this would support the interpretation that this was import timber — such as wainscot — as vessels build of locally cut timber would probably feature a much more uniform pattern. The dimensions of wainscot planks were often standardised to make them suitable for exports, so it seems feasible that the exploitation of the tree-trunk to its maximum width was not the highest priority. The Baltic region was heavily forested, so there was no necessity to make best use of the timber — i.e. to the last ring before the sapwood or even with sapwood — as in regions where timber scarcity prevailed.

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<sup>17</sup> After Danzig (Gdańsk) and Riga, Königsberg (Kaliningrad) was the third largest exporter of timber. It is located at the Pregolya River, so one might want to use the term “Pregolyan”. However, timber export via Königsberg grew in importance much later, and is not relevant for the period discussed here.

<sup>18</sup> the average number of sapwood rings in Southern Finland (closest proxy to the Baltic region where such data is available) is 13.85 according to an unpublished report by Keith Briffa (Haneca *et al* 2009, 5). This average is also comparable to present-day Poland, where oak trees have an average of 15 sapwood rings on average; 9-24 in the 90% confidence interval (Ważny 1990).

<sup>19</sup> Although 14 years appears very specific, it should not be over-interpreted, as it is in itself only a proxy for the average number of tree-rings in the sapwood, which could have been considerably greater given that no sapwood-hartwood line was determined. Sapwood rings could vary between 4 to over 50 rings (cf. Heußner 1999, 524).

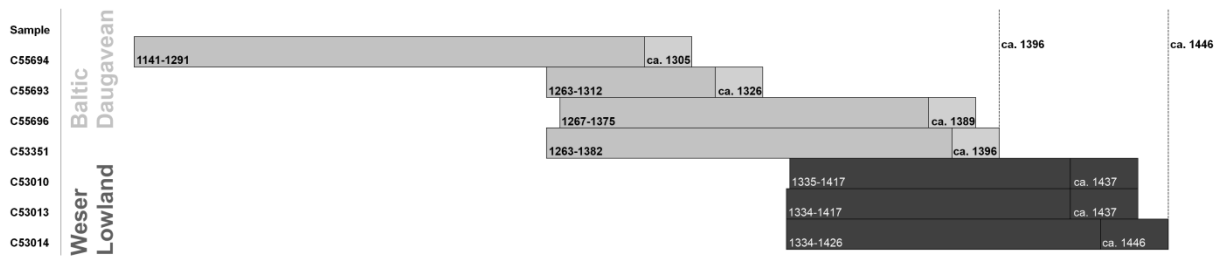


Fig. 5-8. Bar diagram showing the dendrological results of the analysis of the Beluga ship, which fall into two groups: an earlier group of timber cut in the Baltic area (Heußner 2009b, c) and a later group from the Weser Lowland (Heußner 2009a), thus in direct proximity to where the ship was scrapped. Due to the lack of sapwood the cutting dates are approximate values, which may explain the great chronological gaps in the first group (Graph: Daniel Zwick).

### 5.3.3. Construction

In this section, a summary of the construction method is given. A more detailed version is provided in paper C. Although only a slab of planking of ca. 7 m length has survived, the inconspicuous wreck remains contain a multitude of information of the way of construction (Fig. 5-9). The wreck is entirely clinker-built with radially cleft oak planks with widths ranging between 20 - 26 cm and a mean thickness of 2.1 cm. The vernacular — if not downright “antiquated” — way of this wood-workmanship was

to a certain extent preconditioned by the supply of suitable timber, like from wildwood forests, as in the sparsely inhabited eastern Baltic regions.

The planks were interconnected with square-shanked clinker-nails (rivetted nails) with rectangular roves measuring ca. 2.5 x 2.3 cm, and a shaft thickness of 0.6 cm. The lands between the planks were luted with tarred wool. Apart from the lands, also the scarfs were laminarily luted (the term “luting” is contested and is alternatively referred to “inlaid caulking” opposed to caulking material driven into the plank seams after the planks have been joined together).

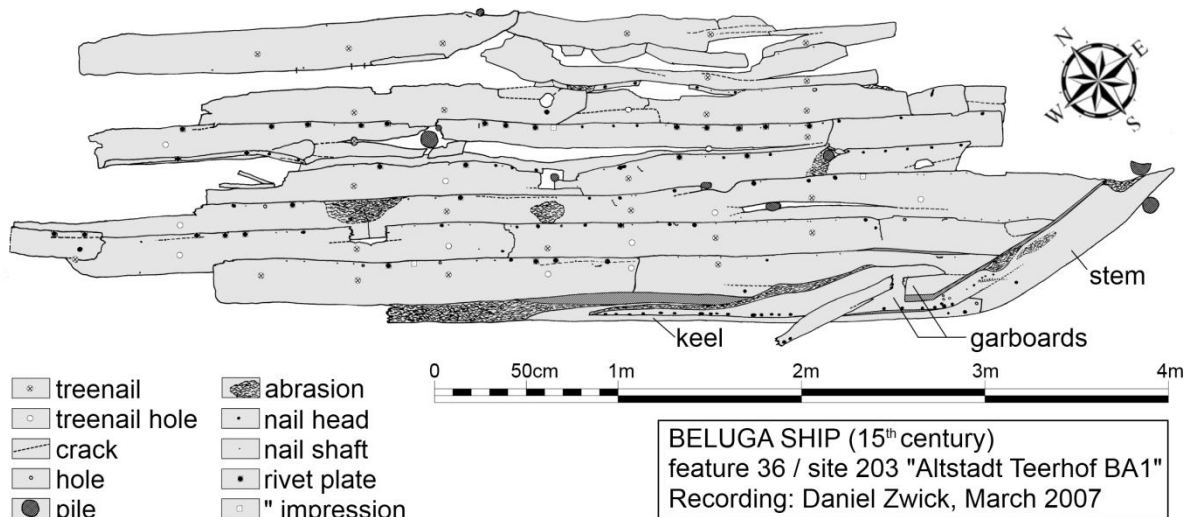


Fig. 5-9. The in situ plan of the Beluga Ship shows the inner side of the starboard planking. On this drawing a loose plank from the second strake was not included and thus the wreck does not show in its maximum extent of 7m. The symbols for the connection elements are slightly magnified (Graph: Daniel Zwick).

The waterproofing technique in vessels built of radially cleft planks was more difficult, as the surfaces were more uneven than sawn planks. This explains the ample quantities of caulking material used. Evidence from Britain, Norway and Denmark has shown that the overlapping lands of clinker

constructions were almost exclusively luted with animal fibres up to the late medieval period, with the exception of scarfs (Auer & Maarleveld 2013, 15).

This was very different in regions in present-day Germany, the Netherlands and Belgium, where

twisted strands of tarred moss was the common caulking material, held in place by laths fastened by caulking cramps or sintels. Moreover planks usually had greater dimensions due to the practise of tangential sawing, where the full diameter of the tree trunk is exploited and the planks interconnected by hooked nails rather than rivets. The principal constructional characteristics observed in the Beluga Ship are typical for Scandinavia, and to a certain extent the British Isles, and very distinctive to contemporary wrecks in the southern North Sea littoral. This includes also the keel and stem construction, which shape is reminiscent of Scandinavian shipwrightry. Both components are connected by a diagonal scarf at a length of ca. 25 cm. The absence of garboard rabbets in the keel indicates a greater deadrise angle than would have been common with T-shaped or plank keels, with the garboards running almost vertically. This would have added lateral stability to decrease side drift. Another criteria on seakeeping capabilities can be inferred from frame distances. Although none have survived, as they had been evidently removed for reuse — indicating that the vessel was scrapped —, rows of treenails indicate their former presence at intervals of 50 cm, a very common distance for small and medium-sized vessels that could also operate under oars. The use of thin radially cleft planks, which would have facilitated a light construction, corroborates this impression.

#### 5.3.4. Interim results, statistical problems and new research questions

The comparative analysis presented by this author has shown that roughly a third of all clinker-wrecks from the North Sea area between 1300 and 1540 were built of oak that was imported from the Baltic Sea region (cf. paper D, tab.1, fig. 5-10). One of the most striking findings is that the Beluga Ship is even more unique than initially thought: In the local context of Bremen it is not only distinctive in terms of construction (cf. Zwick 2012), but virtually the only wreck in the extended North Sea area of that period hitherto known, with planks of a verified and genuinely Baltic — i.e. Daugavian — origin, at least within the remit of this study. To this date, only a few other ship-remains are known to have such provenance, e.g. planks dating between 1320 and 1350 found in secondary use in Stralsund (Grassel

2011, 64f.). Given the general pattern, however, most of the other timbers from the examined period originated from the Vistula region, which raises the question when and in what volume Daugavian timber was exported via Riga.

As previously mentioned, the timber trade from the Daugavian region took precedence over the Vistulian timber in the course of the 16<sup>th</sup> century. This fact puts the Beluga Ship in a special category, as its builders evidently had access to a trade network for Daugavian timber that was not yet as well established as the Vistulian timber trade network.

For the year 1255 a shortage of timber is recorded in metropolitan region of Riga — i.e. 54 years after its foundation — in a written source, which can be attributed to the gradual increase of woodland exploitation (Brown & Pluskowski 2013, 34). Although Daugavean oak timber used for shipbuilding was exported via Riga since 1286, this occurred in negligible quantities. Historical records indicate that oak timber export in any larger quantities — such as wainscots and barrel staves — started in the second half of the 15<sup>th</sup> century, mainly to Bremen, Hamburg and Lübeck (Zunde 1998/1999, 119ff.). This is corroborated by pollen diagrams, suggesting that a significant decline of woodlands in the catchment area of the Daugava River occurred not before the late 15<sup>th</sup> century (Brown & Pluskowski 2013, 34). Thus, the Beluga wreck antedates the upsurge of Daugavean timber export. Could it be seen as a harbinger of a development, in which a new major timber export market developed to meet the growing demand for wainscot timber and other timber commodities?

One possible explanation could be the Scania markets. Forest products from Livonia were traded at least since the early 14<sup>th</sup> century at the Scania trade fair — in Skanör and Falsterbo — which was primarily renowned as herring market (Fossavainen 1994, 23f.). This would have been an important node, where Scandinavians and especially Danes would have had access to goods exported via Riga. Could this explain the amalgamation of a Scandinavian-style construction and wainscot of Daugavean — i.e. Livonian — origin in the Beluga Ship? It certainly would, but naturally final evidence for this likely hypothesis cannot be provided.



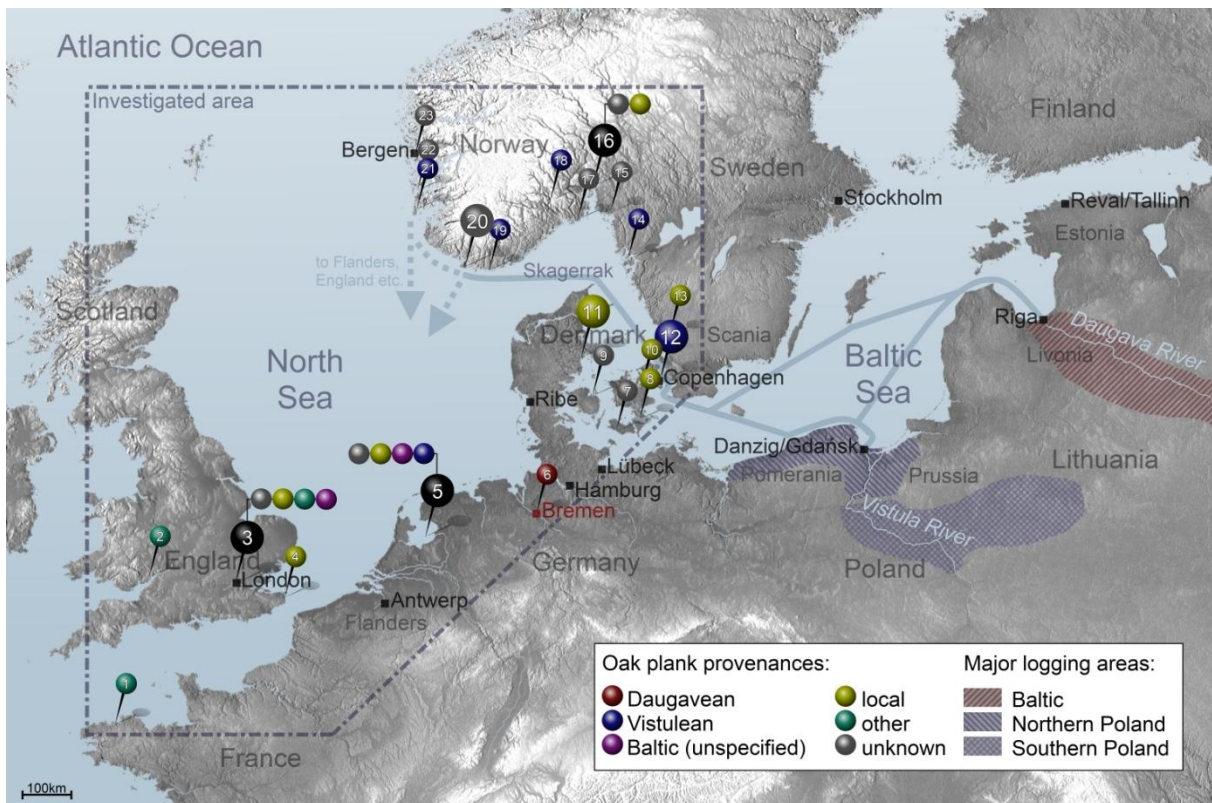


Fig. 5-10: This overview shows the provenances of oak planks from clinker-built shipwrecks dating between ca. 1300 to 1540. Bremen-type vessels are omitted here. The numbers on the pins are itemised as # in table 1 and 3 in paper D (see appendix). The comparison shows that the *Beluga Ship* (#6) is unique in having an ascertained Daugavean provenance, whereas in all other cases they are either “unspecified Baltic” or of Vistulean provenance. This can be attributed to the recent breakthrough in dendro-provenancing, leaving some of the wrecks excavated several decades ago with less precise or no provenances. In other parts dendrology has progressed to determine provenance on a regional scale, as between ‘northern Poland’ — roughly corresponding to Pomerania and Prussia, the latter under the rule of the Teutonic Order. The trade routes from Riga and Danzig as indicated here correspond to the routes detailed in the *Hanseatic Sea Book* (ca. 1470) (Graph: Daniel Zwick).

This research question prompted the principal research question of paper D, namely to identify constructional solutions which were abetted by the availability of high-quality oak as import timber. However, the comparability was very much restricted by a number of factors, which are identified in the following.

Especially in earlier years, when Maritime Archaeology was still in its nascent phase and recording standards of shipwrecks not consistently established, the following constraints need to be taken into account: Shipwrecks were often excavated by land archaeologists or otherwise inexperienced field staff, who did not know the significance of certain constructional details. Shipwrecks were often seen as a single homogenic object, rather than a constructional genesis, in which multi-layered influences become manifest, namely that timber of a wide variety of sources could be used in one wreck, especially in repairs or later rebuilding measures. Therefore very few samples were taken in past decades, which are by no means representative. Moreover, only fairly recently it was possible to

determine provenances precisely. The dataset is distorted by the following factors:

- no average, maximum or minimum dimensions are recorded
- dimensions are recorded, but there is no way of knowing how representative they are. For instance, the longest planks are usually found in the miship-section. This is often not taken into account, especially when only the fore or aft section of a vessel survives. This puts a big question mark on comparing maximum plank lengths, as its statistical evaluation is more likely a reflection of the wrecks preservational state, than the availability of long planks *per se*.
- in cases where plank dimension are provided, indications are lacking in which part of the hull these planks were inserted, and whether they were fully preserved or partially deteriorated. Thus it is impossible to determine, whether — for instance — planks with lesser widths were intentionally manufactured this way, whether they were

tapering planks towards the hood ends, or whether their edges simply deteriorated and were originally wider.

- in several cases where dendrological data is provided, it is not mentioned whether the sample provided sapwood and could be thus dated exactly, or whether a margin was included.
- many reports do not detail from which plank or strake the sample was taken, which is significant, as the choice of planks for the underwater hull could differ for that above the water line (cf. paper D, endnote 45).
- often several dendrological provenances are provided, without indicating whether there is a pattern which part of the hull were built from which timber source.
- the terminology regarding timber-provenance is ambiguous. For instance, for the U34 wreck was mentioned to include both tangentially sawn and radially cleft planks from “southeast Poland / Baltic” region (Overmeer 2006, 68). Upon request, this author learnt that this did not indicate two different felling regions, but it referred to an area somewhere between southeastern Poland and Lithuania (indicated as “Baltic”), thus constituting a single logging area, accessible via the Vistula River system. Moreover, only three samples were taken from the radially cleft planks, thus it is impossible to say whether the tangentially sawn planks originated from a different source (Alice Overmeer, pers. comm. 20.1.2015). This example stresses that even well published shipwrecks may include ambivalent results, and that it is therefore always better to double-check with the excavator to verify the statistical basis from which results were drawn.
- the number and choice where samples are taken is also highly critical. Many clinker-constructions were luted with tarred animal hair in the lands, but moss in the scarfs (cf. Auer & Maarleveld 2013, 15; Thowsen 1965, 45). Many excavators (including this author back in 2007) do not know this and take only one caulking sample in the mistaken assumption that this adequately represents how the vessel was caulked overall.

These were some of the factors which restricted a meaningful statistical evaluation. Thus, the available data, the large gaps therein and the vastly different recording standards put a great challenge on comparability. For this reason, the section titled “Evaluating the link between Baltic timber trade and clinker-built vessels” (paper D) could be only concluded in fairly general terms, tentatively confirming the hypothesis that the plank-dimensions

of most clinker-built vessels were small if compared to the broad tangentially sawn boards, and that roughly one third of all examined wrecks were built of such timber was probably wainscot imported from the Vistulean river basin.

This much anticipated and thus fairly unspectacular conclusion can not only be attributed to the incomplete dataset, but also this author’s choice of comparison. Although the compilation of the data provides a good oversight in its own right, the study (i.e. paper D) bears the mark of a confirmatory bias, as only clinker-built vessels were taken into the equation.

Therefore, the parameters of this study, relating to plank conversion and dimensions, shall be isolated in the following and compared to another major group of lapstrake-constructions, i.e. bottom-based shipwrecks. The latter are often uncritically lumped together with the former as “clinker-constructions”, as their side plankings are also fastened in an overlapping manner. Moreover, the flush-laid bottom-planks are rabbeted in such a way that they gradually overlap in the hood-ends. The lapstrake planks, however, are usually not fastened with clinker-nails, but hooked nails, and are therefore — technically speaking — not clinker-built.

The choice of the right terminology is often causing confusion, as evidenced in an exchange between Arne Emil Christensen and Seán McGrail on the correct use of the term “clenching” and “rivetting”. Christensen (2002, 300) took exception with McGrail’s use of the term clenching, maintaining that no rove is used and the nail tip turned back into the wood, referred to here as “hooked nail” (Fig. 5-6). This has been also inadequately described as “double-clenching” (Steffy 1994, 269) or “cog-nail”. McGrail convincingly demonstrated that Christensen’s critique did not apply here, alluding to the etymological origin of the term ‘clench’ — similar to ‘clich’ or ‘clinker’ — and referred to written sources demonstrating that it was synonymously used to nail tip deformed over a rove (McGrail 2002, 149ff.), which could be also called ‘rivetting’.

Does this imply that — for instance — an English reference to German hulks from 1545 as “*clenchers, both feeble, olde, and out of fashion*” (Friel 1995, 180) refers to clinker-built ships? Nominally yes, but one ought to cast doubt on the reliability of such observations, as clinker-built vessels appeared similar to other lapstrake-constructions to the outside observer, at least above the waterline. This naturally also applies to ship-depictions, as on seals.

In the following section, the extent of the wainscot trade is examined, and the findings merged with the decisive question how the increased availability of wainscot products affected shipbuilding. This time the remit of investigation is extended to include also bottom-based constructions.

## 5.4. Extending the remit of the study

The rationale for the remit of paper D, focussed on the extended North Sea area, including neighbouring sea regions like the English Channel, the Kattegat and Skagerrag, was to assess the distribution of Baltic timber beyond Helsingør, i.e. where the exported products are listed in the Sound Toll Register and thus provide opportunities for a comparative approach. Naturally, the distribution of Baltic timber – both Vistulian and Daugavian – does not reflect only the portion of exported timber, as such timber could have originated from ships built in the Baltic Sea area but abandoned in the North Sea area.

Another limiting factor of the comparative study (paper D) was the focus on modern and traditional lapstrake construction, as defined by Bill (2009b) without considering the bottom-based constructions, which are embedded in the lapstrake tradition too, despite their visual distinctiveness. While the traditional and modern lapstrake constructions often made use of radially cleft timber, and the latter partially tangentially sawn, bottom-based shipbuilding as practised for Bremen-type constructions consistently made use of tangentially processed timber, i.e. broad planks, which were sawn since the early 14<sup>th</sup> century. The only similarity appears that both radially cleft planks and tangentially sawn broad planks were imported from the Baltic region, thus the inclusion of bottom-based vessels is relevant for the general objective of the research question. Thus, the remit is extended to include also bottom-based shipwrecks, while the geographical remit is maintained and only ship-finds that have been successfully dendro-provenanced are considered here.

### 5.4.1. Is there a link between oak imports and shipbuilding?

The comparative analysis on late medieval clinker-built ships and timber imported in the wainscot format (cf. paper D, section “Evaluation the link...”) has regrettably not yielded any deeper insights on whether the steadily growing wainscot export can be linked to a revival of old-fashioned clinker-constructions. The underlying premise of this enquiry was to find out, whether bottom-based ships of the Bremen-type really represented an innovation in its own right or should be rather seen as solution in response to the scarcity of high-quality cleft timber. Oaks with many knots and of twisted, contorted growth could no longer be effectively cleft, and sawn boards needed to be thicker *per se* in order to compensate for the lost rigidity when medullary rays

were severed, as is unavoidable in tangential cuts (Figs. 5-3, 5-11). The greater plank thickness would have entailed a different approach to shipbuilding, as the planks were no longer as flexible to give the vessel any desired shape.

The vantage point of this hypothesis is the Bremen Ship of 1378, where the planks were of such bad quality that during the construction some cracks needed to be patched even before the ship could be launched (Lahn 1992, 44f.) (Fig. 5-12). The oak used for the ship’s construction was floated down the Weser River from the Weser Mountains, and compared to Baltic oak it was of very poor quality. What were the reasons for the use of this timber at a time when higher quality oak was already imported in greater quantities from the Baltic?

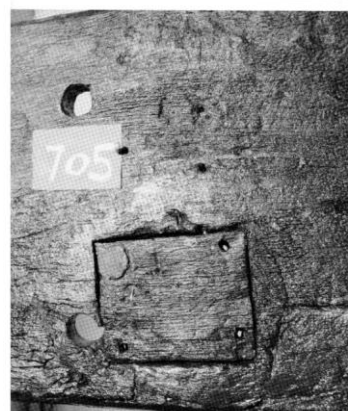


Fig. 5-12. Mended part in the Bremen Ship’s (1378) planking: Patched over crack (top) and bung (left) (Photos: Lahn 1992, figs. 48-49).

Did parts of the Baltic timber trade network collapse in the wake of warfare, or even in the wake of the Black Death Pandemic with recurrences in 1360-63 and 1374? Or was this a coldly calculated cost-benefit assessment of a Hanseatic merchant? To test this hypothesis, the question of the use of Baltic timber needs to be extended to other categories of export timber, but also to ship-wrecks of the Bremen-type, i.e. late medieval seagoing bottom-based constructions. As mentioned above, the comparative analysis of wainscot trade in relation to clinker-constructions (paper D) inhibited a slight confirmation bias, which shall be rectified in this section.

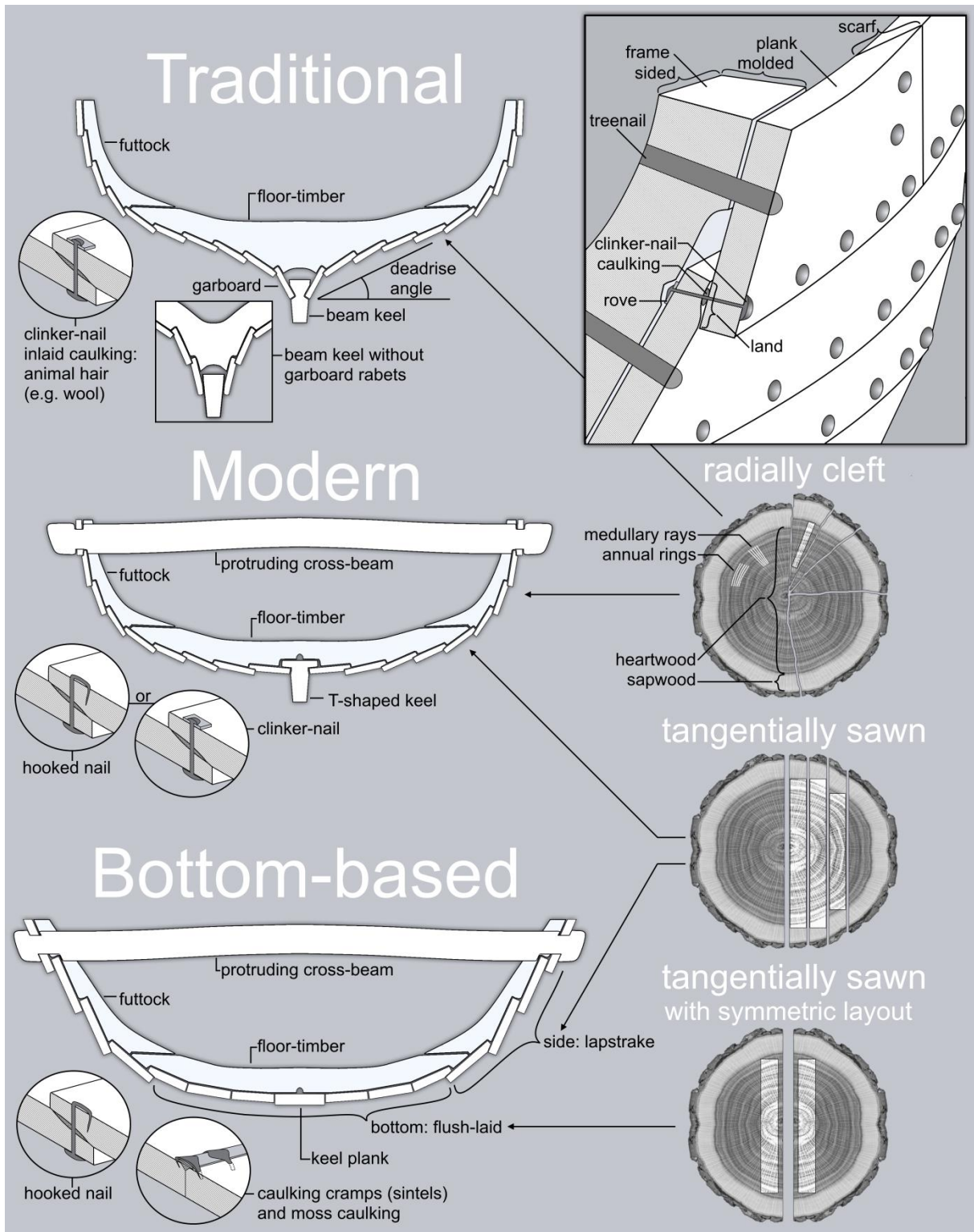


Fig. 5-11. Schematic overview of the three principal late medieval lapstrake constructions. The distinction between 'traditional' and 'modern' types is based on Bill 2009b. The comparative part of paper D only examines traditional and modern lapstrake constructions, but not bottom-based constructions (including the Bremen-type), but in this section such types are also included. The type representations are schematic and modular anomalies apply in several cases. The timber cross-sections as shown on the right side highlight the basic difference of radially cleft and tangentially sawn planks and their use in shipbuilding (Graph: Daniel Zwick).

### 5.4.2. Cog-boards vs. wainscots

The time-span of large seagoing bottom-based constructions from ca. 1150 to 1410 can be significant in this respect. The earliest specimen is the Kollerup Ship of 1150, which antedates the first recorded export of Baltic timber by about 100 years. The trade volume of oak was on a constant rise, and the last vessel of the Bremen-type — the Almere Ship of ca. 1410 (cf. Hocker & Vlierman 1996) — coincides with the peak of Baltic timber imports and the development of whole new logging areas in Lithuania, which timber made already in 1405 the greatest share of all timber exported via Danzig/Gdańsk. Although the bottom-based tradition survived well into the 20<sup>th</sup> century in smaller coastal vessels at the Frisian coast, river barges, and an up-river type of a Severn Trow barge in England, built well into the latter half of the 19<sup>th</sup> century — also featuring the flush-laid rounded bottom and side-planking fastened in the lapstrake fashion (Damian Goodburn, pers. comm.) — the heyday of the Bremen-type as seagoing counterpart was displaced from the seas by either carvel-constructions (paper E, section 9) or clinker-constructions (paper E, section 11). Did the latter experience a revival as the availability of wainscots increased to the proportions of becoming an affordable mass product? And how would the timber category of wide, thick and tangentially sawn planks be referred to in historical documents, which would have been suitable for Bremen-type vessels?

It was suggested that the term *koggenborte* — used in Prussian and Dutch documents in 1386 and 1389 respectively (HR I, Nr. 329) — and *coghenbrede* — as used in Hamburg in 1301 (Kiesselbach 1900, 89) — referred to planks as used in the ‘Bremen Cog’ (Ellmers 2006, 64), literally “cog-boards”. Detlev Ellmers’ assumption is self-referential, as he does not identify any historical documents in which this term is objectively defined, but instead relates them *a priori* to the Bremen Ship — or ‘Bremen Cog’ in his view — as paradigmatic specimen and effectively re-defines *koggenbort* by deducing plank dimensions from this shipwreck. Here he repeats the ouboric fallacy of inference, in the same fashion as the Bremen Ship was defined as cog. In the case of the *koggenbort* however and despite his flawed methodology, he may actually have a point.

There is a document from the year 1404, which makes a quantitative comparison between wainscots and *koggenborte* possible. Unfortunately it does not include measurements but only a price range: 1000 pieces of *koggenbort* achieved a price of 197,1 marks, whereas 1000 pieces of wainscot achieved prices in the range from between 6,9 to 29 marks (Kapfenberger 2003, 27f.). These numbers relate to prices paid by Teutonic Order merchants for Polish

wood — mostly in Thorn/Toruń — or for timber directly shipped to Danzig/Gdańsk. It is striking that the price achieved for *koggenbort* is many times higher than for wainscot, despite the latter refers to the highest quality oak. So it must be the sheer quantitative value, or rather, overall dimensions of a *koggenbort*, which made it so many times more valuable. And indeed, planks in Bremen-type vessels are vastly larger than wainscots. However, did *koggenborts* only found application in the — by archaeologists narrowly re-defined — “cog”, or could this term have generally been used for all large lapstrake constructions? As argued in section 2.3 the term “cog” may simply refer to a large ship rather than exclusively a seagoing variant of the bottom-based tradition. Wide sawn planks that could have been referred to as *koggenbort* could have been also used for entirely lapstrake-built vessels like the U34 wreck from the Netherlands, which had radially cleft planks with widths of 30-40 cm and tangentially sawn planks with widths of 50-60 cm (Overmeer 2006, 66ff.) — the first were possibly referred to as wainscots and the latter as *koggenborts*.

In the opinion of this author, it is not possible to strictly associate *koggenborts* with Bremen-type vessels, but all lapstrake constructions where wide planks were used. *Koggenborts* may have even been used as strong ceiling planks in clinker-constructions, like in the Skernøysund 3 wreck. Conversely, wainscots would have not only been used in clinker-built ships, but also carvel-built ships, like in the ship built in Wismar for Duke Johann Albrecht in 1561 for which 100 pieces of *Wagenschoth tho Pannelwergk* were listed (Olechnowitz 1960, 200). Radially cleft wainscot boards would have been well suited as panelling of the superstructure, as they would have weathered better without forming cracks in exposed maritime environments —dampened by spray-water and dried in the sun —, because due to radial splitting their medullary structure was left intact.

### 5.4.3. Choice or necessity?

Last not least, the question was raised whether the availability of Baltic oak timber may have abbetted the construction of clinker-built vessels at the expense of Bremen-type vessels (Fig. 5-13), which appear to have disappeared from the scene in the early 1400’s.

A similar question was asked by Line Dokkedal (1996, 43) on whether ships built of tangentially sawn planks were more economic to construct than clinker-constructions. In the table below, all shipwrecks with a ‘Baltic’ provenance (from paper D, table 1) were isolated and compared with several Bremen-type vessels (Tab. 5-2). A general pattern emerges, according to which tangentially sawn planks were longer, wider — often twice as wide — and much thicker than radially cleft planks.



Fig. 5-13. One of the most recently discovered Bremen-type wrecks: The Doel 1 wreck from ca. 1326 in situ in an upside-down position (Photo: Archeologische Dienst Waasland).

Although Dokkedal compared a different set of shipwrecks, her observations were similar. She endorsed Detlev Ellmers' (1994, 39) hypothesis that work-time could be saved if working with wider and longer planks, as this would have reduced the number of lands and scarfs that needed to be fastened and caulked, which — together with the cumbersome fitting of each plank — was most time-intensive (Dokkedal 1996, 58). She associated this with a rationalisation process and concluded that it must have been cheaper to build Bremen-type ships. Here one may object that *koggenborts* were far more expensive than wainscots by a factor of 6,5 up to even 28, when wainscot was especially cheap. However, given the dimensions, one *koggenbort* would be approximately the equivalent to 4-8 wainscots. The *koggenbort* may have still been more expensive, but its use may have outweighed the costs for labour. Another possibility why *koggenborts* could have been drastically more expensive is, that (if we accept the premise that large Bremen-type ships were commonly called cogs) two planks cut from the same tree were used symmetrically in the construction of the ship, thus producing two high-quality planks but at a horrendous cost in wastage (Fig. 5-11) (e.g. Vermeersch & Haneca 2015).<sup>20</sup>

Conclusively, it can be stated that the plank format is not necessarily indicative of a scarcity or restricted access to a timber trade network, as most of the Bremen-type shipwrecks had also Vistulean radially-cleft planks used elsewhere in the construction, e.g. as repair pieces, fillers, dunnage or ceiling planks.

Conversely, a clinker-built vessel where radially cleft planks were used for the hull construction could also include sawn boards, as in the Skjernøysund 3 wreck, where tangentially sawn ceiling planks and stringers were inserted (Auer & Maarleveld 2013, 19f.). This demonstrates that shipbuilders had access to a wide variety of formats and that the choice most likely reflected the shipbuilder's preference. Even low quality timber, as used in the Bremen Ship, is not necessarily indicative of a scarcity, but may reflect a sober — if not shrewd — cost-benefit assessment: It may have been cheaper to patch over some cracks and knots and to use local timber rather than higher quality but more expensive *koggenborts* from the Baltic.

Last not least, the question needs to be addressed whether the increasing availability of high quality Baltic oak heralded the decline of Bremen-type constructions in the early 1400's in favour of a revival of clinker-constructions. The table above is suggestive of this, as clinker-built vessels where Baltic timber was used start to increase dramatically in the late 14<sup>th</sup> century, while the Bremen Ship was one of the largest later representatives of its kind, only surpassed by the Skanör Ship in date and size, followed only by several smaller variations, particularly in the Zuiderzee area. It has to be said, however, that the above table is not complete, so there is no compelling evidence — at the moment — to answer this in the affirmative

<sup>20</sup> I am indebted to Frederick Hocker for pointing out the possible significance of plank symmetry in this context.

Wreck	Date + = terminus post quem - = terminus ante quem	Estimated length (m)	Find location	Country	Provenance	Plank	radially cleft	tangentially cleft	plank length cm (max)	plank width (cm)	plank thickness (cm)	Reference
Doel 1	1326 1340	21	Doel	BE	NW-Germany NW-Germany Poland	bottom side repair	X X	X	777 1082 162	31-55 35-45	3.5-6.8 4.0-5.0	Vermeersch & Haneca 2015
Doel 2	1333±7 1342±9	14+	Doel	BE	N-Poland	bottom ceiling repair	X X	X	793 +597 221	42-46 36-43 10-24	6.0-7.0 4.0-6.0 1.0-3.7	Vermeersch <i>et al</i> , forthcoming
Vejby	1372	16+	Vejby	DK	N-Poland	bottom ceiling dunnage	X	X	+875 885 252	ca. 40 ca. 42 12-25	ca. 6.4 ca. 5.4 1.5-5.0	Bonde & Jensen 1995, Thomsen 2002
Bremen	1378	24	Bremen	DE	NW-Germany		X	X	952	41-65	3.8-6.5	Lahn 1992, Daly 2007, 115
Bole	1386 ± 10	20+	Skienselva	NO	N-Poland		X	X				Nævestad 1998, 180ff.
Skjernøysund 3	1396 1390	26+	Skjernøysund	NO	Poland	bottom ceiling	X	X	870 +646	33-38 49	4.0-5.0 8.0	Auer & Maarleveld 2013
Avaldsnes	1392 +	22	Avaldsnes	NO	N-Poland					35	4.0	Alopeus & Elvestad 2004
Beluga	1396+ 1446+	8+	Bremen	DE	Daugavean NW-Germany	lower strakes repair	X X		400	20-26 20-26	ca. 2.1	<b>paper C &amp; D</b>
Gdansk W5			Gdansk	PL	NW-Poland							Krapiec & Krapiec 2014,145
Dokoen 2	1405/1425	10+	Copenhagen	DK	N-Poland		X	X				Gothche & Host-Madsen 2001
G35	1422 ± 6	19	Zuiderzee	NL	Netherlands							Overmeer 2006, 51; forthcoming
Dokoen 3	1423 ± 3		Copenhagen	DK	Poland		X	X		24	2.8	Nielsen forthcoming
Skaftö	1430 +	25	Skaftö	SE	N-Poland		X			35-40	3.5-4.0	von Arbin 2014
U34	1528 ± 6	30	Zuiderzee	NL	SE-Poland		X			30-40	4.3-5.3 5.0-6.0	Overmeer 2006, 66ff.
O28	1535 ± 5	17	Zuiderzee	NL	'Baltic'			X				Overmeer 2008, 51

Tab. 5-2. All shipwrecks from paper D's table 1 containing planks of 'Baltic' origin are compared here with shipwrecks of the Bremen-type, hachured in grey.

## 6. WRECKED IN THE RUBBLES OF THE LIVONIAN CONFEDERATION: EVALUATING THE TRANSPORT GEOGRAPHICAL CONTEXT OF A SHIPWRECK AND A CASTLE (16<sup>TH</sup> CENTURY)

The thesis is concluded with a case study from the last remaining northern crusader state — the Livonian Confederation. While section 4 dealt with shipwrecks from a time characterised by a formative phase, in which new coasts were explored, conquered and settled, this section deals with the same region 300 years later, in a phase marked by decline and state collapse. Shipbuilding went through some considerable changes, notably by the advent of the

carvel technique, but in the local economy ships were essentially still built in a medieval technique and the following case study illustrates such a construction at the verge of early modern shipbuilding. In this section the question is raised, whether the eventful historical context may have affected the wreck's peculiar construction and circumstances of deposition.

### 6.1. The Maasilinn Ship

Thirty years ago – in 1985 – a shipwreck was discovered in the Väike-Väin Sound, dividing the western Estonian islands of Saaremaa (German: *Ösel*) and Muhu. It was situated 370 metres off the coast of the island of Saaremaa at a depth of 3 metres, in a natural harbour at the foot of the castle ruin of Soneburg (Fig. 6-1) (Mäss 1991, 315; Mäss 1994b, 191). It was excavated, lifted and freeze-dried in 1987 to prepare for exhibition (Mäss 1994a, 97), but owing to the relatively new field of underwater archaeology

and the lack of experience, only partially recorded and sampled. The shipwreck dates into a period marked by intensified castle building and fortification in a last but effectively vain attempt to avert the downfall of the last Baltic crusader state – the Livonian Confederation. There are several indications that the wreck's peculiar way of construction, residues of slaked lime and traces of fire can be linked to historical events. Thus it shall be revisited and contextualised in its maritime transport geography.

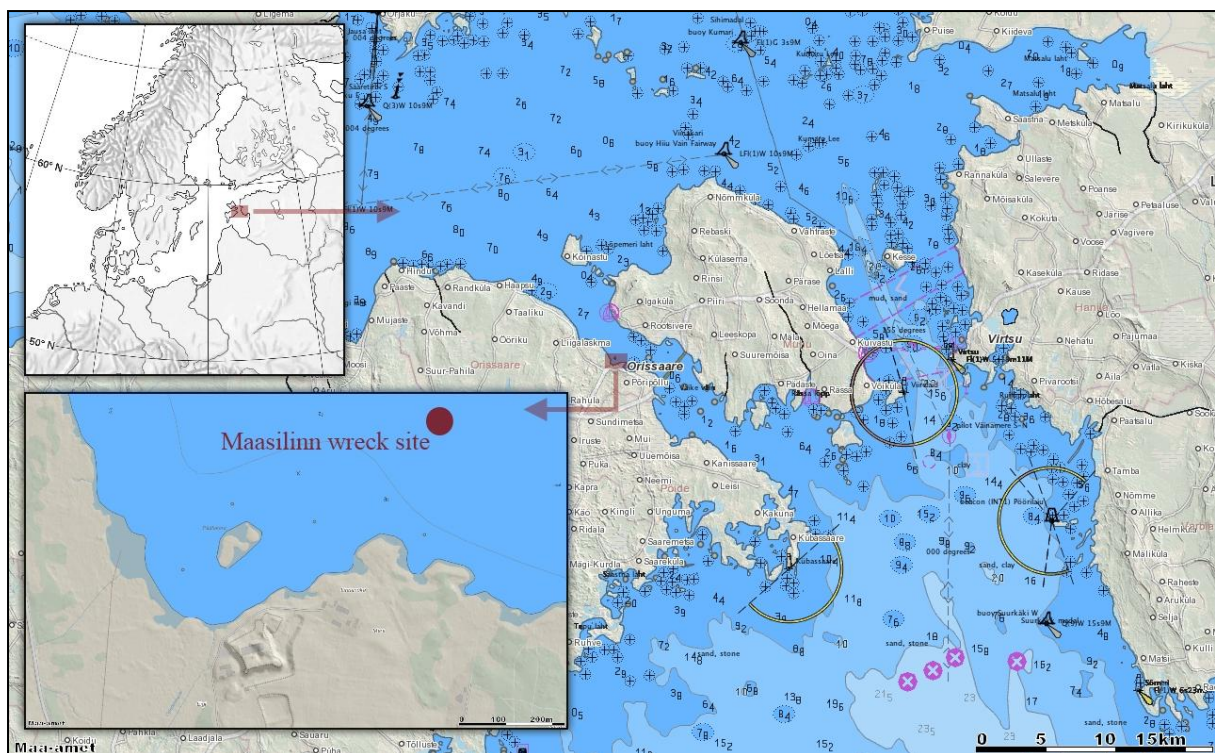


Fig.6-1. The approximate site of the Maasilinn Wreck off the castle ruins of Soneburg, the outlines of which are indicated in the contour map. The site is located in the Väike-Väin Sound, dividing the island of Saaremaa and Muhu (Map source: <http://xgis.maaamet.ee/xGIS/XGISwithownmodifications>).



### 6.1.1. Date, provenance and workmanship

The analysis of samples taken from the clinker planks indicate felling dates between 1543 and 1546 (Aluve & Pärt 1986, 5f.). Almost the entire hull was built of pinewood<sup>21</sup>, which was cut locally in Western Estonia (Aluve & Pärt 1986, 5f.). It is believed that the use of a local softwood species can be attributed to the wreck's local origin at the fringe of the northern oak timber-line (cf. Arens 1986, 47). While oak would have been the preferred species for shipbuilders, its limited availability or high cost were probably deemed a worse trade off, than excepting losses on durability. Thus, the imminent use must have been considered a more decisive factor for the vessel's envisaged purpose. The low investment is also reflected in the rough and archaic workmanship. The knotty wood has been little shaped during the assembly of strakes and insertion of frames (Arens 1986, 47). Both factors, the choice of materials and the workmanship, indicate its purely utilitarian purpose with respect to short-term operability.

Nonetheless, the addition of a secondary layer of carvel planking must have presented a major effort. In similar constructions, this was achieved by the cumbersome use of fillers — triangular in cross-section — to smoothen the exterior stepped surface of the clinker-planking for an additional layer of carvel planking. This was not the case here. Neither was caulking material observed nor samples taken by the excavators.

### 6.1.2. Construction

The Maasilinn Ship is the hitherto earliest known type of wreck, in which a secondary layer of carvel planks were fastened on top of an originally clinker-built hull. It has recently been aptly suggested to refer to this type as “converted clinker” (Grundvad 2010, 4), a suggestion that is adopted here.

To an outsider, this vessel would have looked akin to a carvel-built vessel. With a length of up to 16 m, a beam of ca. 5.5 m, it would have been a small to mediocre-sized vessel without a great draught, thus enabling it to call at small rural or natural harbours. Traces of fire were detected and only the forepart and bottom remained preserved (Mäss 1991, 316). Although the vessel was referred to as being possibly an *nisk*, a local cargo carrier similar to the Finnish *haaksi* or Swedish *baxe* (Mäss 1994, 192) we will not go into the question of the local term, as

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<sup>21</sup> The claim that also maple was used (cf. Ilves 2002) was objected by the excavator (Vello Mäss, pers. comm.). Maple would have been even less suitable for shipbuilding than pine.

converted clinker vessels were a pan-Baltic phenomenon, and the type-name would refer to a regional term rather than construction.

#### 6.1.2.1 Keel and stem

A notable feature is the keel construction. The frames are not directly fastened to the keel, resulting in a deep bilge-well (Mäss 1991, 316). This feature would have allowed the bilge water to gather at the lowest point of the hull, so that it could be bailed or pumped out, leaving the cargo dry (Mäss 1991, 317).

Ilmar Arens suggested that the outer carvel shell was added at a later stage and the garboards were in fact originally the rudiments of a former keel, which was hollowed out and a new keel was fastened underneath (Arens 1986, 47). He justified this by pointing out that the notches that would have flanked the “original keel” must be limberholes and that the original keel must have been therefore directly fastened to the floor-timbers (Fig.6-2A).

However, this assertion was not backed by observation and keel-to-floor fasteners should have been easy to identify archaeologically. Moreover, the whole assertion seems to be based on a schematic sketch, according to which the notches could also — more likely — be part of the joggled surface of the frame, to receive the upper edges of the clinker planks (Fig. 6-3). Vello Mäss likewise disagrees with this interpretation and points out that frame nr. 5 extends into the bilge-well, thus indicating that the deep keel is an original feature (Fig. 6-4) (Mäss 1991, 318).

Although a singular frame is not necessarily indicative of sequence, as it was not dated and could have been inserted at a later point, like a frame in the FPL-77 wreck (Auer 2009, 13, note 8), there are good reasons to believe that the deep keel was an original feature. However, Mäss' conjecture that the clinker and carvel phases must be synonymous (Fig. 6-2B) because of the thinness of the clinker-built shell would have “lacked structural integrity” (Mäss 1991, 318) must be equally dismissed. Planks with a thickness of 2.5 cm and a height of about 20 cm were not uncommon in late medieval clinker-built ships and these dimensions are typical for radially cleft planks (cf. paper D, tab. 1). In Danish shipbuilding almost exclusively cleft planks were used for clinker-constructions as late as the 16<sup>th</sup> century (Bill 2009, 256). This raises the question of building sequence, i.e. whether both layers were synonymous or if the carvel planking was added during a later rebuilding, which will be addressed in the following section in more detail.

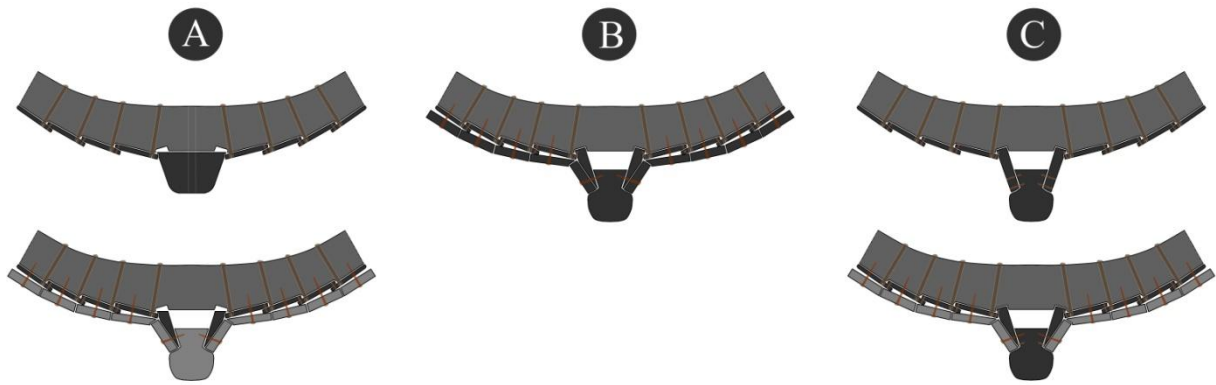


Fig.6-2. Schematic reconstruction of building sequence (A) Arens' reconstruction, based on the assumption that the garboards are in fact rudiments of a keel and — what has been elsewhere interpreted as recesses for the garboards — as limber holes. (B) Mäss' reconstruction assuming a simultaneous phase for both layers of planking. (C) Alternative sequence proposed by this author (also endorsed by Vello Mäss, pers. comm 18.10.2013) if the carvel planking was added at a later stage, in which case the clinker-garboards were adzed off. Treenails are shown in brown and iron nails in red, the shading indicates sequence, i.e. the darker the earlier (Graph: Daniel Zwick).

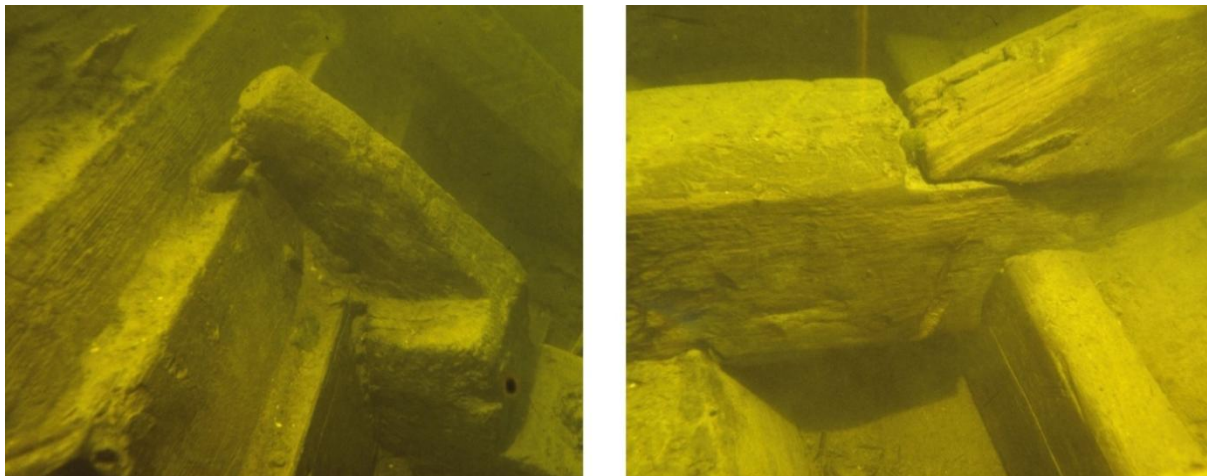


Fig. 6-3. In-situ photo of the wreck, where the fittings did not come loose yet. Left: treenails protrude the clinker planks right above the landings. Right: The garboard strakes that form the keel-well are rebated tightly into the floor timbers, which cast doubt on Arens' interpretation as limber-holes (Photos: Vello Mäss).

Before addressing the building sequence, however, another noticeable feature of the Maasilinn wreck should be mentioned: The stem-keel connection. It is fastened with a mortise joint rather than a hook or vertical scarph, as has been customary in preceding centuries. Similar mortise joints in stem-keel connections can be also observed in other clinker-built vessels around 1500 in Dutch shipyards (Reinders & Oosting 1989, 107), as well as Dutch carvel-built shipwrecks dating to ca. 1583 and ca. 1627 (B&W 1 and 5, cf. Lemeé 2006, 148ff, 233ff.). This novel technique would have reduced the need for crooked timber, but more difficult to implement, as Jan Bill points out (Bill 2009, 256). Although crooked timber was used as stem knee in the

Maasilinn wreck, the available crooked timber might not have had the necessary dimensions for the actual keel-stem transition. The fact that even the keel was made of material normally not preferred by shipbuilders — i.e. fir (Vello Mäss, pers. comm.) — indicates a shortage or restricted access to certain timber species, which might have made this solution necessary. Both, the distinctive keel construction and the keel-stem mortise have been addressed as possible ideosyncratic feature of an ancient Estonian shipbuilding tradition (Mäss 1991, 318). However, both features are not as unique as initially thought, and parallels can be found throughout the Hanseatic sphere, particularly in the Baltic Sea.



*Fig. 6-4. This photo shows the inner part, featuring the bilge-well and frame 5 (Photo: Vello Mäss, modified by the author).*

### 6.1.2.2. Building sequence

Regrettably, there are no dendrological results yet to answer the pressing question of whether the Maasilinn wreck's carvel planks were added right after

the clinker-built hull was completed, as conjectured by Vello Mäss, or at a later stage during rebuilding, as believed by Ilmar Arens. Three similarly constructed 16<sup>th</sup>-century wrecks may help to elucidate this question further (Tab. 6-1).

		Maasilinn	FPL 77	W-36	Dėbki
	Find location	Maasilinn (EE)	Darss (DE)	Gdynia (PL)	Dėbki (PL)
	Length	ca. 16 m	ca. 10 – 12 m	ca. 15 - 18 m	> 9.2 m
Clinker layer	Date	after 1546	ca. 1590	after 1596	1618, 1638
	Provenance	Western Estonia	Øresund region	Vistula Bay	Germany
	Material	mainly pine, partly ash	oak with sapwood	oak	mainly pine, partly oak
	Timber conversion	cleft (?)	radially cleft	sawn	tangentially sawn
	Plank width	19 cm	20 - 25 cm	32 - 35 cm	36 cm
	Plank thickness	2.5 cm	2 - 3 cm	3 cm	3 - 3.5 cm
	max. plank length	-	368+ cm	370 cm	-
	Connection: scarfs	-	20-30 cm	(vertical) 30 cm	13cm
	Luting	-	animal hair	animal hair	animal hair
Carvel layer	date	-	ca. 1590	After 1596	1598, 1605
	provenance	?	Wendish Quarter	Southern Baltic	?
	Material	mainly pine, ash	oak	pine	pine
	Filler material	-	fir, pine fillers	pine fillers	pine
	Timber conversion	sawn	tangentially sawn	sawn	tangentially sawn
	Plank width	19 cm	< 48 cm	23 – 31 cm	17-22 cm
	Plank thickness	4.1 cm	4 cm	3 cm	6 cm
	Plank length	-	< 516 cm	-	-
	Connections: joints	-	butt-end	-	traverse
Caulking	?	?	?	moss	
Ceiling	Date	n.a.	simultaneous to carvel layer	?	simultaneous to carvel layer
	Plank width	n.a.	-	-	16 cm
	Plank thickness	n.a.	4.5 cm	-	4.5 cm
Skeleton	Keel construction	T-shaped	-	T-shaped	-
	Keel – floor timber	not connected	-	not connected	Bolted 22cm
	Floor timber - futtock	-	scarf joints or flush abutment	rebated, partly added sideways during rebuilding	not connected
	Frame scantlings width/thickness	19 cm / -	8 - 21 cm / 9.5 -15 cm	15 cm / 10 cm	11 - 18 cm / 11 -18 cm
	Frame spacings	Closely spaced	15 cm	60 cm	20 cm
	Fr. provenance		mainly Øresund, 1 frame from the Wendish Quarter		
	Fr. date		ca. 1590		
References	Arens 1986, Mäss 1991, 1994 and pers. comm	Auer 2009, Auer pers. comm., Grundvad 2010, 2011	Ossowski 2006, ibid et al 2005 and pers. comm	Ossowski 2006, ibid et al 2005 and pers. comm	

Tab.6-1. A structural analysis of the Maasilinn Wreck in comparison to other 16<sup>th</sup>-century and early 17<sup>th</sup>-century clinker wrecks with a secondary layer of carvel planking.

In the case of the FPL-77 wreck<sup>22</sup> two building phases could be identified on the grounds of structural rather than chronological sequence.<sup>23</sup> It has been sailed as clinker vessel for quite a while, before

it was converted — if only superficially — into a carvel vessel, as indicated by the replacement of nails and plugged former nail holes (Auer 2009, 15; Grundvad 2010, 16f.). This is further corroborated by the dendrological results: The clinker planks were felled in the Øresund region with 1577 as *terminus post quem*, and the carvel planks were felled in the Wendish Quarter with 1589 as *terminus post quem* (Daly 2011, 113ff.) (Fig.6-5).

<sup>22</sup> The same wreck is referred to as "4AM Wreck" in Daly 2011.

<sup>23</sup> Felling dates are not always a good indicator, as is exemplified in the Dėbki wreck, where the felling dates of the carvel planks even predates that of the clinker planks: Not all planks were immediately used, but may have been stored for a certain time.

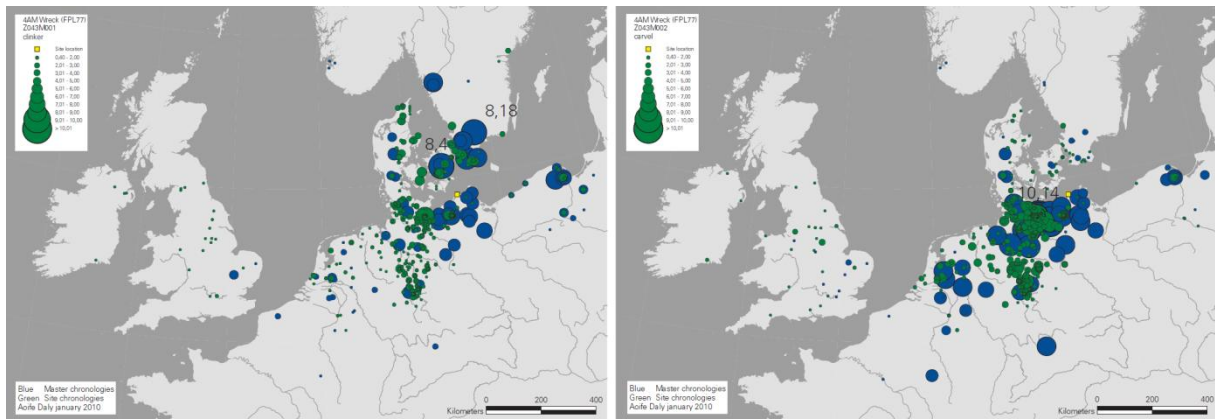


Fig. 6-5. The plank analysis of the FPL-77 wreck showcases a distinctive origin for each group of planks: The clinker planks (left) most likely originated from the Oresund region with the highest  $t$ -values for Zealand (8,4) and Scania (8,18), and the carvel planks (right) probably originated from a region, which could be captured as the Hanseatic's "Wendish Quarter". The yellow dot indicates the location of the actual wrecksite (Daly 2011, figs. 4-5).

Unfortunately, it remains unknown whether the carvel planking of the Massilinn wreck originated from a different region than its clinker planking. The tool-marks indicate that the clinker-planks were worked with an axe – thus probably radially cleft – whereas the carvel planks feature saw marks (Mäss 1994, 193). Nonetheless, further details can be inferred from similar wrecks. The FPL-77 wreck's ceiling planks were added at the same time as the carvel planks, as indicated by treenails that transect both (Auer 2009, 15), and exactly the same observation was made in the Dębki wreck (Ossowski et al. 2005, 354). However, in the case of the latter, the clinker and carvel phases could not be so clearly distinguished as in the former, and it was even conjectured that both phases might be synonymous. Waldemar Ossowski argues that the absence of a keel-to-frame fastening on the one hand, and the absence of a keel-to-clinker-garboard fastening on the

other hand, indicate that both layers are simultaneous (Ossowski 2006, 262). There might have been initially a connection between keel and clinker-garboards, but the lower ends were notched out to receive the garboards of the carvel planks. The same could be argued in case of the Maasilinn wreck (Fig. 6-2C). Despite the absence of chronological data that would allow to determine whether both shells are simultaneous or consecutive, an observable constructional feature is at least suggestive for a simultaneous construction in the Maasilinn wreck: Each frame is connected to a plank with two treenails, one of which is placed in the landing/plank overlap, suggesting that they were driven in with little regard for the clinker planks, probably from the inside (Figs. 6-5, 6-7). In some cases the treenail holes are even directly situated at the plank edges (Fig. 6-6). This might have weakened the clinker-to-frame fastenings and certainly affected water-tightness.



Fig. 6-6. Some of the treenail holes were drilled through the land, often directly at the edge of the plank, as the yellow arrow indicates (Photo: Vello Mäss, modified by the author).

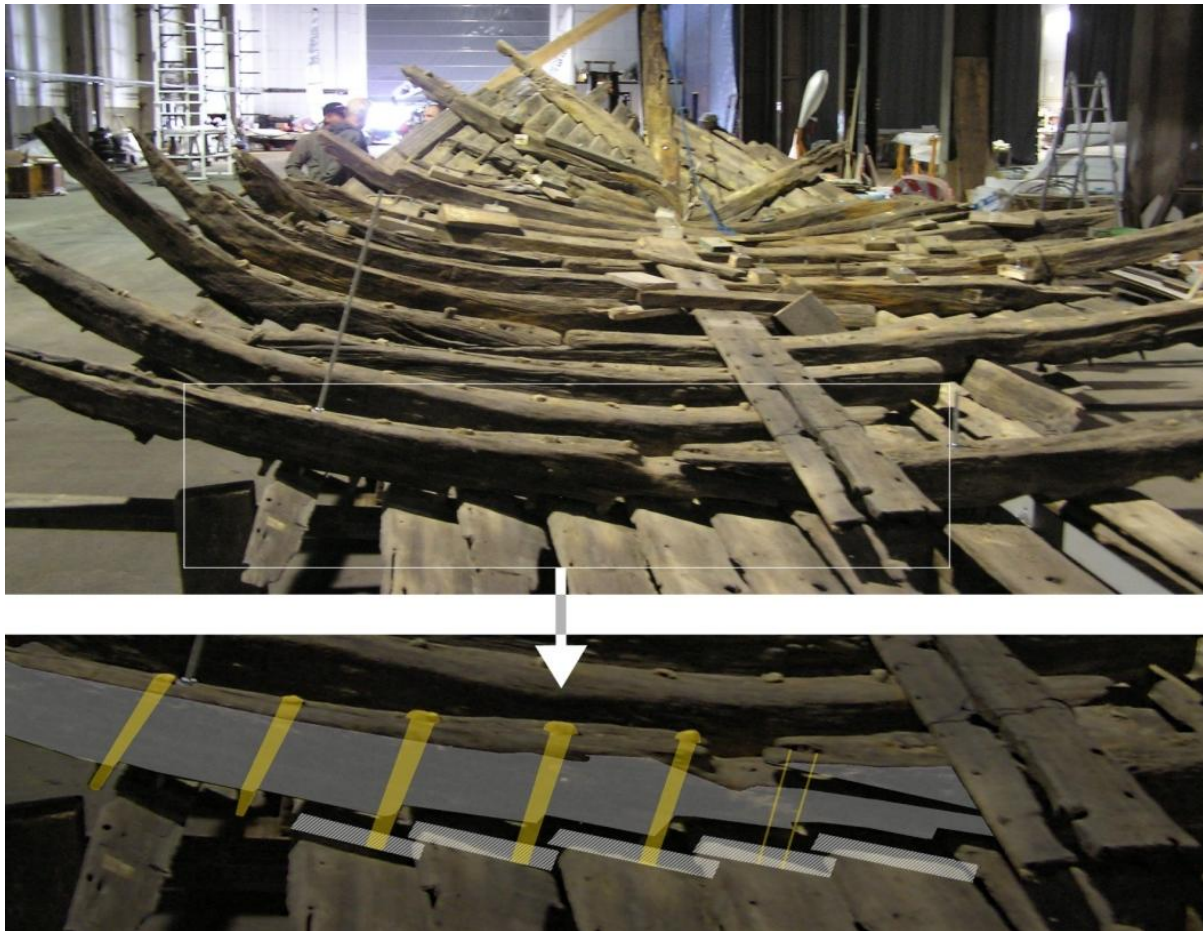


Fig. 6-7. Cross-section roughly sketched in: The featured frame shows a floor-timber was assembled from multiple pieces and the treenails — as also highlighted in previous figure — are driven in very close to the landing (Photo: Vello Mäss / edited by this author).

The second shell of carvel planks were nailed on top of the former with iron spikes (Arens 1986, confirmed by Vello Mäss, pers. comm.). This is a distinctive feature, as in none of the other wrecks from this period carvel planks are fastened in this fashion, but with treenails. Is there a link between the inadequately placed treenails in relation to the carvel planks? They seem to have been added in a makeshift manner by nailing them on top of the inner shell, rather than properly fastening them with treenails. At the recovery of the wreck, most carvel planks simply “fell off” (Vello Mäss, pers. comm.), certainly due to the corrosion of these iron nails. The use of iron spikes to add a second layer is only known from a fairly modern vessel from the times of the industrial revolution: In the case of the Nors Å wreck, factory manufactured nails were used to fasten the carvel planks. This was usually done to extend the life time of old and worn ships known as *Sandskuder* in Denmark, putting them into an “envelope” (Göthe 1985, 304). If the carvel shell was meant as an envelope, this would clearly indicate a much later date for the carvel planking, perhaps even after the

collapse of the Livonian Confederation and when the Island of Saaremaa became Danish.

Similar to the Danish *Sandskuder*, in Sweden a type of vessel was known as *Roslagsjakter* — still present around the turn of the 19th century — where a clinker-built hull was clad in flush-laid planks. This was called *halvsuning*, and was done whenever the original clinker-built hull became old, leaky and abraded (Pettersson 1969, 14). The recently discovered — but still undated — Kvarnholmen II wreck near Stockholm has a length of 15 m and a beam of 5 m and is entirely built in pine, thus very similar to the Maasilinn wreck in terms of overall dimensions and the excessive use of softwood. In addition to the clinker-planks, a secondary carvel planking was added; planks twice the thickness of the former (Lindström 2011, 14f.) (Fig. 6-8). Lindström suggests that the second layer was added because the clinker-planking was worn out. The overall degree of deterioration, however, is very advanced, which relativises this impression.

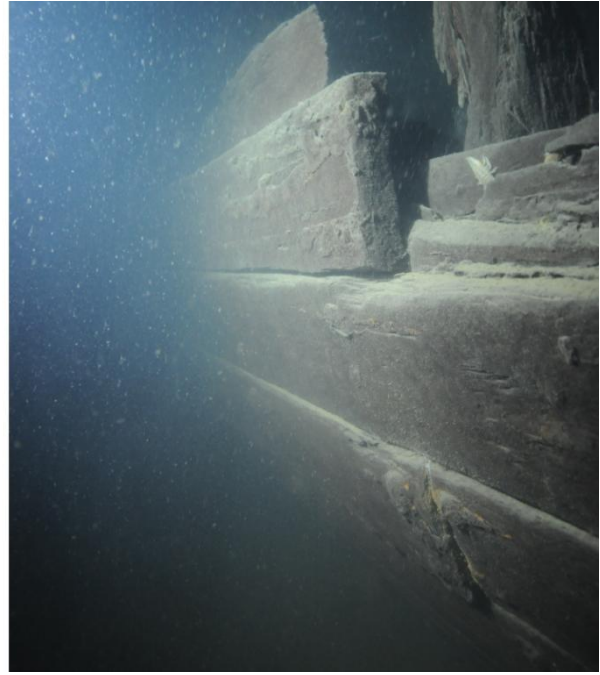


Fig. 6-8. The Kvarnholmen II wreck in situ. Clinker-planks on the inside (left), covered by flush-laid planks on the exterior side (right) (Photos: Jens Lindström, Sjöhistoriska Museet).

Although Vello Mäss strongly favours a simultaneous sequence, the archaeological evidence is still too ambivalent to make a solid assertion on sequence. The early modern finds indicate a consecutive sequence for the planking on the grounds of extending the life-span of a worn-out vessel, but the possibility of a simultaneous phase should not be ruled out for all 16<sup>th</sup> century wrecks. As stressed earlier (paper B, 52), analogous features do not necessarily indicate a singular branch of development. The underlying reason for an occularly similar technological solution may have different causes. Therefore, different factors will be assessed in the following section, which may have caused this technical solution in the Maasilinn wreck.

### 6.1.3. The significance of the secondary carvel skin

The outer carvel planking of the Maasilinn wreck would have struck an outside observer as a fairly innovative feature. Clinker-built vessels would have been still the most common type of vessel in the north-eastern part of the Baltic Sea, particularly in small rural harbours. The particularity of the additional carvel layer in the Maasilinn wreck cannot be understood in isolation from what could be called a ‘Carvel Revolution’ (paper E, section 9). Although it has not been directly affected by the wave of innovation, as it is a carvel vessel by analogy only, it is nevertheless the earliest known wreck to feature this peculiar construction. Four different factors were identified, which may have brought about this constructional solution.

#### 6.1.3.1. The utilitarian factor: Maintenance and repair

The practise of adding a secondary layer of carvel planking has been often ascribed to maintenance and repair, as was demonstrably the practise in early modern times, with the *Sandskuder* and *Roslagsjakter*. Carvel planks were indeed easier to replace, as they were merely fastened onto the outer side, whereas clinker-planks were fastened to each other, and thus had to be clumsily inserted. Moreover, it eased driven caulking, as it could be done from the outside, as opposed to the inlaid caulking material which must have been also difficult during repairs (cf. Grundvad 2011, 25ff.; Hasslöff 1970, 62). Thus, the decision of fastening carvel planks on top of the clinker planks could be attributed to a solution that could potentially save a lot of time, only at the expense of building material. The ready availability of wood in the heavily forested areas in the east could have been a decisive factor for double-hulled constructions being restricted to the Baltic Sea, so that an increased expenditure of resources was deemed a better trade-off than the time and workmanship. A 1587 account from a carpentry workshop in Elbing states that a vessel was reinforced with 24 ‘hull planks’ of oak by means of an additional outer layer and oakum and moss caulking (Gierszewski 1961, 80 acc. to Ossowski 2006). This suggests that in this instance the addition of a second layer of planks was related to water-tightness. In the case of the Maasilinn wreck, however, the carvel planks were simply nailed on top of the clinker planks. Neither filler planks nor caulking material has been noted by the excavators, which would have been essential for water-proofness.

The latter would have been an obvious feature for the excavators to mention, if it was present in great quantities, so its apparent absence indicates that the carvel shell cannot — at least not primarily — be linked to problems related to water-tightness.

#### 6.1.3.2. The environmental factor: The shallow-water coastal environment

It is notable that the Western Estonian Islands (Lääne-Eesti) had no single deep-sea harbour, which may explain the strengthened bottom construction (Mäss 1994b, 191). The use of the term harbour in medieval sources does not indicate built structures such as breakwaters, jetties, quays or piers, but often refers to a sheltered roadstead, where vessels anchored and their cargo transhipped with lighters. The Väike-Väin Sound, dividing the islands of Saaremaa and Muhu, must have been an important seaway, as evidenced by the ancient harbour of Tornimäe, and the ancient forts at Muhu and Soneburg. Iron rings were found in the stonework of the Teutonic Order's castle of Soneburg, indicating that small vessels could be moored directly under the castle's walls, while larger vessels were anchored some 200-300 metres off the shore (Arens 1986, 46; Mäss 1991, 315). A dendro-analysis of timber from a jetty-structure showed that it dates into the same period as the Maasilinn wreck, so it even might have had a proper mooring.

Although the interspace between both skins — by the absence of fillers — would not have been watertight, the carvel skin shielded the clinker shell from abrasive action, such as grounding, and absorbed the impact of collisions with submerged rocks in a shallow water environment. This could have been an issue not only because of the shallow-water coastal environment of the Western Estonian Islands, in which this vessel operated, but principally because the clinker planks would have been particularly vulnerable due to their minor thickness and softness. They were made of pine for the most part, a softwood much less resistant to abrasion than oak planks.<sup>24</sup> This would explain why these carvel planks were just nailed on top of the outer clinker shell, with no apparent attempt to insert fillers or to caulk the carvel layer, thus serving more as bumper than envelope.

One author even went a step further and argued that the second carvel skin became necessary due to frequent beaching, as indicated by a heavily worn out keel (Ilves 2002, 143). In fact, there is a similar case in Denmark with regard to the *sandskuder*, which

operated in a rural trade between Norway and Denmark, transporting agricultural and other raw commodities to coastal villages, often purposefully avoiding ports to be exempt from taxes. The Nors Å wreck was addressed as being possibly such a type, which also features a second carvel skin fastened with iron nails, and thus being directly comparable to the Maasilinn wreck, except for its more recent age (Göthche 1985, 304). Vessels of the *sandskuder*-type were beached by using the tidal ranges, anchoring close at the shore, letting the vessel fall dry at low tide to un- and reload cargo, and floating up again as the tide rose. The difficulty of this operation is stressed in written sources: The loading process often needed to be aborted whenever strong winds amplified an incoming tide and the *sandskude* had to leave with an incomplete load (Göthche 1985, 302). While small boats could be beached almost anywhere and simply pulled up the shore, the tidal range was of elementary importance for the ability of larger vessels to fall dry. Since there is virtually no tidal range in the Baltic Sea, it can be doubted that a vessel of the size of the Maasilinn wreck was ever purposefully beached. In this author's opinion, the worn out keel emphasises the combination of the use of softwood and the shallow-water environment, with many obstacles beneath the waterline.

#### 6.1.3.3. The climatic factor: The Little Ice Age

It has been suggested that the second layer was added to withstand ice-drift, which could have greatly damaged the hull (cf. Arens & Westerdahl 1986, 13; Mäss 1991, 318). Given the likelihood — as concluded in previous section — that the carvel-layer served as bumper rather than envelope, this could have also shielded the hull from the abrasive effect of floating sheets of ice. Interestingly, many parallels can be drawn to shipping in the far north. Aside from the economical factor and restrictive access to high quality timber like oak, the choice of pine — a softwood — for the clinker-hull might also indicate that the vessel was originally designed to be a light vessel. Softwood remains dated to early 17<sup>th</sup> century boat from an island off the Tajmyr Peninsular in the Russian Polar Sea has been interpreted that it could be more easily dragged on land or on the ice sheet (Čepelev 2002, 73). This can be ruled out however, in the case of the (much larger) Massilinn Ship, but it shows that it might have been part of a wider shipbuilding practise, where it was common to use softwoods.

Arctic seafaring of the Pomors (northern Russians) started to peak in the 16<sup>th</sup> century and they relied on a type known as *koche* or *kotch* for coastal voyages and for navigation in the open seas with ice. Those featured an additional skin-planking known as *kotsa*, to enable them to sail through ice floes without taking damage to the hull (Marchenko 2012, 12f.).

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<sup>24</sup> Although one could argue that Norwegian vessels were also commonly built with radially cleft pine planks for the lack of oak, yet needed no extra reinforcing, one has to consider that the fjords were no shallow-water environment.



Depictions portray them as having a high-sided hull — sometimes single-masted (Belov 1951) — appearing surprisingly similar to what has been typically described as “cog” (Fig. 6-9). The etymological similarity is thought-provoking. This additional skin-planking may have been a fairly regular feature not only in Arctic circles, but also the northern part of the Baltic Sea. Records from the Stockholm shipyard dating to 1607-08 indicate the rebuilding of 2 *lodjas*, 2 *pinkes* and 2 Bothnian barges as pinnaces, whereby it is arguably implied that these were re-planked in a carvel-fashion (Hasslöff 1972, 59). It is notable that these types, at least the *lodjas* — Russian water-craft — and Botnian vessels, must have hailed from the northernmost fringes of the Baltic Sea, where harbours would have frozen over every winter. The mid 16th-century Maasilinn Ship is the earliest known wreck to feature an additional planking layer. This period was marked by a substantial intensification of global cooling, a trend colloquially known as the Little Ice Age, which has already started a few centuries earlier in the wake of the Medieval Climate Optimum. Was this constructional solution driven by climatic change? In the following, this hypothesis will be explored further in the context of paleoclimatic reconstructions and historical sources, starting with the latter.

Only few years before the timber for the Maasilinn Ship was cut, the exiled Swedish priest and cartographer Olaus Magnus published the *Carta Marina* in 1539, which combined a wealth of ethnographic, climatic and faunal information with geography, and arguably a dash of Catholic propaganda, as Olaus sided with the papacy when Sweden joined the Reformation under Gustav Vasa.

On his map, Olaus Magnus indicated the areas of the Baltic Sea that froze in winter (Fig. 6-10).

Taking the extent of ice on Olaus Magnus’ map at face-value, it would be nothing out of the ordinary, corresponding to what would be considered an average winter still today (cf. Fig. 6-11). Although the derivation of climatological indications from a seamonster-depicting map might seem somewhat counter-intuitive, a recent study has come to the surprising conclusion that the whorls off the Icelandic coast were not drawn in deliberately, but correspond to satellite data on the intermittent formation of warm and cold eddies (Rossby & Miller 2003, 84). This front remained fairly stable and migrates seasonally no more than 35 nautical miles, so it seems possible that this re-occurring meteorological phenomenon could have been observed in the 16<sup>th</sup> century, and is not merely a coincidence. Olaus Magnus is known to have embarked on many sea-voyages and he would have had ample opportunity to compile meteoric information from either own observations or by exchange with mariners. The fact that he also often embarked on vessels bound for Sweden and other Baltic Sea ports (Rossby & Miller 2003, 80) increases the likelihood that his depiction of the ice extent is no less truthful than the eddies. Based on this premise, it would not have been uncommon for the Western Estonian Islands and the Gulf of Riga to freeze during winter in Olaus Magnus’ time. The sound between Hiiumaa and Saaremaa would freeze over even in extremely mild winters and the waterbody dividing the islands from the mainland would freeze in mild winters (cf. Seinä & Palosuo 1996.), so it can be expected that the whole region was affected by ice drift on an annual basis.

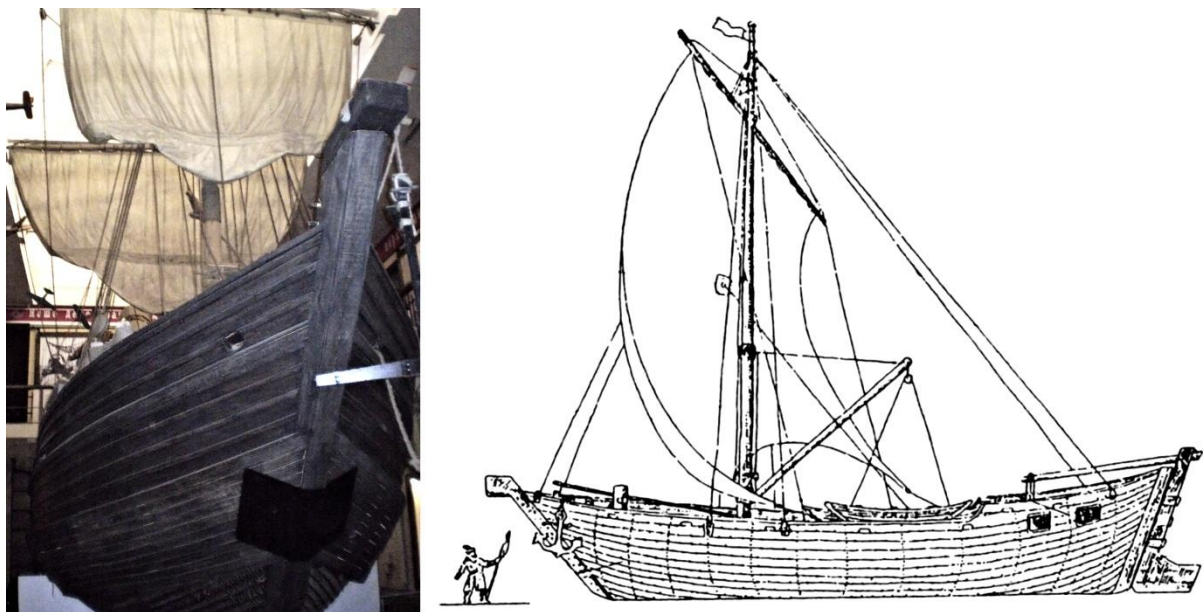


Fig. 6-9. The kotch: A two-masted reconstruction (left) of a 17<sup>th</sup> century kotch in the Museum of Krasnoyarsk, showing the underwater hull in clinker-planked fashion, strengthened all about the waterline with an additional layer of carvel planks (Photo: Кузнецов). A single-masted reconstruction (right) was made on the basis of ship-depictions carved into re-used planks (Graph: Belov 1951).



Fig. 6-10. The first excerpt from Olaus Magnus' *Carta Marina* of 1539 shows Livonia, Estonia and Finland, depicting the Gulf of Finland and the Gulf of Riga frozen over. The second excerpt shows the Western Estonian islands of Dagö (Hiiumaa) and Ösel (Saaremaa). On the latter, the caption for Arensburg (Armborg) and Soneburg (Süneborg) were apparently confounded.

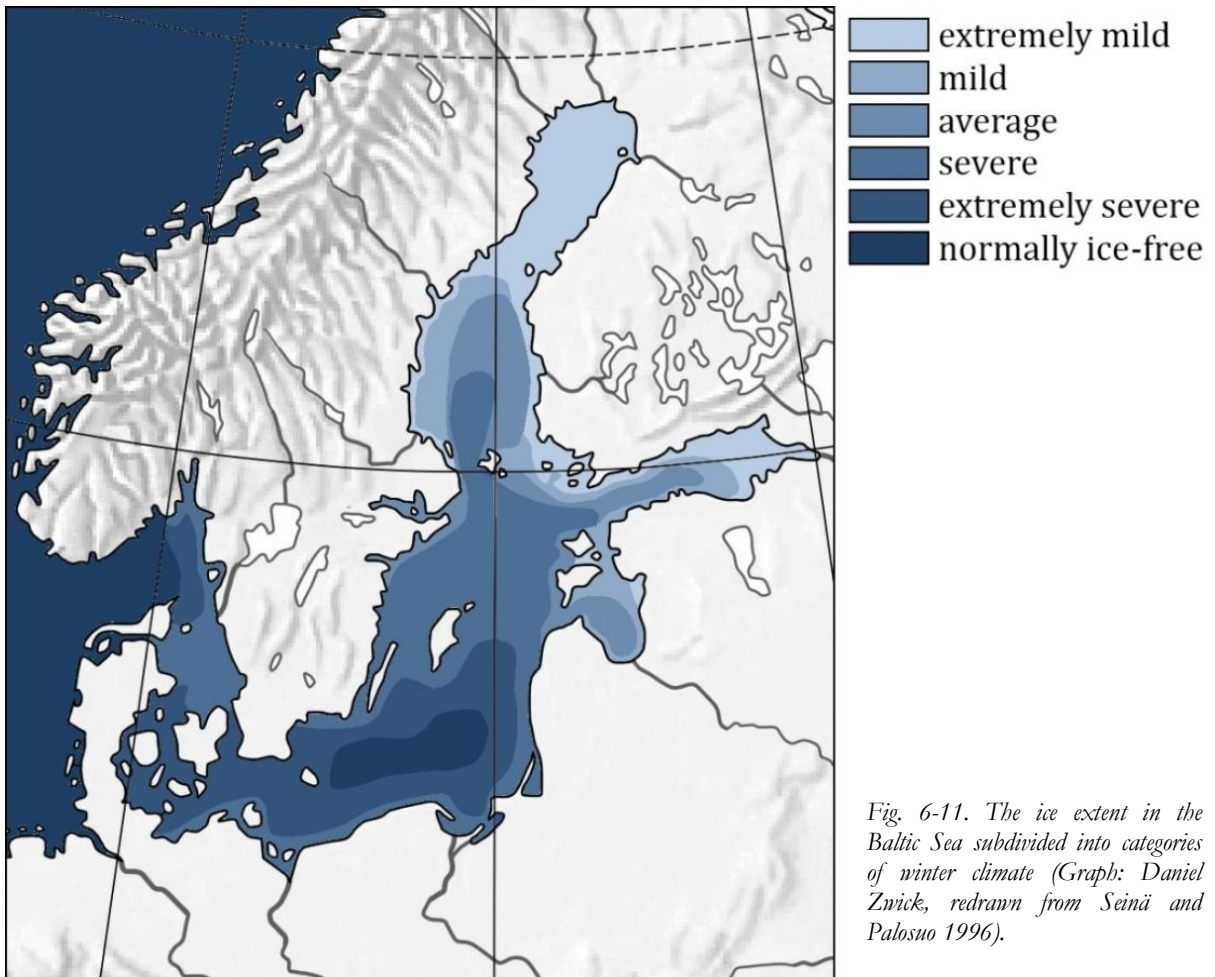


Fig. 6-11. The ice extent in the Baltic Sea subdivided into categories of winter climate (Graph: Daniel Zwick, redrawn from Seinä and Palosuo 1996).

The freezing of those waters was no novelty. However, with the intensification of the Little Ice Age, the ice drift and ice sheet thickness and pressure will have posed a new challenge. While small vessels could be laid up ashore, moored in small side arms where no significant ice pressure can build up,<sup>25</sup> or even sunk with ballast stones to remain inundated beneath the ice sheet during the winter, it seems questionable whether vessels of the size of the Maasilinn Ship could escape the harsh winters in a similar way or had to be exposed to ice-drift and ice-pressures, especially when ice sheets are pushed against each other by currents and wind. This raises an important question: Was the carvel skin on top of the clinker-built shell reinforcement against ice-drift?

This may have been the case, if the primary problem was abrasion. For the compensation of ice-sheet pressure, it would have been to little avail and the reinforcement of frame and particular the addition of low cross-beams would have been the first priority. In the harbour of Kalmar several medieval vessels were discovered, featuring up to three cross-beams in one section (Åkerlund 1951), which may well be a response to ice-sheet pressure. Interestingly, all converted clinker-construction are medium sized vessels of between 10 to 20 metres (tab 6-1). Such vessels were often either too large to be pulled on land during the winter and arguably also too large to sink, as to protect the ships from the ice drift on the surface, as still practised until the recent past. Yet such vessels operated in rural or natural harbours with no built harbour installations such as breakwaters that could have sheltered the ships from ice sheet pressure. So, can this peculiar construction explained in terms of a niche, in which medium-sized vessels would have faced dire consequences in these waters if not converted?

To answer this question, some light shall be shed on when and how swift the cooling trend occurred, and whether it was abrupt enough to possibly affect instant constructional adaptation.

Swedish chronicles suggest that the change from a mild climate towards the end of the 15<sup>th</sup> century was well perceived in contrast to a cool and unpleasant period around 1560 (Utterström 1955 acc. to Pfister & Brázdil 1999, 8). This is supported by a climate

<sup>25</sup> This can be substantiated from own observation: The author has left his 7m wooden clinker boat in the water during the past winters to prevent the formation of dry cracks. The water froze with an ice thickness of up to 5 cm in a sheltered area of Kiel Fjord. The ice movement scraped off some of the anti-fouling coating, while leaving no substantial damage. So it seems feasible that especially planks at the water-line might have suffered more substantially in cases of greater movement of ice sheets and needed replacing — or indeed — strengthening with an additional layer of planks.

reconstruction with a record low in the mid 16<sup>th</sup> century, which was harsher in the eastern Baltic Sea — i.e. at Soneburg — than in Stockholm (Fig. 6-12), and a marked decrease in temperature around 1570 with cool summers lasted well until around 1650 (Briffa *et al* 1990, 438; 1999, 157, 166). This perceivable cooling trend and the necessity of navigation triggered the first periodic — albeit irregular — recordings of ice observation. It started in the 16<sup>th</sup> century when Sweden established a harbour pilot service, in which the coastal population was required to collect navigation marks with the beginning of the ice season and put them back in place as soon as the ice melted (Rudovic 1930 acc. to Jevrejeva 2001, 55).

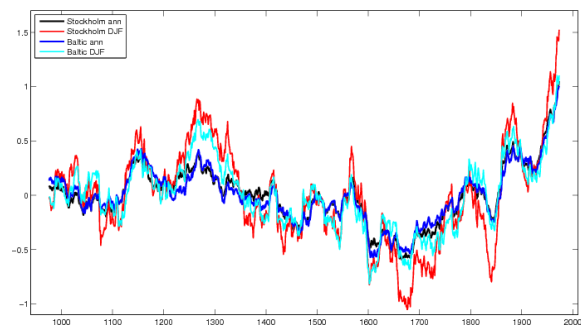


Fig. 6-12. Mean annual and winter\* temperature simulation for Stockholm and the Baltic Sea east of Gotland (\*DJF = December-January-February) (Graph: Schimanke *et al* 2011, fig. 11c)

While the smoothed trend based on tree-ring data indicates a gradual yet steep decline in this period (Jones *et al.* 1998, 462, fig.1), a number of particularly harsh winters were historically recorded since the beginning of the 16<sup>th</sup> century in the Baltic Sea region (Fig. 6-13). This seems to have concerned particularly the Fennoscandinavian region, which climate is directly linked to the North Atlantic Oscillation.

Particularly harsh winters fall statistically into the last quarter of the 16<sup>th</sup> century and would be consistent with the hypothesis formulated above, of the outer carvel shell being a response to greater ice extent, if it was added roughly a decade after the vessel was built. The spatially closest observations were made in the city of Riga since 1529, where the number of days till ice break-up were recorded. Only a very slight decreasing trend in the severity of winters was observed over a period of almost four centuries, i.e. 2 days of earlier melting per century on average (Jevrejeva 2001, 61), yet the individual record displays a great annual irregularity in the ice break-up time (Fig. 6-14). While the averaged value does not seem to make a real difference, a particularly harsh winter may have affected constructional change. The circumstance that break-up times were recorded since

1529 might in itself point to a perceivable decline in temperatures and thus the interest in collecting meteorological observations systematically.

The coldest period of the Little Ice Age, however, began in the mid-17<sup>th</sup> century (Schimanke *et al* 2011,13) and this is well reflected in art, particularly in the Netherlands (Fig. 6-15). The Dutch might have come up with an analogous feature at this time — dubbed the “Double-Dutch method” — where two layers of carvel planking were simultaneously laid. Thijs Maarleveld (1994, 162) ascribes this to the lack of experience of assembling flush-laid planks while applying a shell-first principle for the building of large ships. He argues that the Double-Dutch method was

only a short episode in Dutch shipbuilding, because it was basically redundant for its imagined purpose, thus — in this author’s abstraction — an atavism of conceptual evolution, i.e. a ‘perceptual set’ (cf. paper B, 54). In the light of the hypothesis presented here, the short-lived appearance of the Double-Dutch solution from the late 16<sup>th</sup> to the 17<sup>th</sup> century could have been also a response to particularly harsh winters, in which underwater hulls were damaged by ice-drift. In this case, it could be still explained in conceptual evolutionary terms, namely as ‘evolutionary convergence’, leading to analogous adaptations at different places — from Russia to the Netherlands — and within distinctive shipbuilding traditions.

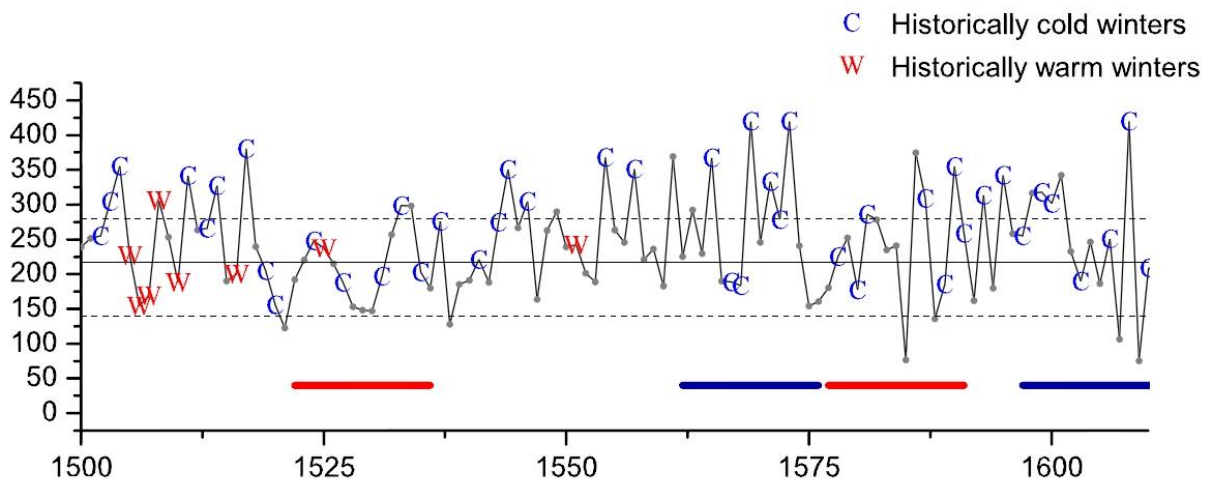


Fig. 6-13. Modelled ice extent ( $10^3 \text{ km}^2$ ) in the Baltic Sea dividing into particularly cold (blue) and warm (red) winters (Eriksson 2009, fig. 14).

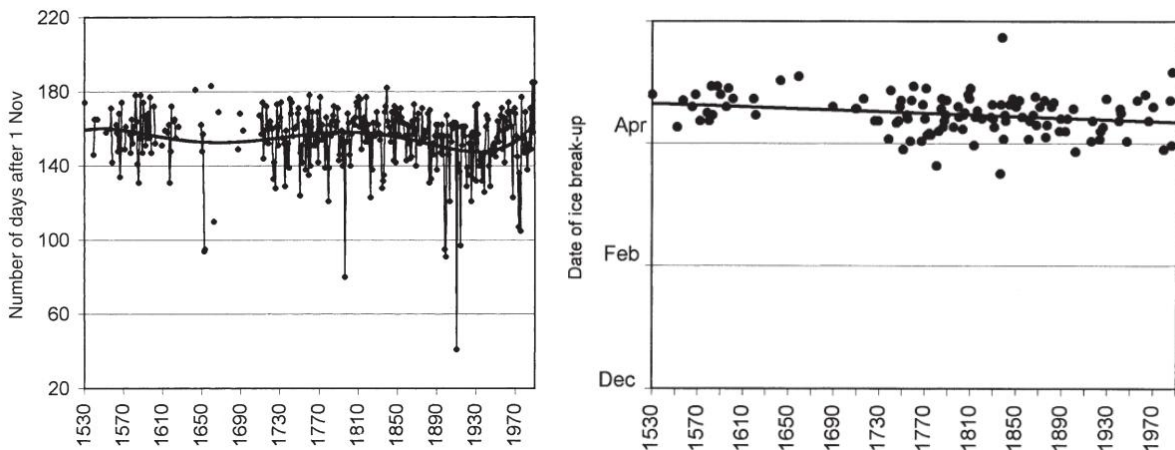


Fig. 6-14. Left: Time series of ice break-up in the port of Riga, the closest approximation to Saaremaa. Right: Time series of date of ice break-ups for severe winters with average linear trend (Jevrejeva 2001, fig.1, 4).



Fig. 6-15. Frozen-in vessels in the Little Ice Age on the oil painting 'Winterlandschap met schaatsers' by Hendrick Avercamp around 1608. While the lowermost excerpt shows a pram and fishing vessels, the top-right excerpt shows a coastal vessel that would have not been considerably smaller than the Maasilinn Ship (Source: Rijksmuseum SK-A-1718).

Conclusively, no assertion can be made whether the additional carvel skin is really linked in any way to the cooling trend and increased ice-drift of the Little Ice Age. The question remains highly hypothetical, but the digression into the mere possibility of a climatologically affected change in shipbuilding is not in vain, as an investigation of similar wrecks could specifically focus on traces of abrasion or damages at water-line level. The Maasilinn wreck is unfortunately not preserved up to water-line level, so conclusive proof for this hypothesis cannot be provided.

#### 6.1.3.4. The socio-economic factor: Prestige-biased transmission

Last not least, another factor may have abetted the addition of a carvel skin. The carvel-planking was associated with an innovative shipbuilding technology. The implementation of carvel-technology in northern European shipyards — primarily driven by the hiring of foreign shipbuilders — is well documented since the 1450's in the southern North Sea area, since the 1480's in Denmark (Bill 2009, 253), and since the 1530's in Sweden, precipitated by a decade in which Hanseatic carvels were bought for the newly established Swedish navy (cf. Adams & Rönnby 2013, 115). The documentary evidence pinpoints to the emergence of this innovative

technology and indicates that the east was lagging behind the west in adopting this new technology (paper E, section 11), which — however — remained largely linked to the establishment of professional navies. Most shipyards — particularly rural and small ones — were not directly affected by this new development, as the archaeological record suggests. In Denmark most vessels were still built in clinker up to the end of the 16<sup>th</sup> century, and carvel remained an exception (cf. Bill 2009, 254). Even most of the carvel wrecks discovered in Danish waters, which date into the last quarter of the 16<sup>th</sup> century, were not built domestically. Their provenances indicate a foreign origin, indicating that these kind of ships were not readily available for merchants at home and needed to be acquired overseas (Bill 2009, 255). Given the east-west divide in spreading carvel-technology, the Maasilinn Ship with its carvel-skin must have been a fairly uncommon sight in the Baltic Sea's northeastern fringe. At that time carvel vessels were associated with the state, innovation and wealth, while clinker-built ships were vernacular vessels. The Maasilinn wreck too was one of those vernacularly-built vessel, which however was disguised under the carvel skin. Was this intentional and could the carvel-shell have had another purpose that was not strictly utilitarian?

It needs to be noted that the change to carvel-technology was barely a wholesome transition, but a gradual process, in which only some aspects of the technology were adapted, often restricted to the most superficial analogies, as in this case. The long-winded gradual process is emphasised by the fact that even long after carvel-built hulls became the norm, many rural communities continued to built clinkered hulls up to the 19<sup>th</sup> century.

This also concerned another group of vessels, the so-called ‘half-carvels’, essentially clinker-built vessels which were only carvel planked above the water-line, as attested for Sweden between the 17<sup>th</sup> and 19<sup>th</sup> centuries (Erikson 2010). The shipping record for Sweden of 1911 lists 72 of such vessels, but are found as early as 1782 in customs accounts (Hasslöf 1972, 58). Not unlike the Maasilinn Ship, these vessels would have appeared to the outside observer — i.e. above the waterline — as carvel vessels, but were in verity embedded in the clinker-tradition.

Those odd constructions have been interpreted with the merchants’ intent to cast off the stigma of provincialism and peasantry, and to emulate the wealthier long-distance merchants in their carvel-built ships (Erikson 2010, 78f.). The latter had access to the more sophisticated shipbuilding technology practised in the great urban centres, like in the Low Countries and some Hanseatic ports, and thus also to a greater choice of commodities than just agricultural surplus as peasants, so “disguising” the vessel as prestigious carvel would have had a tangible utilitarian purpose too, as it would have enhanced the expectations of the traded good. A quite modern principle basically, as the package design and the way a commodity is advertised boosts the sale value.

However, this explanation can be doubted on the basis that converted-clinker or half-carvel constructions were normally of modest dimensions and on that basis alone would have not have the chance of being perceived as prestigious. Moreover, an ethnographic study also identifies another reason: One of the last shipbuilders who engaged in this building method was asked why he chose this construction, upon which he responded, that he found it easier to determine the shape of the underwater hull when employing the shell-first clinker method, while he continued the hull construction above the waterline in carvel fashion, as not much could go wrong once a vessel has been planked up to the turn of the bilge (Hasslöf 1972, 58). Obviously, this is the shipbuilder’s subjective preference, based on his personal experience and the inheritance of shell-first clinker technology. Mediterranean shipbuilders would have certainly disagreed.

Could the theory of a prestige-biased transmission be applied in the case of the Maasilinn ship?

There are clear indications that a prestige-biased (or rather ‘prestige-inspired’) adoption of the carvel skin can be confidentially ruled out in this case, as it would presuppose an incentive for mercantile competition, which was absent. In the year 1532 on the *Landtag* — the Livonian Diet — the cities of Windau, Reval and Dorpat declared to prohibit the inhabitants of Courland and Ösel to export cattle and fish anywhere, before not having offered their goods at the domestic market in Riga (Seibertz 1853, 82). This suggests that Cours and Oselians must have engaged in this practice before, and apparently achieved better prices elsewhere than in the nearby Riga. So this can be seen as a restrictive measure for price regulation. Thus, the lack of opportunity to sell at places where the highest price could be achieved would have deprived the merchants of any incentive to compete, or to market their goods with the aggregated value of make-believe prestigious shipping. Moreover, this would have certainly not been important for agricultural commodities anyway.

Whether the Maasilinn Ship was engaged in any trading with agricultural goods from the Island of Saaremaa remains unknown, there can be however little doubt that this ship was directly embedded in the logistical network of Soneburg Castle, as indicated by the lime residues in the wreck’s bilge on the one hand, and the quarrying of lime right at the foot of Soneburg Castle on the other hand. There would have been hardly any incentive for a presitigious ship for the mundane transport of lime.

#### 6.1.4. Discussion

As could be demonstrated in previous section, the contextual factors bear a direct relevance to the interpretation of the Maasilinn wreck. Despite its modest size, it may have been engaged in naval warfare, as the shallow-water environment around the Island of Saaremaa would not have been suitable for larger state-of-the-art warships. Therefore a hostile act cannot be excluded as possible cause for the fire and sinking of the Maasilinn Ship. As will be addressed in the next section, the inflammable nature of the cargo may also point to an accident.

The way of construction — both in terms of workmanship and choice of materials — reflect the restricted access to high quality species. This may have been affected by the time of war, scarcity and imminent collapse, but not necessarily, as it could be also interpreted as a sober cost-benefit calculation for the mundane requirements of a coastal vessel in a rural peripheral area.

This approach to shipbuilding would be consistent with the makeshift feature of a secondary skin. While its purpose as “envelope” to make an old leaking hull waterproof again — as in the case of the *sandskuder*

— could be confidentially ruled out, as no traces of caulking or wedges were found, the favoured interpretation is that of a “bumper”, or external reinforcement, which would have protected the hull from the abrasive effect of groundings, small collisions and ice drifts, as argued in section 6.1.3.2. and 6.1.3.3.

It seems noteworthy, however, that so-called ‘converted clinker’ or ‘half-carvel’ constructions should not be seen as discrete ship-types in their own right, but rather as technological solutions, which can be applied for a whole range of ships. Similar pressures or developments may have affected similar patterns of problem-solving in different places, without necessarily revealing any direct links of cultural contact or even a tradition.

## 6.2. Exploring the castle's link to the nearby Maasilinn wreck

The mid-16<sup>th</sup> century was a heated period of extensive fortification rebuilding, in a last — but eventually vain — effort of the Livonian Confederation to protect its territorial sovereignty and to prevent invasion and dissolution. Soneburg was a provincial stronghold directly under a commandry of the Livonian Order, controlling territories dispersed on the islands of Ösel/Saaremaa and Dagö/Hiiumaa (cf. Arbusow 1918, tab.1). Thus this province and its scattered territory across the Western Estonian Islands would have been in need of vessels that were under the direct disposal of the *komtur* — the reeve — of Soneburg. In the following section, the political dimension will be further explored in the context of the maritime transport

geography of this region, to shed further light on the historical circumstances encompassing the Maasilinn wreck.

There is a wealth of contextual information that could further illuminate under what historical circumstances the Maasilinn Ship was built, operated and eventually sunk. It is notable that wooden piles thought to be the remains of a harbour structure date to the same time as the Maasilinn wreck (Arens 1986, 47), and thus highlights the importance of interpreting the wreck together with the castle and harbour as assemblage, not to forget the historical context of the Bailiwick of Maasilinna, of which Soneburg (Fig. 6-16) was its administrative centre.

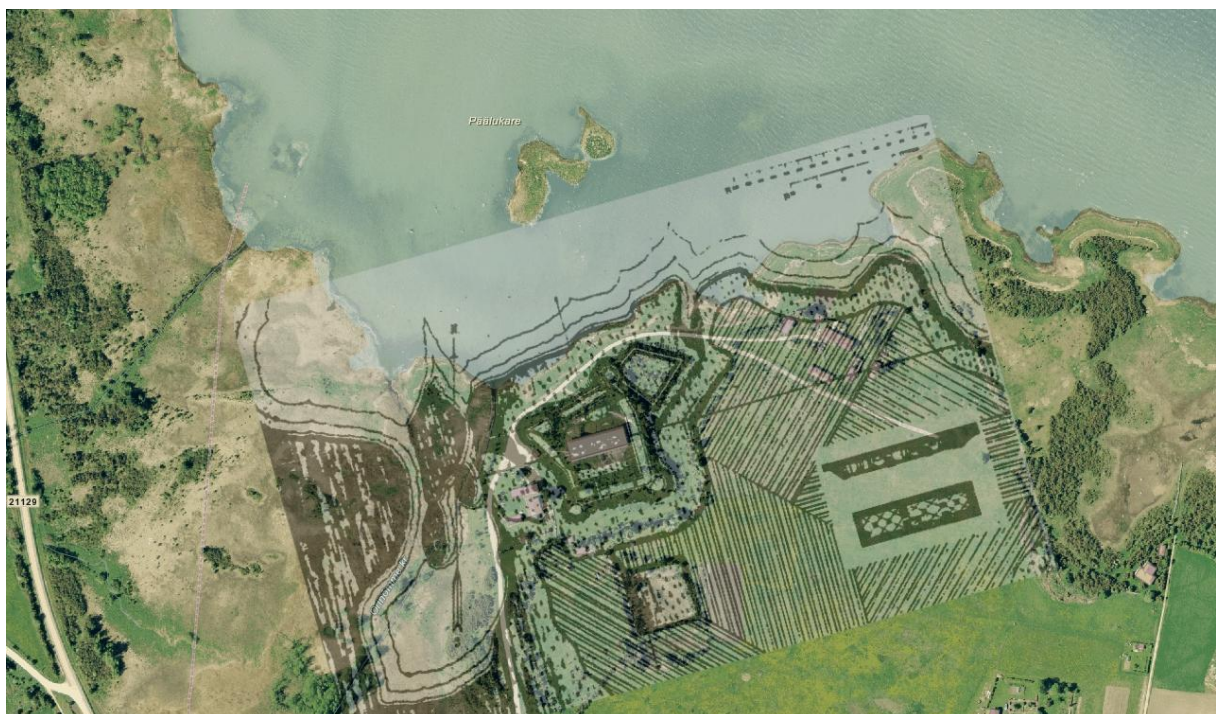


Fig. 6-16. Plan by Reinhold Guleke (1834-1927) of the ruins of Maasilinn Castle (Soneburg), superimposed on a satellite-image. The plan was georeferenced to the castle ruin, and fits well to some other landscape features, like a square depression — possibly corresponding to the outlines of a quarry pit — to the south, and a valley with a creek to the west, which was originally a small bay, which must have silted up around the turn of the 19<sup>th</sup> century (Edited graph: Daniel Zwick. Plan: Estonian Ethnographic Museum inv. nr. 568:3 in Arens 1986, 48. Satellite Image: <http://xgis.maaamet.ee>).

The cargo remains already indicate a relevance to the locality: Inside the hold, slaked lime was detected (Mäss 1994b, 190). Lime, as we know, was quarried right at the foot of the castle. It can be questioned, however, whether it came as slaked lime (calcium hydroxide) on board. It seems more likely, that it came — in fact — on board as quicklime (calcium oxide). Quicklime is produced by heating crushed limestone in a kiln for several hours at high temperature and results in a powder often used to make mortar. If quicklime gets in contact with water, an exothermic reaction ensues and turns it into slaked lime, a process that releases enough heat to ignite combustible materials, such as wood. This would explain the torched remains of the vessel and the cause of sinking. As indicated by the special keel construction, the Maasilinn wreck could have been even a purpose-built quicklime freighter. Despite the builders seem to have been very well aware of the hazardous nature of the cargo, a quicklime accident may have occurred. A hostile act cannot be ruled out however.

There are indications that quicklime was used as a thermal weapon — a “medieval napalm” so to say — in naval battles, comparable to the Greek Fire used by the Byzantines. Although written evidence is scant, there are several mentions between the 13<sup>th</sup> and 15<sup>th</sup> centuries of pots of quicklime being hurled on the decks of other vessels, not necessarily as incendiary material, but primarily to blind adversaries. A late 14<sup>th</sup> century source reads: *“The eighth thing that one should have in war at sea is that one should have many vessels filled with powdered lime and one should throw them at one’s enemies, so that the vessels shatter and the lime enters adversaries’ eyes and then they are as if blinded, and this is a very dangerous situation, since, if the enemy cannot see because of the lime that they have in their eyes, one can easily kill them and drown them in the water”* (Sayers 2006, 265).

Now the question arises whether the lime was really just meant as building material, or instead used purposely to ignite a fire in a warlike-scenario. Even with the introduction of early gunnery, the use of such “archaic” ammunition seems realistic, as all kinds of materials served as shots, such as pellets of stone, metal and baked clay (Sayers 2006, 266). Both scenarios are possible in the light of historical events, the mid 16<sup>th</sup> century was virtually a heated period of inner and outer conflict, so the torched remains of the Maasilinn wreck may be related to that struggle, which is also reflected in the castle history itself.

Soneburg castle was built in lieu of Peude Castle, which was besieged and destroyed during the Oselian uprising in 1343 (Tuulse 1941, 85). It took the Teutonic knights two years to quell the uprising and re-establish their rule by the construction of this castle, which was not incidentally named Soneburg: At the besiegement of Peude the Germans capitulated on the condition of safe conduct, but were nevertheless slain. As a punishment, the

Oselians were obligated to build the new castle of Soneburg in ‘atonement’ — *Sone* (or *Sühne*) being the German term for the latter — and *Burg* for castle (Tuulse 1941, 185). In the chronicles of Hermann of Wartberge, the construction of a good and “firm” (i.e. stone) castle in Saaremaa was mentioned for the year 1345 — *“constuxit (...) in Osilia castrum bonum et firmum (...)”*, built by Master Burchard of Dreileben and later continued by Master Goswin of Herike, which is thought to refer to Soneburg Castle (Strehlke 1863, 72). Importantly, the castle was built at a small harbour, which was allegedly still in use in the 16<sup>th</sup> century (Tuulse 1941, 185). This is supported by archaeological evidence and a brief survey has revealed massive piles and cribwork contemporaneous with the wreck (Roio 2006, 306). The castle was built directly at the waterfront and to prevent it from flooding the foundation consisted of locally quarried cyclopean ashlars (Tuulse 1941, 186). Post-glacial land rise also affects this part of the region, so the actual shoreline was even closer to the castle than indicated on the late 19<sup>th</sup> century map (Fig. 6-16) due to a relatively higher water-level.

This is further enhanced by the fact that iron rings were integrated into the castle’s walls, with which vessels could be moored right under the protection of the walls (Arens 1986, 46). The outer bailey was probably built during reconstruction works carried out under the bailiff Tonys Ubelacker in 1518, albeit the bastions and gun emplacements were built somewhat later, as could be deduced from the sculptural details (Tuulse 1941, 187) (Fig. 6-17).

The reinforcements took so much lime, that Tonys Ubelacker — bailiff of Soneburg — had to send a message to the Grandmaster of the Teutonic Order to inform him that he would not be able to send lime in that year, as it was all used for local construction works (PrUB JH I, 3 21968 - 1518 VII 14).<sup>26</sup> This suggests that lime was normally sent to the Grandmaster on an annual basis. The building activities continued in several phases. In 1550 the bailiff of Soneburg ordered a remarkable quantity of roof tiles from Tallinn (Kreem 2002, 24). The 19<sup>th</sup> century map shows a body of water in the west of the castle, which is now completely silted up, except for a small creek (Fig. 6-16). This might have been even deeper in the 16<sup>th</sup> century and part of the area where limestone was quarried and loaded. Northern Estonia and the Island of Saaremaa in particular was a limestone area (Tuulse 1941, 19), where building material was quarried and shipped off. Thus Soneburg might have played a pivotal role in shipping building material to various sites of the Livonian Confederation, which engaged in a last concerted effort to reinforce its castles during the Livonian War of 1558-1583.

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<sup>26</sup> I am indebted to Juhan Kreem for drawing my attention to this excerpt.





Fig. 6-17. The ruins of Maasilinna Castle (Soneburg) with gun emplacements.

The fact that the Maasilinn wreck carried slaked lime or quicklime on board suggests that it was not a random merchant vessel, but possibly under the direct command of the bailiff, as has been previously suggested (Arens 1986, 48). It was also suggested that the lime on board was destined for the re-building of the castle (Ilves 2002, 143), a hypothesis that is however doubtful, as lime was quarried right at the castle's foot and was therefore certainly not meant for the castle's own fortifications.

As the Livonian Confederation crumbled, the Danish king acquired in 1559 the Bishopric of Ösel-Wiek (Latin: *Osilia Maritima*), which shared the islands of Ösel/Saaremaa and Dagö/Hiumaa with the bailiwick of Soneburg. After five years, the bailiwick of Soneburg was to follow suit and was also sold to the Danish crown in 1564, so that Denmark gained full sovereignty over the Western Estonian islands.

The attempt of King Christiern to gain a foothold and to recuperate former strength and glory was however constantly thwarted by Swedish seaborne assaults. Recognising that Soneburg could not withstand Swedish raids in 1568 and 1575, the castle was razed by the Danes in 1576, no doubt, to prevent the Swedes from occupying it permanently at some point. Ilmar Arens believes that the Massilinn ship may have caught fire when the Danes blew up Soneburg, while dismissing the likelihood that this may have happened during the Swedish attacks, as they would have rather seized than burned the vessel (Arens 1986, 49). But it seems questionable whether burning matter from a blown up stone fortress could reach the ship that was anchoring about 300 metres off the castle. As pointed out earlier, the quicklime could have inflamed itself due to a chemical reaction and does not strictly point to a hostile or otherwise explosive event.

### 6.3. *Livonia Maritima* in retrospect: Applying a Braudelian concept to a maritime transport zone

It has been pointed out that the event of a shipwreck is unique in space and time, thus corresponding to a *courte durée* event-based history according to the Annales approach proposed by Fernand Braudel. Yet, as such, it cannot be fully understood without a wider 'system of use' in a global mechanism of the *longue durée*, involving structures, worldviews, mentalities and geohistory, which interactions find impression in patterns (Staniforth 2003, 104). Such an approach applied to the Baltic Sea was endorsed by Johan Rönnbj, stressing that factors shaping the landscape over centuries like the post-glacial rebound ought to be addressed in a *longue durée* context, or its appropriated *maritima durées* for aspects in which the sea shaped long-term cultural expressions (Rönnbj 2015, 272), of which some have been addressed in section 2.2.

Through this zoomed-in *courte durée* approach, archaeological remains can be interpreted in the light of specific historical events. This, however, does not tap the full potential of understanding the significance of this region in the wider context. Subliminal factors of the unique maritime landscape spawn recurrent patterns throughout the centuries, leading to a surprising degree of constancy in geopolitical decision-making, transport corridors, as well as strategic and navigational bottlenecks. These shall be assessed in this section by applying a *longue durée* perspective. In this section, an attempt will be made to apply a Braudelian concept by demonstrating how *longue durée* aspects (marked as "►(...)◄") are tacitly interspersed in a mundane *courte durée* perspective, based primarily on historical events. The Maasilinn case study showcases a castle and an associated ship-find, which provide a snapshot in time, which is embedded in an ancient coastal maritime transport zone.

It was suggested that the Maasilinn ship could have belonged to the bailiwick of Maasilinna (Arens 1986, 48). If compared to the geo-political situation, it would be very likely that the bailiwick was in possession of vessels, as its territories were scattered across three islands, namely Ösel/Saaremaa, Dagö/Hiiumaa and Mon/Muhu (Fig. 6-18). The smallest (not counting islets) is Mon/Muhu, being just opposite of the Väine-Väike Sound and known as Saaremaa's "breadbasket" due to favourable farm land (Arens 1986, 48). The village of Koguva on

Mon/Muhu is the closest connection to Soneburg, and may have been the main connection between the two islands for ferrying and dispatches (Parve 2010, 96).

► The favourable farm land is already indicated much earlier in a peace treaty of 1241 between the Teutonic Order and the Estonians, in which the latter are obligated to pay their tax in grain that could fill a cog sent from Riga. It also provides for the case that the bishop or master of Riga is unable to acquire a cog, in which case ships and pilots need to be sent "*ab ipsis Osilianis in Rigam seu Maritimam deducentur*" – from Oselia in the Riga Bay (Bunge 1953, 220). This indicates not only that agriculture was practised already on these islands 300 years before this case study, but that the rural population was sometimes expected to deliver their agricultural products in their own ships, which reminds of Jan Bill's (1997) finding that small-scale seafaring in Danish waters was often carried out by farmers. ◄

The importance of Mon/Muhu is revealed involuntarily on a late 16<sup>th</sup> century map, in which Soneburg gets replaced as provincial centre by the name of this island (Fig. 6-20-1). Despite the exposed location of the Island of Ösel/Saaremaa — located like a bar in front of the Estonian mainland — the absence of deep water harbours and the shallow water environment enclosing the island must have protected the island to a certain extent. Thus, it was only accessible for small and medium-sized craft with little draught. This is indicated by shallow depths of 2,5 m in the middle of the sound, getting increasingly deeper towards the north-east, but much shallower in the southeastern entrance with a depth of about 0,5 m, i.e. wading depth (Fig. 6-19). For this an region a post-glacial land rise of 1 mm was reconstructed (Ågren & Svensson 2007, fig. 4.3) (Fig. 2-2), which would make a sea-level difference of ca. 0.47 m for 1550. According to another estimate, the post-glacial land rise in this region would have been at ca. 1,7 mm per year (Ekman 1996), thus a sea-level difference of 0,79 m for 1550. It can be anticipated in both scenarios that the southeastern access was not even traversable for small ships, perhaps fishing craft in calm weather. Thus, Soneburg Castle was effectively only accessibly from the northern sound entrance and was not exposed to seaborne attacks from the southern side.

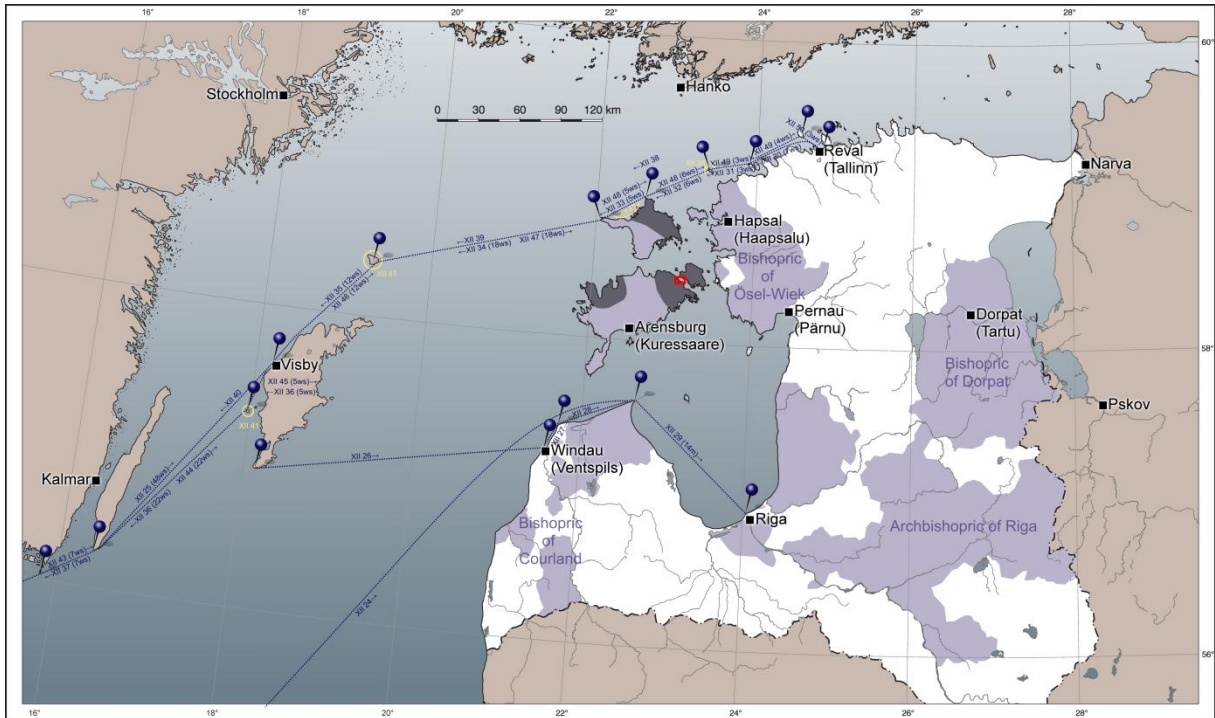


Fig. 6-18. The lands of the bailiwick of Soneburg are marked in grey and are part of the Teutonic Order ruled territories (white) of Livonia. The reason for including the route description of the Hanseatic Sea Book, which has no apparent connection to the bailiwick, will be elucidated in the context of figure 6-20. The red square is magnified in figure 6-19 (Graph: Daniel Zwick).

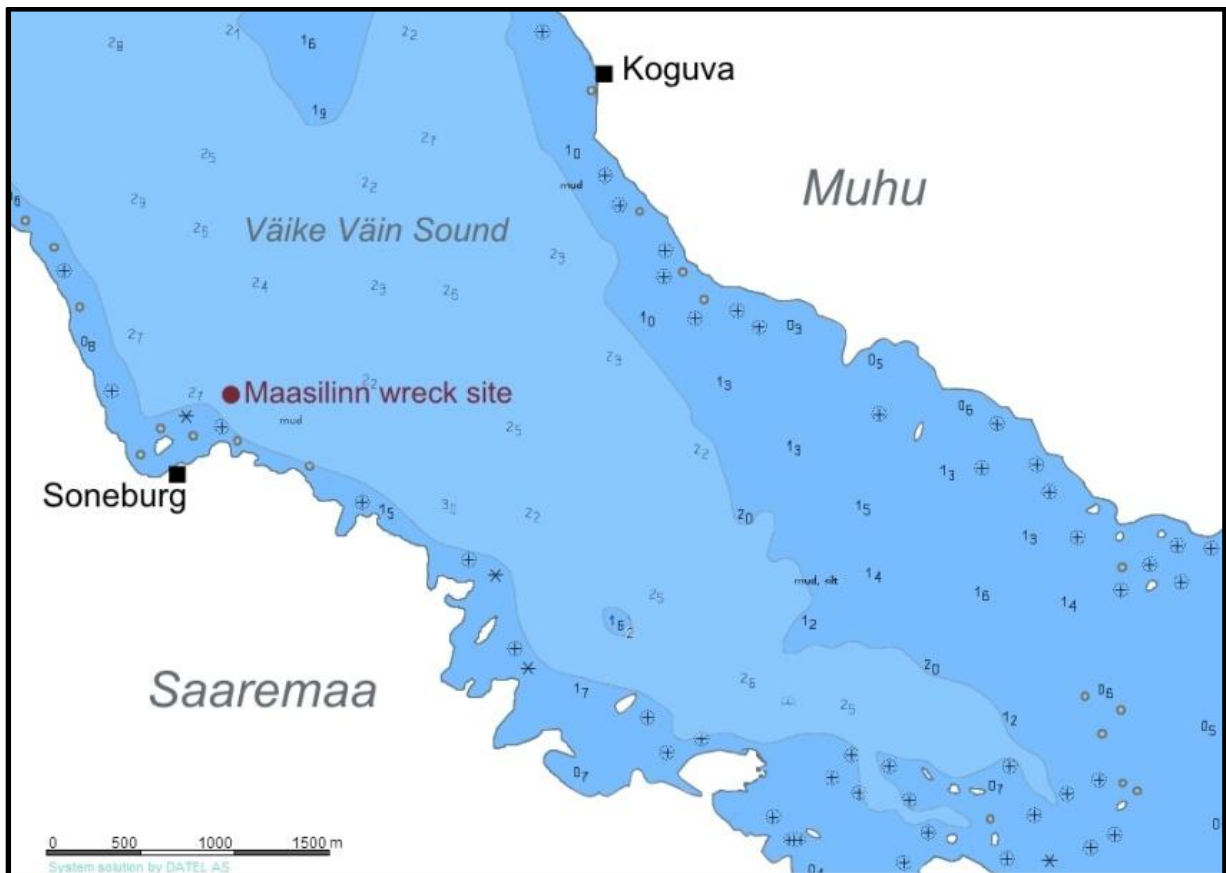


Fig. 6-19. The castle and ship in the local context of the Väike Vain Sound, dividing the islands of Ösel/Saaremaa and Mon/Muhu (Map source: <http://xgis.maaamet.ee/xGIS/XGIS> with own modifications, edited by the author).

Considering the strategic location of Soneburg Castle, it seems strange that the bailiffs of Soneburg were either unable or unwilling to exert power, especially the safeguarding of the straits dividing the islands from the mainland. In 1411 the Livonian towns banned the export of grain in accordance with the Grandmaster of the Livonian branch, to whom the bailiff of Soneburg was subject to. The western part of Saaremaa, however, was part of the Bishopric of Ösel-Wiek, which was not bound to the Grandmaster's policies. Thus, there were effective ways — perhaps also indirectly for the bailiffs of Soneburg — to evade the Grandmaster's rulings, so that the ban could not be implemented wholesale (cf. Kreem 2002, 25). The role of the Soneburg bailiffs was ambivalent — if not dubious — when for instance in 1497 the town of Reval/Tallinn accused the bailiff to have given safe conduct to Swedish pirates, who have harmed merchants from Reval/Tallinn in the *Ozelszunde* (HUB 11, 125) — literally “Ösel Sound”, probably referring to the Suur-Väin Strait — or when the bailiff openly abdicated any responsibility for ships captured in the waters that would nominally fall into his jurisdiction (Kreem 2009, 76). The island itself was subject to seaborne attacks, however, when — for instance — in 1438 the bailiff of Soneburg reported about small bands of pirates of Finnish, Swedish and Estonian origin plundering Ösel/Saaremaa (Kreem 2002, 26; 2009, 72). The seeming inaction on the part of the bailiff may either indicate that he had not the naval power to intercept pirates, or secretly made common cause with them. Both may have been the case. The fact that the waters around Saaremaa and Soneburg in particular were only accessible to small and medium sized vessels with little draught was certainly a great advantage, which may have triggered an “asymmetrical” way of naval warfare, providing safe havens for small raiding vessels to retreat, which could not be pursued by larger more powerful vessels.

► This restricted accessibility for larger ships could explain why the Teutonic Order attacked the island of Ösel/Saaremaa with a land army, crossing the frozen sea in winter 1227 (HCL XXX, 3; LRC 1614-1646) and again in 1270 (LRC 7847-7944) (cf. section 2.2.3). It was probably not possible to reach these waters in their high-sided cogs safely. Henry of Livonia described an incidence in the year 1215 when 9 crusader cogs had to seek shelter in a natural harbour on Ösel/Saaremaa during a storm, but could not navigate in these waters properly, for which reason a difficult kedging manoeuvre had to be carried out while exposed to Estonian attacks. As for the Väike Väin Sound, in 1227 the sea-level difference would have been — according to the two aforementioned reconstructions — between 0,79 m and 1,34 m. Thus, traversing through the southeastern approach would have meant a depth of between 1,29 m and 1,84 m in the best case scenario (not counting in possible sedimentation etc.). If compared with the reconstructed draught of the Kollerup ship, estimated

in the range between 1,2 m and 1,4 m (Westphal 1999, 109), this would have been too narrow, as the reduced depths in wave troughs need to be also taken into account. Thus, the smaller *piraticis* of the Oselians could have easily escaped across some shoals, not accessible for the “floating fortresses” of the crusaders, leading to an asymmetric warfare to the advantage of the Oselians. This however lasted only as long as the summer. Aside from the shallowness of the surrounding waters, Ösel/Saaremaa was obviously also protected by the seasons, except the winter. This protection also included the spring months, when the ice was too thin to carry, but too thick to permit navigation. That is at least how envoys of the Bishop of Ösel justified their delayed arrival in Rome in 1458 (Kreem 2011, 266), so seaward protection came at the price of seasonal isolation.

Ortelius' map (Fig. 6-20-2) contains clear nautical indications regarding Cape Domesnäs/Kolka, described thus: “*Domes nest, petra est sub aquis, longe se in mare extendens*” — i.e. a warning of rocky shoals extending far into the sea and should be circumnavigated with great distance. This reference might have been directly taken from the following excerpt of the Livonian Rhymed Chronicles: “*Now Ösel [Saaremaa] lay locked in the sea and this protected it so that it had never been attacked by an army. In the summers they needed little defense and so for many years they remained unbaptized and free of taxes. They were a treasonous people. In the summers they ravaged the surrounding lands with their ships, inflicting great damage. This greatly disturbed the Master and he earnestly inquired how they might cross the ice in winter to that land and subdue it. It was reported to him that in winter the sound, in which the island lay, froze solid. In summer, however, one had to sail twelve miles by ship, being careful to avoid the numerous rocks which lay in the water. Hence, whoever wished to attack the island with an army had to do it in the cold days of winter when the ice could bear a hundred armies.*” (LRC 1614-1645, ed. Smith & Urban 1977, 23).

Throughout time, there are numerous references to the cape, which suggest that it was an important landmark. The earliest is on the Mervalla runestone from Sweden from ca. 1000, which is dedicated to a husband called Sven, who often sailed in his knorr to Semgallia around Cape Kolka (Fig. 6-21). And in 1518 “evil people” were reported to have cut down a group of prominent trees at Cape Kolka, hitherto used as navigation marks, so a tower was erected in lieu on the behest of mariners from Riga (Schnall 2003, 36). It seems very possible that the group of trees were a prominent landmark for taking bearings to determine when it was safe to change course. The cutting down of the trees may have been a deliberate attempt to make ships run aground in order to plunder them, so their literal description of “evil people” was probably not just an incidental elaboration. Removing or destroying navigation marks was a common strategy in naval warfare (Westerdahl 2011a, 74). ◀



Fig. 6-20. The map of Old Livonia published in Abraham Ortelius' *Theatrum Orbis Terrarum* between 1573-1598 reflect the perception of the maritime landscape and the relative importance of some landmarks. (1) The island of Ösel/Saaremaa is depicted in red and misattributes the name "Mon" to Soneburg, which may reflect the importance which this island had for the Bailiwick of Maasilinna. The island of Mon/Muhu is actually shown as the island marked in green. (2) Cape Kolka (Domesnäs), (3) Hobeurg was erroneously inserted as town-symbol, undoubtedly because of its suggestive toponym. In verity, the importance of this site stems from being a rock formation which served sailors as landmark (Hanseatic Sea Book XII, 26). (4) Likewise, the offshore islands of Stora Karlsö and Lilla Karlsö were also a landmark for ships bound for Visby (ibid. XII, 41, 43-46).

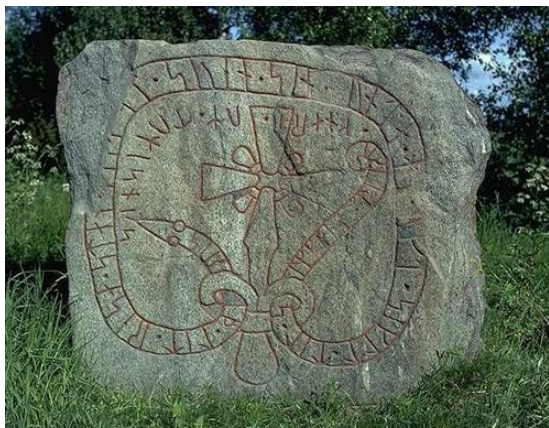


Fig. 6-21. The Mervalla runestone of ca. 1000 with the transcribed text: Sigríðr lét reisa stein þenna at Svein, sinn bónda. Hann oft siglt til Seimgala, dýrum knerri, um Dómisnes. (Source: Riksantikvarieämbetet archive number Ytterselö 92:2).

When Ivan the Terrible declared war on the Livonian Confederation, the bailiff of Soneburg declared in 1558 his forces too few to reinforce Wesenberg and Reval against the Russians (Cröger 1870, 149). The bailiwick of Soneburg under its last bailiff Heinrich von Lüddingshausen-Wulff could mobilise during the struggles of 1558-59 about 700 Estonian and 100 Swedish peasants in addition to the castle's garrison, listed with 22 noblemen on horseback and soldiers (12 guns to a man). At times, an additional number of 15 soldiers needed to be recruited as not to leave the castle unprotected (Parve 2010, 106). Unfortunately, we have no details on whether any crews for vessels were included in these numbers. But given the surprisingly low number of the garrison and the bailiwick's available personnel, it seems apt to suggest that the Maasilinn ship was operated by the local population — possibly peasants — and hired whenever lime had to be transported on behest of the bailiff. This is consistent with the construction, which is typical for a rural origin, as expounded above.

It could be asked to what extent the number of peasants raised as militia were free or unfree. There are several indications, that the land population became gradually freer, which might explain why less were obligated to do military service. Wolter von Plettenberg famously freed in 1532 Hansken of Koguva, the first instance in which this was initiated on behest of a grandmaster (Parve 2010, 93). Already around the year 1400, Swedish peasants on Hiiumaa freed themselves from servitude by payment of 20 marks to the bailiff of Soneburg (Cröger 1870, 66). The fact that the documents distinguish between Swedish and Estonian peasants seem to imply a degree of autonomy and jurisdictional liberties.

► And these were not the only Estonian islands colonised by Swedes. The island of Osmussaar (in the itinerary: *Hothensholm*) had a Swedish population since at least the 14<sup>th</sup> century (Peil 1999, 6), and the island of Runõ in Riga Bay was granted permission by the Bishop of Courland to practise Swedish Law in 1341 (Rußwurm 1855, 189). ◀

When in 1559 the Danish King acquired the Bishopric of Ösel-Wik (Lat: *Oselia Maritima*), the Swedish king concerned himself too to gain possession of Estonia, particularly the Swedish-speaking islands between the Finnish and Livonian coast. So the Swedish principalities declared that if the Grandmaster intends to avert war with Russia, he could transfer the right of succession of Soneburg, Pernau or Jerven to the Swedish king in exchange for 200.000 taler (Cröger 1870, 172). This would be territory directly bordering on the Danish possessions in Estonia, but - perhaps more importantly - would be intersecting with the sea ways.

► Interestingly, the first Danish expeditions to the Baltics also followed the objective to gain a foothold in Ösel/Saaremaa first, e.g. in 1170, while the Swedes attempted to establish a stronghold in Lihula in 1220,

possibly in competition to each other and the rising German influence in this region ◀

Applying Max Weber's concept of 'monopoly of violence' from a terrestrial to a maritime context, Jan Glete addressed the role of maritime supremacy on state formation (Glete 2007, 13ff.). Was the Danish-Swedish struggle for the *Dominium Maris Baltici* a policy to rule the Baltic Sea, a guarantor — if not precondition — for exerting power on its coastal territories? In 1562, Sweden intercepted many Danish, Dutch, English, Scottish and eastern Frisian ships engaged in trade with Russia, on their way to the Narva estuary, and 32 Lübeckian ships were even permanently arrested (Arbusow 1918, 200). Harbours in the Baltics were of imminent importance to intercept vessels operating on this trade artery.

The Danish attempt to get a foothold on the Estonian Islands can be seen as extension from the island of Gotland, which was then also under Danish control, with — no doubt — further plans to thwart Swedish interests of extending its influence in the Eastern Baltic. Both Sweden and Denmark competed for the inheritance of the coastal provinces of the crumbling Livonian Confederation and entered contracts of acquisition with the Order rather than using the sword.

In exchange for forfeiting his claim on Holstein, Magnus of Holstein was given the Bishopric of Ösel-Wiek by his brother King Christiern of Denmark (Arbusow 1918, 188). He soon tried to extend the rule by pressuring the remaining provinces of the Livonian Confederation. In 1560 Magnus had the bailiff of Soneburg — Heinrich von Lüddingshausen-Wulff — arrested to pressure him to cede his bailiwick to the Dane (Arbusow 1918, 189). The same was arrested in Pärnu by mercenary cavalry of the Order for the non-payment and was brought to Arensburg, where he was imprisoned by Magnus, allegedly to settle the matter, but probably because for revenge and to gain possession of Soneburg (Cröger 1870, 167), which he gained possession of together with Hapsal and Leal, for forfeiting the Bishopric of Courland in turn (Cröger 1870, 177).

Conclusively, it can be summarised that the fertility of the island of Ösel/Saaremaa favoured the cultivation of grain while the hydrology of the island provided a favourable environment for piracy and other forms of asymmetrical warfare to emerge. The climatic factor increased the island's defensibility, but also its isolation. Aside from the colonization, which ensued in the wake of the Baltic Crusades, some population patterns remained very stable throughout the centuries (e.g. Swedish population on Estonian islands), and strategic geo-political objectives as followed by the kingdoms of Sweden and Denmark seem to have changed little in this area over the centuries, possibly because of the continued importance of the trade route into Russia, or the possibility to disrupt it from hostile bases in the Baltics.

## 7. GENERAL CONCLUSIONS

In each section the method of enquiry was geared to an aspect of shipbuilding, navigation or trade and examined within the framework of a case-study. Naturally, these case studies differed vastly both in their relative spatiotemporal context and subject, so each section was concluded in its own right.

Nevertheless, some general observations can be made.

► **Early Bremen-type ships:** Amongst the 13<sup>th</sup>-century large ship-finds in the home-waters of the Danish and German crusading factions, ships built in the Scandinavian/Nordic tradition still prevail in numbers (cf. Englert 2015), while early Bremen-type variants have just appeared on the scene (section 2.3). However, on opposite shores, it is predominantly Bremen-type vessels which can be encountered in Baltic waters (Aegna, Matsalu, Pärnu) or on a presumed long-distance routes into this region (e.g. Kuggmären, Bossholmen, Egelskär, Kronholm). And although the Riga 3 wreck was no true Bremen-type, it nevertheless displays some comparable features and may be a transitional form or a variant in its own right. Aside from the overwhelming presence of the Bremen-type, there are some smaller Nordic clinker-built vessels in Finnish waters which might have served the coastal trade, none of them showed the hallmarks of a long-distant trading vessel like the Egelskär wreck (cf. Wessmann 2006). The over-representation of early Bremen-type vessels in the Baltics and nearby areas may suggest that this type was particularly suited for long-distance voyages into often hostile waters.

► **Variants and intermediate forms:** The early phase for the emergence of Bremen-type vessels is characterised by mixed features (section 2.3.5), which deviate from a pre-defined set of type-specific characteristics. This exposes problems still encountered in creating a typology for ship-finds, which do not adequately factor in so-called "hybrid" types (paper A, 345ff.; paper B) and may obscure the classification procedure. The case studies of the Riga 3 ship (section 4.1) and the clinker-building phase of the Maasilinn ship (section 6) highlight the long-term presence of what has been termed as "modern lapstrake constructions" by Jan Bill (2009b), i.e. ships with mixed features from Scandinavian/Nordic-type vessels and the Bremen-type. As such, it might have been a building tradition in its own right.

► **Cogs and long-distance voyages:** Cogs seem to have been deployed in strikingly similar roles both in the Baltic and the Mediterranean Sea. In the early phase of the Baltic Crusades, cogs were provided by

the merchant community which fulfilled an intermediary role in organising the maritime logistics for Livonian-bound crusaders. As such, the Gotlandic merchant community seem to have played a pivotal role (cf. section 2 and 4). A similar role could have been played by the Basques, who likewise facilitated long-distance transits between Flanders and the western Mediterranean Sea (cf. paper E). Historical sources indicate that cogs were the predominant vessels of the Basques, which were clinker-built. Another aspect of this mediator role is neutrality: Both the Gotlanders and Basques were often not involved in the conflicts themselves.

► **Itineraries and rutters:** Maritime logistics in the times of the crusades cannot be understood without examining the medieval cosmography. Some shipwreck-locations and toponyms can be indeed related to places described in itineraries and rutters, although all associations have to ultimately remain in the realm of speculation.

► **Timber-trade and shipbuilding:** Although the access to timber sources can be reflected in the quality of the ship-timbers, as the Maasilinn ship is likely to reflect in terms of its limited access to import timber as a condition of its rural origin – reflected in the choice of lower quality wood species and a makeshift conversion (cf. section 6) –, an attempt to infer such patterns on a broader scale (section 5, paper D) has not satisfactorily demonstrated whether shipbuilding-techniques were in any way responsive to the availability of timber through trade networks, although several hypotheses were proposed on the basis of some observed anomalies. This can be partially explained by limiting factors, such as the uncertainty of whether ship-timbers with a Baltic provenance excavated in the North Sea area actually arrived there as imported timber, which cannot be known in most cases. Although – as pointed out in section 2.2.4.4 – there might be a tendency of ships being predominantly scrapped in home-ports, in which case a Baltic-provenance in a North Sea port would be indicative of an imported timber, this tendency has not been quantifiably verified yet. Moreover, the North Sea as chosen investigation area for this comparative study – although vast in itself – may not be a sufficient remit for a case study, as comparisons to the Baltic Sea seem critically important for such a comparative approach. Another restricting factor is that the study only examined plank dimensions without relating them to the overall dimensions of the ship-finds. Thus, the hypotheses set up in section 5 have to remain largely unanswered for the time being, but can help to guide future enquiry into this subject.

## 8. SUMMARY

This study examines the maritime organisation of predominantly Danes and Germans in the period of the Northern Crusades, which includes navigation and orientation, fleet organisation, but also shipbuilding and the establishment of a maritime trade network and other maritime-related infrastructure. While the chronological framework of this study is defined by a historical period of the Northern Crusades – defined in the introductory chapter 1 – spanning four centuries, a great variety of historical and archaeological sources are addressed in the course of the investigation. This study starts with an examination of the natural physical landscape of the Baltic Sea and how its populations adapted to geographical and climatic factors in the maritime sphere.

Chapter 2 examines the logistical links from the North Sea to the Baltic Sea, bypassing the Jutland peninsula, which opened up to a large-scale colonization and urbanisation movement and long-distance trade networks from western European, particularly from Danish and German places of origin in the wake of the Wendish, Baltic and Prussian crusades, starting in 1147. The foundation of Schleswig and Lübeck and the growing importance of the *Ummelandfahrt* are identified as paradigm shifts, which can be both corroborated by privileges on the one hand and ship-finds on the other hand. Early Bremen-type vessels seem to have played a particularly important role, and presently the overwhelming evidence points for a southern Jutlandic origin of this type. The great variances observed in the constructional characteristics strongly suggest a maritime organisation that was not bound to a singular local tradition, but can be most likely linked to long-distance trade networks of this time, which bounded merchants of different denominations together, such as the Gotlandic-Lübeckian *gilda communis* or the *fraternities danicum* in Cologne.

While the previous chapter was most focussed on the legal and environmental precondition as well as the driving forces – i.e. actors – behind the opening up of the Baltic Sea, chapter 3 also investigates maritime organisation, but its practical aspects, i.e. navigation, orientation and fleet organisation. A major focus of

this chapter lies on the re-evaluation of a 13th-century itinerary – colloquially known as King Valdemar's Itinerary – describing the sea route between the then Danish territories of Blekinge and Estonia, along the Swedish and Finnish coastline. By drawing analogies to similar sources which served the orientation and army and fleet logistics, a new interpretation can be suggested according to which the itinerary was meant as basis for calculating travel time and organising leading fleets. This chapter is first and foremost focussed on Danish maritime logistics to its Estonian enclaves.

This is compared and contrasted to an evaluation of actual 13th-century ship-finds in chapter 4 in the wider region associated with the Baltic Crusades, i.e. Riga (historical province of Livonia, today Latvia), the Matsalu Bay (Estonia), Kuggmaren (Sweden) and Egelskär (Finland), all of which – except the Riga 3 ship – are Bremen-type vessels too. In the concluding section, the question is raised whether Bremen-type vessels correspond to the historical cog type, which was frequently mentioned in contemporary chronicles and source in connection with the crusades in general (as was deduced in paper E) and this region in particular.

In contrast to the preceding parts, chapter 5, is first and foremost focused on trade – i.e. Baltic timber trade – and examines the probable impact of the availability of high quality Baltic oak on western European shipbuilding. The Beluga Ship (paper C) is introduced as exemplary case study, from which contextual study (paper D) further research questions are derived, assessing the use of timber imports in the light of possible cost-benefit decisions.

Chapter 6 examines the local transport geography of a castle where lime was cut and distributed via ship. A nearby wreck's role within this context is analysed. In its conclusion, Chapter 6 takes a *longue durée* approach to make a hypothesis for Saaremaa's strategical importance, reaching back in time to the very beginning of the chronological framework of this study, i.e. the early attempts of the Danes to gain a foothold on Saaremaa in the Valdemarian period in the 12th and 13th centuries.



## 9. ZUSAMMENFASSUNG

Diese Arbeit spiegelt den Versuch wider, Schiffwracks und Aspekte der Maritimen Kultur in den historischen Kontext der Nordischen Kreuzzüge (von 1147 bis 1561) zu stellen. Hierbei wird Fernand Braudels *longue durée* Ansatz verfolgt, um die Entwicklungen im Schiffbau und der Seefahrt in eine geografische Langzeitperspektive des Nord- und v.a. des Ostseeraums zu stellen, wobei Aspekte der greifbaren Landschaft (wie Küstenformationen, die zur terrestrischen Navigation dienten, oder der Waldreichtum des südöstlichen Ostseeraums und dem daraus resultierenden Holzexport für den Schiffbau) aber auch der kognitiven Landschaft (durch die mittelalterliche Kosmografie geprägt) Rechnung getragen werden. Diese Studie nimmt sich dem *frontier zone* Konzept in zweierlei Hinsicht an: Einerseits mit Bezug der christlichen Seefahrer in Gewässern der letzten Heiden Nordeuropas und andererseits mit Bezug auf Wasser als natürliche Grenze, aber zugleich auch als Raum der Möglichkeiten für Gesellschaften mit einer hochentwickelten maritimen Organisation.

Einige wichtige methodischen Fragen bezüglich der Vergleichbarkeit von historisch überlieferten Typen und archäologischen Traditionen werden in diesem Kontext nachgegangen, besonders mit Hinblick auf die essentialistische Ausrichtung ersterer und der materialistischen Ausrichtung letzterer. Der *longue durée* Ansatz hat sich als wichtig erwiesen um beide Disziplinen zusammenzuführen.

Aufgrund der hier behandelten gewaltigen Zeitspanne wird kein Versuch unternommen eine ganzheitliche Geschichtserzählung zu den Nordischen Kreuzzügen aus maritimer Sicht darzulegen, sondern bestimmte Interessenschwerpunkte werden definiert und in Fallstudien exemplarisch — meist anhand eines Schiffwracks — aufgearbeitet.

Zudem wurde diese Dissertation kumulativ — d.h. publikationbasiert — eingereicht, auf der Grundlage von fünf Artikeln in Konferenzbänden und Fachzeitschriften mit *peer-review* oder identischen Auswahlkriterien. Die Themen und Ergebnisse dieser fünf Publikationen werden im Rahmentext an verschiedenen Stellen aufgegriffen, diskutiert und z.T. sogar selbstkritisch hinterfragt, was exemplarisch den Arbeitsfortschritt des Autors veranschaulicht.

### Kapitel 1: Einleitung

Neben der Zielsetzungen des Studie wird der Umfang, Einschränkungen und für dieses Thema relevante Forschungsgeschichte vorgestellt, wobei der Schwerpunkt auf die Besonderheit von Schiffsfunden als eigenständige archäologische Kategorie gelegt wird, deren Auswertung einer besonderen Methode bedarf. Da diese Studie darauf abzielt Schiffwracks in

ihren raumzeitlichen Kontext zu stellen, wird das Konzept der "maritimen Logistik" herangezogen, um die vielfältigen Anknüpfungspunkte aufzuzeigen (1.2.2). Der Zeitraum wird durch die historisch definierte Epoche der "Nordischen Kreuzzüge" vorgegeben; ein unter Historikern nicht unumstrittener Begriff. Daher wird eine Definition des Begriffes und eine kleine Forschungsgeschichte zu den Nordischen Kreuzzügen vorangestellt (1.2.3).

### Kapitel 2: Die Ostsee als maritime Landschaft

Um die naturräumlichen Bedingungen für das Leben an den ostseeischen Küsten und der Schifffahrt zu begreifen bedarf es eines Überblickes durch welche geomorphologischen und klimatologischen Einflüsse der Ostseeraum geformt wurde (2.1), aus der sich einige regionspezifische Verhaltensweisen der dort beheimateten Bevölkerungen erklären, von denen einige mit maritimen Bezug im Abschnitt anthropogene Landschaften (2.2) aufgeschlüsselt werden: Sowohl der Fischfang in Schonen (2.2.1), die rudimentären Navigationstechniken die im Ostseeraum noch immer Anwendung fanden als in anderen Meeren bereits mit wissenschaftlichen Hilfsmitteln navigiert wurde (2.2.2.), wie auch die saisonale Logistik auf dem Wasser und dem Eis, die im stetigen Wechselspiel stattfanden – die Schifffahrt in den warmen Jahreszeiten und die Kreuzzüge in den kalten Jahreszeiten – (2.2.3.) können allesamt durch die speziellen naturräumlichen Gegebenheiten erklärt werden, an die sich die Ostsee-Bevölkerungen nicht nur angepasst, sondern diese sich regelrecht zunutze gemacht haben. Anschließend werden Überlegungen angestellt, ob die Verteilung von Schiffsfunden auch bestimmten Mustern unterworfen ist, welche die naturräumlichen und transportgeografischen Gegebenheiten widerspiegeln und nicht nur Hinweise zu dessen Repräsentationsgrad sondern auch zu Transportnetzwerken liefern kann (2.2.4.). Da sich der Ostseeraum seit Mitte des 12. Jahrhunderts für Westeuropa stärker öffnete mit der einsetzenden Kolonisierung und Urbanisierung der südlichen und östlichen Ostseeküsten, neuen Weithandelsverbindungen und dem Aufstieg der Hanse im Zuge der territorialen Landnahme der wendischen, baltischen und preussischen Kreuzzüge, wird im folgenden Abschnitt (2.3) untersucht über welche Transportzonen oder Häfen eine westeuropäische Seeanbindung erfolgte, wobei die verkehrstechnische Rolle der wichtigsten Routen aus historischer und archäologischer Sicht beleuchtet werden. Die erste Route führt um das Skagerrak und wurde als Ummelandfahrt bezeichnet (2.3.1.), die zweite führt durch den Limfjord (2.3.2.), bei der dritten handelt es sich um Schlewigs Rolle als Fernhandelshafen und dessen Westanbindung über

die Hollingstedter Landverbindung (2.3.3.) und die letzte Route führt über Lübeck (2.4.4) das ebenfalls über eine westliche Landverbindung nach Hamburg und später auch eine Kanalverbindung verfügte. Diese Transportknotenpunkte werden nur in Kürze im Hinblick auf Schiffsfunde und Fernkontakte beleuchtet, da sie den thematischen wie logistischen Ausgangspunkt für Fahrten dienten, die in die östlichen Provinzen führten in denen die Kreuzzugsbewegung aktiv war.

### **Kapitel 3: Maritime Logistik in unkartierten Gewässern**

Der Titel ist in zweifacher Hinsicht relevant, da er zum einen die Schifffahrt in der Fremde widerspiegelt, zum anderen aber auch darauf anspielt, dass die besprochene Zeitepoche eigentlich eine kartenlose Zeit war und Routen v.a. mündlich, z.T. schriftlich, aber fast nie grafisch festgehalten wurden.

Um diese — für den modernen Menschen — völlig fremdartige Vorstellung von der mittelalterlichen Welt und der Orientierung in dieser darzustellen, wird das Kapitel (3.1) mit einem Blick auf die mittelalterliche Kosmografie eröffnet, welche Beispiele aufzeigt, wie das Weltbild durch eine noch unsäkularisierte Geografie geprägt wurde, und wie dies *de facto* die Landschaftswahrnehmung beeinflussen konnte, und nicht zuletzt die Fahrtrouten. Diese werden im nächsten Unterkapitel (3.2) im Rahmen von Itineraren thematisiert. Basierend auf der römischen Tradition der Listenkarten und Itineraren, folgten auch im Mittelalter Heereszüge einer itinerarisch vordefinierten Route. In diesem Kapitel wird aufgezeigt, wie stark diese römische Tradition noch im Mittelalter präsent war, was u.a. im Ausbau eines Heeres-Straßensystems verbunden war, und wie ein mögliches maritimes Pendant zu diesem aussehen könnte, abgeleitet aus historischen Quellen und einer Siegelabbildung.

Eine für dieses Thema sehr relevante Quelle ist das See-Itinerar in König Waldemars II Erdbuch, das eine Reiseroute entlang der schwedischen und finnischen Küste vom schonischen Utlängan zum estnischen Reval beschreibt; beide Landesteile im Besitz der dänischen Krone zur Zeit der Baltischen Kreuzzüge. Dieses wird in Kapitel 3.3 aus mehreren Blickwinkeln neu bewertet. Interessanterweise wurde weder das Itinerar noch das waldemarische Erdbuch umfassend historisch aufgearbeitet, so dass diese Quelle oftmals von Nicht-Historikern herangezogen wurde, darunter von vielen Archäologen in der Bewertung der maritimen Kulturlandschaft Schwedens. Bislang war die am weitesten verbreitete Meinung unter Archäologen, dass das Itinerar keinesfalls in Zusammenhang zu den Kreuzzügen stehen kann, da in der gleichen Kompilation auch ein anderes Itinerar zu finden ist, das eine Reiseroute von

Ripen nach Akkon aufzeigt und in identischer Form bereits Adam von Bremens *Gesta Hammaburgensis Ecclesiae Pontificum* beiliegt, die mehr als eine Dekade vor dem ersten Kreuzzug von 1095 abgefasst wurde. Diese weitverbreitete Meinung zeigt auf, wie wenig vertraut Archäologen oft mit dem quellenkritischen Ansatz der Geschichtswissenschaften sind, denn dieses Paradox konnte leicht dadurch relativiert werden, dass das Itinerar von Ripem nach Akkon dem Adamschen Werk posthum beigelegt wurde und auf einem Bericht eines dänischen Kreuzzüglers basiert, der zwischen 1200 und 1230 abgefasst wurde. Zudem existierte zu dieser Zeit noch nicht das Konzept eines "Kreuzzuges", sondern ein solches stand in der Tradition einer Pilgerfahrt, den es auch schon zu Adam von Bremens Zeit gab.

Die Implikationen dieser Erkenntnis lässt auch das See-Itinerar von Utlängan nach Reval in einem veränderten Licht erscheinen, da es zusammen mit besagtem Itinerar von Ripen nach Akkon im waldemarischen Erdbuch enthalten war. Zunächst wird der Frage nachgegangen, inwieweit beide Itinerare Ausdruck einer kreuzfahrerischen Doktrin war und wie sich beide in das mittelalterliche Weltbild eingefügt haben (3.3.2).

Obwohl dieser Abschnitt sehr hypothetisch ist, werden einige Hinweise erbracht, dass beide Itinerare im weitesten Sinne Routen ins Heilige Land darstellten, da Reval bzw. das Baltikum eine Zwischenstation der alten Warägerroute in den Orient über den *Tanais* bzw. das russische Flusssystem darstellte. Dieser mögliche Zusammenhang wird v.a. durch die *orbis terrarum* Karten hergestellt, dessen Bedeutung für die mittelalterliche Kosmografie bereits zuvor (3.1) hervorgehoben wurde. Auf dieser Grundlage ergibt sich eine neue Lesart der Quelle. Auf der Basis von im Itinerar genannten Orten, der etymologischen Herleitung von Toponymen, dem Streckenmaß und der Heterogenität der Quelle, sowie im Vergleich zu einem anderen zeitgenössischen Itinerar, wird in den folgenden Unterkapiteln die Quelle aus verschiedenen Blickwinkeln betrachtet, mit dem Ergebnis, dass das See-Itinerar höchstwahrscheinlich als Berechnungsgrundlage für Flottenbewegungen in die estnischen Provinzen diente, und möglicherweise ein Zusammenhang zum dänischen *Leding*-System der Küstenverteidigung besteht, das auch seit den Wendischen Kreuzzügen offensiv eingesetzt wurde.

### **Kapitel 4: Schiffe in Grenzregionen**

Eng mit dem zeitlichen und geografischen Kontext des obigen Kapitels verknüpft, wird nun der Frage nachgegangen, welche Art Schiffe in der baltischen Region operierten, und christliche Enklaven mit Getreide, Baumaterialen, Siedlern und jährlich eintreffenden Kreuzfahrerkontingenten versorgten. In der Archäologie werden Schiffe zumeist einer

kulturellen Bautradition zugeordnet. Dieser Ansatz wäre hier verfehlt, da die Kreuzfahrerbewegungen im Ostseeraum sich stark überschneiden und nicht auf staatlicher Ebene orchestriert wurden, sondern sich oft aus Fahrtgemeinschaften — sogenannten *fraternitas* — zusammensetzten, wobei für die deutsche Kreuzfahrerbewegung nach Livland v.a. Gotlandfahrer eine zentrale Rolle beikam. Zudem fielen die nordelbischen Territorien und Lübeck von 1201 bis 1227 unter dänische Herrschaft, und es gibt Anzeichen, dass Lübeck seine maritimen Anschluss im Ostseeraum v.a. der Dänenzeit verdankt.

Das erste Fallbeispiel (4.1) behandelt die Hafententwicklung Rigas und ein Schiffswrack (Riga 3), das in die Gründungsphase der Stadt datiert, welche nach Lübeck die zweite deutsche Stadtgründung (1201) an der Ostsee ist und als Hauptstadt Livlands den wohl wichtigsten verkehrs- und handelstechnischen Knotenpunkt des Baltikums bildete. Obwohl das Riga 3 Schiff vielfach als Kogge angesprochen wurde, weist es einige Merkmale auf, die eindeutig von der herkömmlichen Koggen-Definition abweichen. Die Schiffshölzer eines Wracks aus der Matsalu Bucht in Estland (4.2) werden vom Autoren bestimmt und interpretiert. Aufgrund des fragmentarischen Zustands und der ungenauen Datierung lassen sich keine festen Rückschlüsse ableiten. Dennoch lassen die eigenwillige Dimensionierung der Bodenwangen und einige andere konstruktive Eigenheiten den Schluß zu, dass es sich hierbei um ein Schiff der Bremen-Typs handelt. Ein weiteres Schiff des Bremen-Typs wird in dem folgenden Fallbeispiel zum Kuggmären Wrack von ca. 1215 beleuchtet, welches vor einer Insel der Stockholmer Schären gesunken war (4.3). Da hier bereits eine detaillierte Konstruktionsanalyse durch die Ausgräber erfolgt ist, wird dieses Wrack im Hinblick auf dessen möglichen Rolle im Transportnetzwerk beleuchtet. Die hier aufgestellten Hypothesen basieren auf den Ergebnissen einer makrobotanischen Untersuchung von Proben aus der Bilge, die dem Autoren zur Verfügung gestellt wurden. Diese ergab, dass das Schiff vorgereinigte Gerste transportierte. Obwohl Gerste nicht nur Futtermittel war, zeigt ein ähnliches Wrack mit identischer Herkunft rund 240 km südlich des Wracks — das um 1240 datierende Bossholmen Wrack — eine ganz ähnliche Ladung an Getreide auf, sowie Aaskäfer, die in Pferdemist zu finden sind. Zudem wurde auf letzteren Wrack auch Moosrückstände einer Spezies sichergestellt, die nur auf den Åland Inseln vorkommen. Im weiteren Teil wird anhand von historischen Ereignissen dieser Zeit spekuliert, ob der Getreide- bzw. Pferdetransport entlang der schwedischen Küste möglicherweise mit der dänischen Kreuzfahrerbewegung in Estland im Zusammenhang stehen könnte, nicht zuletzt da beide Schiffswracks auf der im waldemarischen See-Itinerar beschriebenen Strecke versanken. Abschließend wird das Egelskär Wrack aus der zweiten Hälfte des 13. Jahrhunderts behandelt, dass aufgrund seiner Ladung

eindeutig im Kontext eines Fernhandelsfahrers zu interpretieren ist und wahrscheinlich in einen hanseatischen Bezug gestellt werden kann (4.4). Auch dieses operierte auf einen im See-Itinerar beschriebenen Streckenabschnitt. Basierend auf diesen Fallbeispielen, wird abschließend (4.5) diskutiert inwieweit der archäologisch häufig nachgewiesene Bremen-Typ mit den Koggen korrelieren könnte, die — nach zeitgenössischen Chroniken und Quellen — für die Kreuzzüge im Allgemeinen und diesen Raum im Besonderen eine wichtige Rolle gespielt haben.

## **Kapitel 5: Ostseeischer Holzexport und dessen Auswirkung auf den Schiffbau**

Ein Kernthema der Dissertation ist ein Wrackfund aus Bremen — das Beluga-Schiff — welches bereits 2007 vom Autoren ausgegraben und dokumentiert wurde und auf den ersten Blick wenig Relevanz zum Thema der Dissertation aufweist. Allerdings hat die Erkenntnis, dass einige der Plankenhölzer — sogenanntes "Wagenschot" also hochqualitatives astfreies Eichenholz aus wildwachsenden Wäldern — von Bäumen stammen, die bis ins späte 14. Jahrhundert im Baltikum gefällt wurden, das Wrack in einen neuen interessanten Focus gerückt: Der Holzexport aus Häfen des Deutschen Ordens, in diesem Falle vermutlich Riga.

Die baulichen Merkmale erinnern allerdings an die skandinavische Schiffbautradition, wobei anzumerken ist, dass diese auch über Skandinavien hinaus — z.B. den Britischen Inseln — verbreitet war. Während zunächst ein Abriss über die Ergebnisse der dendrochronologischen Untersuchung und die baulichen Merkmale erfolgt, werden im folgenden Abschnitt die Zwischenergebnisse der Studie dargelegt, in der das Beluga-Schiff in den Kontext von über 50 anderen klinkerbauten Schiffsbefunden aus dem erweiterten Nordseeraum — inklusive dem Englischen Kanal und der südöstlichen Nordatlantik, Skagerrak und Kattegat — aus dem Zeitraum zwischen 1300 und 1540 stellt, um das Beluga-Schiff besser einzuordnen.

Die vergleichende Studie hat gezeigt, dass rund ein Drittel aller Wracks dieser Zeit mit Planken gebaut wurden, die aus dem Ostseeraum stammen. Allerdings darf das Beluga-Schiff auch weiterhin als Unikum gelten, denn es ist eines der wenigen Wracks, dessen Bauholz aus dem Baltikum stammt, d.h. höchstwahrscheinlich aus dem Düna-Flusstal, wohingegen alle übrigen Importhölzer aus dem Gebiet der Weichsel und anderer Flüsse im heutigen Polen und Litauen stammen und v.a. über Danzig verschifft wurden. Ein weiteres Anliegen dieser Studie war eine statistische Auswertung von Schiffsholz-Maßen mit Bezug auf Ursprung, was allerdings aufgrund großer Daten-Lücken nicht

möglich war und daher statistisch wenig Sinn ergeben hätte.

Um das Alleinstellungsmerkmal des baltischen Ursprungs zu beleuchten, wird der Frage des Wagenschot-Handels nachgegangen. Nach einer Definition und einem Abriss wie vielfältig Wälder genutzt wurden, mit der Feststellung, dass der Bedarf an Schiffbauholz in Konkurrenz zu vielen anderen Nutzungsarten stand, wird aufgezeigt wann der Handel mit Wagenschot begann und in welchem Umfang. Erst im Verlauf des späten 16. Jahrhunderts wurde Danzigs Rang als Hauptexporthafen von anderen Städten wie Riga und Königsberg in Frage gestellt.

Vor diesem Hintergrund zeigt der Befund des baltischen Plankenholzes des Beluga-Schiffs einen frühen Zugang zu einem noch relativ unerschlossenen — in den Anfängen befindlichen — baltischen Holzexportmarkt. In diesem Zusammenhang könnte die skandinavische Bauweise einen wichtigen Hinweis liefern, denn livländische Holzprodukte wurden seit dem frühen 14. Jahrhundert auf den schonischen Messen gehandelt, wo Skandinavier und v.a. Dänen Zugang zu Produkte hatten, die über Riga exportiert wurden. Abseits der Hauptexportroute für Holz, über Danzig nach West- und Mitteleuropa v.a. England und Flandern, könnte das Beluga-Schiff als Musterbeispiel für eine weitaus weniger bekannte Handelsroute dienen.

Zuletzt wird der Frage nachgegangen, ob das stetige Anwachsen des Holzexportmarktes einen Einfluss auf den Schiffbau hatte, insbesondere mit Hinblick auf Klinkerkonstruktionen — für dessen Beplankung meist radial gespaltenes Wagenschot verwendet wurde — und bodenbasierten ("bottom-based") Konstruktionen — für die meist tangential gesägte Bretter verwendet wurde. Es wird aufgezeigt, dass letztere Kategorie möglicherweise synonym zu sogenannten "Koggenborten" sein könnte und inwieweit die Quantität und Qualität der Holzprodukte ausschlaggebend für die Konstruktion gewesen sein könnte. Beide Holzprodukte — Wagenschot wie Koggenbort — setzten aufgrund ihrer Beschaffenheit eine völlig unterschiedliche Verarbeitungsweise voraus. Zuletzt wird die Frage aufgeworfen, ob das "Aussterben" großer bodenbasierter Konstruktionen mit der gestiegenen Verfügbarkeit von Wagenschot als günstige und zugleich hochqualitative Massenware zusammenhing, und letztendlich von reinen Klinkerkonstruktionen (und natürlich Kraweel-Konstruktionen) verdrängt wurde? Obwohl diese Frage nicht abschließend beantwortet werden kann, zeigt eine Zusammenstellung an 15 Wracks, die alle mit Importholz gebaut worden sind, diesen Trend deutlich auf.

## Kapitel 6: Versunken im Schutt der Livländischen Konföderation

Die Arbeit wird mit einer Fallstudie um das um 1550 datierende Maasilinn Wrack abgeschlossen, dass zu Fuße der Soneburg auf der estnischen Insel Ösel entdeckt und bereits in den 1980ern gehoben wurde. Dieses Wrack ist in vielerlei Hinsicht interessant, da es einem Brand zum Opfer fiel und womöglich den kriegerischen Konflikt widerspiegelt, die den Untergang des letzten verbliebenen Ordens- bzw. Kreuzfahrerstaates einläutete. Es hatte Kalk geladene, das zu Fuße der Burg abgebaut und verschifft wurde und somit die regionale Transportgeografie aufzeigt, und wies zudem noch eine seltene Hybrid-Konstruktion auf, wo die klinkergebaute Rumpfschale von einer zweiten kraweelen Beplankung umschlossen war.

In einer Neuinterpretation des Wracks wird sowohl die Art der Ladung, wie die Bausequenz und die möglichen Gründe für diese Konstruktion evaluiert. Die Ausgräber des Wracks erwähnen, dass das Wrack Rückstände an gelöschten Kalk (*Calciumhydroxid*) in der Bilge aufweist. Allerdings hält dieser Autor es für viel wahrscheinlicher, dass es zunächst als ungelöschter Kalk (*Calciumoxid*) an Bord kam. Wenn letzteres mit Wasser reagiert und sich in *Calciumhydroxid* umwandelt, wird große Hitze freigesetzt, was die Brandursache erklären würde. Ob Unfall oder kriegerische Auseinandersetzung, noch im Spätmittelalter fand ungelöschter Kalk Verwendung als thermische Waffe. Die Kielkonstruktion scheint aber direkt so ausgelegt, dass sich das Bilgenwasser in einem tiefen Kiel sammelt und so nicht mit der Ladung in Kontakt kommen konnte. Auch werden Überlegungen zur Bausequenz anhand einer Vergleichsstudie ähnlicher Wracks im Ostseeraum angestellt, wobei die Kernfrage darauf abzielt, ob die sekundäre Beplankung später hinzugefügt worden ist oder von vornherein so ausgelegt war. Anhand der dendrochronologischen und archäologischen Untersuchungen ist diese Frage nicht eindeutig zu klären.

Allerdings werden mögliche Gründe für diese Konstruktion ausgelotet (6.1.3), die sich auf Instandhaltung und Reparatur bezieht, die sekundäre Beplankung als Schutz vor häufigen Grundberührung mit Bezug auf das Flachwasser-Gebiet der Moonsund Inseln, oder als Schutz vor stärkeren Eisgang in der zeitgleichen Kleinen Eiszeit, und — als letzte Möglichkeit — ein Versuch das Fahrzeug wie ein Kraweelbau aussehen zu lassen, der gerade in dieser Zeit im Ostseeraum Einzug erhielt und ein größeres Prestige als profane Klinkerkonstruktionen hatte. Zur richtigen Einordnung des Wracks wird es in den geografischen Kontext gestellt, insbesondere der naheliegenden Ordensburg zu dem das Schiff höchstwahrscheinlich einstmals gehörte (6.2). Abschließend wird das braudelsche Konzept einer

*longue durée* auf die Transportgeografie dieser Landschaft angewendet, wobei gezeigt wird, dass viele historische Entwicklungen einer längerfristigen Raumordnung unterworfen sind und in dessen Lichte interpretiert werden können.

### **Generelle Schlussfolgerung**

Da in dieser Arbeit Fallstudien vorgestellt wurden, die nicht nur geografisch und chronologisch weit gestreut sind, sondern sich auch in den jeweiligen Fragestellungen stark unterscheiden, wurde jede Fallstudie mit einer eigenen Diskussion abgeschlossen. Dennoch lassen sich über den Zeitraum von über 400 Jahren einige übergreifende und wiederkehrende Themen identifizieren.

Eine wichtige Erkenntnis ist dass Schiffbautraditionen weder als statische Systeme zu sehen sind, noch zwingend einen speziellen Bezug auf eine kulturelle Verbindung aufweisen. Dies spiegelt sich insbesondere in den Frühformen des Bremen-Typs wider, der das maritim-archäologische Befundmaterial im baltischen Raum sogar noch stärker zu dominieren scheint, als in den heimischen Gewässern. Auch scheinen sich Schiffstypen grenzübergreifend ausgebreitet zu haben, insbesondere in strategisch wichtigen Verkehrsknotenpunkten die von Handelskonföderationen bereist wurden, deren Händlerschaft sich aus Personen aus verschiedenen Regionen und Ländern zusammen setzten.

## 10. BIBLIOGRAPHY

### 10.1. Primary literature, compiled and translated editions

Abbr	Source	Edition / translation
ACS	<i>Arnoldi Chronica Slavorum</i>	<ul style="list-style-type: none"> <li>Lappenberg &amp; Pertz 1868: J. Lappenberg and G. H. Pertz, <i>Arnoldi chronica Slavorum</i>. Monumenta Germaniae Historica C 30, (Hanover, 1868).</li> </ul>
ARF	<i>Annales regni Francorum</i>	<ul style="list-style-type: none"> <li>Abel 1850: O. Abel, <i>Einbards Jahrbücher</i>, (Leipzig, 1850)</li> <li>Kurze &amp; Pertz 1895: F. Kurze and G. H. Pertz, <i>Annales regni Francorum, inde ab a. 741 usque ad a. 829 : qui dicuntur Annales laurissenses maiores et Einhardi</i>, (Hanover, 1895).</li> </ul>
DD	<i>Diplomatarium Danicum</i>	<ul style="list-style-type: none"> <li>Blatt &amp; Hermansen 1938: F. Blatt and G. Hermansen, <i>Diplomatarium Danicum</i> 2.1: 1250-1265, (Copenhagen, 1938).</li> <li>Skyum-Nielsen 1979: N. Skyum-Nielsen, <i>Diplomatarium Danicum</i> 1.6. — 1224-1237 (Copenhagen, 1979).</li> </ul>
DS	<i>Diplomatarium Svecanum</i>	<ul style="list-style-type: none"> <li>Hildebrand 1842: B. E. Hildebrand, <i>Svenskt Diplomatarium</i> III.1, (Stockholm, 1842).</li> </ul>
DRB	<i>Danmarks Riges Breve</i>	<ul style="list-style-type: none"> <li>Blatt &amp; Skyum-Nielsen: F. Blatt and N. Skyum-Nielsen 1979, <i>Danmarks riges breve</i> I.6. (Copenhagen, 1979).</li> </ul>
GD	<i>Gesta Danorum</i>	<ul style="list-style-type: none"> <li>Christiansen 1981: E. Christiansen, <i>Saxo Grammaticus, Danorum regum heroumque historia</i> Vol. 2, British Archaeological Reports International Series 118.1 (Oxford, 1981).</li> <li>Friis-Jensen &amp; Zeeberg 2005: K. Friis-Jensen and P. Zeeberg, <i>Saxo Grammaticus: Gesta Danorum / Danmarkshistorien</i> 2 (Copenhagen, 2005).</li> <li>Elton &amp; Powell 1894: O. Elton and F. Y. Powell, <i>The first nine books of the Danish history of Saxo Grammaticus</i>, (London, 1894).</li> </ul>
<i>Gesta</i>	<i>Gesta Hammaburgensis ecclesiae pontificum</i>	<ul style="list-style-type: none"> <li>Schmeidler 1917: B. Schmeidler, Adam Bremensis. <i>Gesta Hammaburgensis ecclesiae pontificum</i>. Monumenta Germaniae Historica 2. (Hannover/Leipzig 1917).</li> </ul>
HCL	<i>Heinrici Chronicon Livoniae</i>	<ul style="list-style-type: none"> <li>Bauer 1975: A Bauer, <i>Heinrich von Lettland: Livländische Chronik</i> (Darmstadt, 1975).</li> <li>Brundage 2003: J. Brundage, <i>The Chronicle of Henry of Livonia</i> (New York, 2003).</li> </ul>
HCS	<i>Helmoldi Chronicon Slavorum</i>	<ul style="list-style-type: none"> <li>Schmeidler 1868: B. Schmeidler, <i>Helmolds Slavenchronik</i>. Monumenta Germaniae Historica C 30, (Hanover, 1937).</li> </ul>
HR	<i>Hanserecesse</i>	<ul style="list-style-type: none"> <li>Koppmann 1870: K. Koppmann, <i>Die Recesse und andere Akten der Hansetage von 1256-1430</i>, vol. I (Leipzig, 1870).</li> <li>Koppmann 1872: K. Koppmann, <i>Hanserecesse</i> I.2 (Leipzig, 1872)</li> </ul>
<i>Historia</i>	<i>Olaus Magnus: Historia de gentibus septem-trionalibus, (Rome, 1555)</i>	<ul style="list-style-type: none"> <li>Granlund 2010: J. Granlund, <i>Historia om de nordiska folken</i>, (Hedemora, 2010).</li> </ul>
HUB	<i>Hansisches Urkundenbuch</i>	<ul style="list-style-type: none"> <li>Höhlbaum 1876: K. Höhlbaum, <i>Hansisches Urkundenbuch</i> 1: 975-1300. (Halle 1876)</li> <li>Stein 1899: W. Stein, <i>Hansisches Urkundenbuch</i> 8: 1451-1463, (Leipzig, 1899).</li> <li>Stein 1916: W. Stein, <i>Hansisches Urkundenbuch</i> 11: 1486-1500, (Munich/Leipzig 1916).</li> </ul>
	<i>Liv-, Est- und Curländisches Urkundenbuch</i>	<ul style="list-style-type: none"> <li>Bunge 1855: F. G.v. Bunge, <i>Liv-, Est- und Curländisches Urkundenbuch</i> II, (Reval, 1855).</li> </ul>
LRC	<i>Livländische Reimchronik</i>	<ul style="list-style-type: none"> <li>Meyer 1876: L. Meyer, <i>Livländische Reimchronik</i> (Paderborn 1876).</li> <li>Smith &amp; Urban 1977: J. C. Smith and W. L. Urban (eds), <i>The Livonian Rhymed Chronicle</i>. Uralic and Altaic Series 128 (Bloomington, 1977).</li> </ul>
PrUB	<i>Preussisches Urkundenbuch</i>	<ul style="list-style-type: none"> <li>R. Philippi, A. Seraphim, M. Hein, K. Conrad et al.</li> </ul>
	<i>Scriptores Rerum Danicarum</i>	<ul style="list-style-type: none"> <li>Langebek 1783: J. Langebeck, <i>Scriptores Rerum Danicarum</i> (Copenhagen 1783).</li> </ul>
	<i>Scriptores rerum Prussicarum</i>	<ul style="list-style-type: none"> <li>Hirsch 1863: T. Hirsch, <i>Die litanischen Wegeberichte</i>. In: T. Hirsch, E. Toeppen, E. Strehlke (eds.), <i>Scriptores Rerum Prussicarum</i> 2 (Leipzig 1863), 663-744.</li> <li>Strehlke 1863: E. Strehlke, <i>Hermann de Wartberge Chronicon Livoniae</i>. In: T. Hirsch, M. Toeppen, E. Strehlke (eds), <i>Scriptores Rerum Prussicarum</i> 2. (Leipzig 1863), 9-178.</li> </ul>

## 10.2. Secondary literature

- Ågren & Svensson 2007: J. Ågren und R. Svensson, *Postglacial Land Uplift Model and System Definition for the New Swedish Height System RH 2000*. LMV-rapport 2007:4 (Gävle, 2007).
- Åkerlund 1951: H. Åkerlund, *Fartygsfynden i den Forna Hamnen i Kalmar*, (Uppsala 1951).
- Adams 2013: J. Adams, *A Maritime Archaeology of Ships. Innovation and Social Change in Medieval and Early Modern Europe*, (Oxford 2013).
- Adams & Rönby 2002: J. Adams und J. Rönby, Kuggmaren 1. The first cog find in the Stockholm archipelago, Sweden. In: *The International Journal for Nautical Archaeology* 31.2, 2002, 172-181.
- Adams & Rönby 2013: J. Adams and J. Rönby, One of His Majesty's 'Beste Kraffwells': the wreck of an early carvel-built ship at Franska Sternarna, Sweden. In: *The International Journal of Nautical Archaeology* 42.1, 2013, 103-117.
- Albrechtsen 2006: S. Albrechtsen, *Grunde, Rev og Flak*, (Roskilde, 2006).
- Allen *et al.* 2005: S. J. Allen, D. M. Goodburn, J. M. McComish and P. W. Rogers, Re-used boat planking from a 13th-century Revetment in Doncaster, South Yorkshire. In: *Medieval Archaeology* 49, 2005, 281-304.
- Allmand 2011: C. Allmand, *The 'De Re Militari' of Vegetius. The Reception, Transmission and Legacy of a Roman Text in the Middle Ages* (Cambridge, 2011).
- Alopaeus & Elvestad 2004: H. Alopaeus and E. Elvestad, Avaldsnesskipet - et "nordisk" skip fra Polen? In: T. Torfæus (ed.), *Mellom Vinland og "Ringens herre"*. Karmøyseminaret 2004 (Karmøy, 2004), 73-86.
- Aluve & Pärt 1986: K. Aluve and I. Pärt, *Aruanne Maasilinna laevavraki nr. 1 puidu dendrokronoloogilisest määrangust* (unpublished report of the Estonian Maritime Museum).
- Alvik & Haggren 2003: R. Alvik and G. Haggren: Keskiäikainen haaksirikko paikka Nauvon ulkosaaristossa. In: *Suomen keskiajan arkeologian seura (SKAS)* 2, 2003, 18-27.
- Anderson & Bamberger 1773: A. Anderson and J. P. Bamberger, *A. Andersons historische und chronologische Geschichte des Handels von den ältesten bis auf jezige Zeiten* (Riga, 1773).
- Andersson 1989, L. Andersson, *Pilgrimsmärken och vallfart: Medeltida Pilgrimskultur i Skandinavien*. Lund Studies in Medieval Archeology 7, (Lund, 1989).
- Andreasen & Grøn 1994: F. Andreasen and O. Grøn, Sløjkanalen – Limfjordens udløb mod nord. In: *Marinarkæologisk Nyhedsbrev fra Roskilde* 1994.3, 11- 14.
- Andrews 1925/26: M. C. Andrews, The Study and Classification of Medieval Mappae Mundi. In: *Archaeologica* 75, 1925/26, 61-76.
- Ankarberg 1995: C.-H. Ankarberg, Älvsnabben – Kapartillhall och flottbas i Stockholms skärgård. In: G. Flink (ed.), *Kung Valdemars segelled* (Stockholm, 1995), 103–110.
- Arbusow 1918: L. Arbusow, *Grundriss der Geschichte Liv-, Est- und Kurlands*, (Riga, 1918).
- Arens 1986: I. Arens: Nytt Vrakfynd i Estland. Om ett fartygsfynd från 1500-tallet vid Ordensfästningen Soneburg (estn. Maasilinn) på Ösel sommaren 1985. In: *Bottnisk Kontakt* 3, 1986, 46-50.
- Arentzen 1984: J.-G. Arentzen, *Imago Mundi Cartographica* (Munich, 1984).
- Auer 2009: J. Auer, *Fieldwork report. Ostsee Bereich IV, Fischland, FPL 7* (Esbjerg, 2009).
- Auer & Maarleveld 2013: J. Auer and T. Maarleveld, *Skjernøysund Wreck 3: Fieldwork Report 2011*. Esbjerg Maritime Archaeology Reports 5 (Esbjerg, 2013).
- Bately & Englert 2007: J. Bately and A. Englert, *Obithere's Voyages. A Late 9th-century Account of Voyages Along the Coasts of Norway and Denmark and Its Cultural Context* (Roskilde, 2007).
- Baykowski 1994: U. Baykowski, The Kieler Hanse-Cog – A Replica of the Bremen Cog. In: C. Westerdahl (ed.), *Crossroads of Ancient Shipbuilding. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology*, (Roskilde, 1991), 261-264.
- Belasus 2009: M. Belasus, Das hochmittelalterliche Schiff vor der Möweninsel bei Schleswig. In: U. Müller, S. Kleingärtner, F. Huber (eds.), *Zwischen Nord- und Ostsee 1997-2007: Zehn Jahre Arbeitsgruppe für maritime und limnische Archäologie (AMLA) in Schleswig-Holstein*, (Bonn, 2009), 89-98.
- Belov 1951: М.И. Белов, Арктические плавания и устройства русских морских судов в XVII веке. In: *Исторический памятник русского арктического мореплавания в XVII веке*. (Moscow, 1951).
- Bengtsson & Lovén 2012: H. Bengtsson and C. Lovén, Spår av den längre Erikslegenden. In: *Fornvännen* 107, 2012, 24-40.

- Benninghoven 1961: F. Benninghoven, *Rigas Entstehung und der frühhanseische Kaufmann*, (Hamburg, 1961).
- Benninghoven 1965: F. Benninghoven, *Der Orden der Schwertbrüder: Fratres milicie Christi de Livonia*, (Cologne, 1965).
- Benninghoven 1993: F. Benninghoven, Die Rolle des Rieghafens für Rigas Seeschiffahrt im 13. Jahrhundert. In: *Zeitschrift für Ostforschung* 42, 1993, 240-246.
- Bevan & Philot 1873/1969: W.L. Bevan and H.W. Philot, *Medieval Geography. An Essay in Illustration of the Hereford Mappa Mundi* (London 1873, reprint Amsterdam 1969).
- Bill, J. 1994. Iron Nails in Iron Age and Medieval Shipbuilding. In: C. Westerdaal, *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology (Roskilde, 1994), 55-64.
- Bill 1997: J. Bill, *Small Scale Seafaring in Danish Waters AD 1000-1600*. Ph.D. dissertation (Copenhagen, 1997).
- Bill 2009a: J. Bill, Zwischen Kogge und Kraweel. Traditioneller Kleinschiffbau in Südkandinavien in einer Zeit der Wende. In B. Scholkmann, C. Vossler and M. Wolf (eds.), *Zwischen Tradition und Wandel. Archäologie des 15. und 16. Jahrhunderts* (Büchenbach, 2009), 251-260.
- Bill 2009b: J. Bill From Nordic to North European - Application of Multiple Correspondence Analysis in the Study of Changes in Danish Shipbuilding A.D. 900-1600. In R. Bockius (ed.), *Between the Seas. Transfer and Exchange in Nautical Technology*. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology (Mainz, 2009), 429 - 438.
- Bill et al. 1997: J. Bill, B. Poulsen, F. Rieck and O. Ventegodt, *Dansk Søfarts Historie n° 1: Fra Stammebåd til Skib. Tiden indtil 1588* (Copenhagen, 1997).
- Bjørnbo 1912: A. A. Bjørnbo, *Cartographia Groenlandica*. Meddelelser om Grønland 48, (Copenhagen, 1912).
- Blomkvist 2005: N. Blomkvist, *The Discovery of the Baltic. The Reception of a Catholic World-System in the European North (AD 1075-1225)*. Northern World. (Leiden/Boston, 2005).
- Bøgh 2008: A. Bøgh, Korståge? Om den nyere korstogsbevægelse i dansk historieskrivning — samt en anmeldelse. In: *Historisk Tidsskrift* 108, 2008, 175-187.
- Bonde et al 1997: N. Bonde, I. Tyers and T. Wążny, Where does the timber come from? Dendrological evidence of the timber trade in Northern Europe. In: A. Sinclair, E. Slater and J. Gowlett (eds.), *Archaeological Sciences 1995* (Oxford, 1997), 201-204.
- Bonde & Jensen 1995: N. Bonde and J. S. Jensen, The dating of a Hanseatic cog-find in Denmark. In: O. Olsen, J. Skamby and F. Rieck (eds.), *Shipshape — Essays for Ole Crumlin-Pedersen*, (Roskilde, 1995), 103-122.
- Braudel 1992: F. Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II* (London/new York/Sydney/Toronto, 1992).
- Breide 1998: H. Breide, A few thoughts about 'The Baltic Itinerary'. In: M. Lindström (ed.), *The Marine Archaeology of the Baltic Sea Area. Conditions in the present; possibilities and problems in the future*. Research Report 1, (Stockholm, 1998), 44-59.
- Breide 2006: H. Breide, *Sjövägen till Estland. En medeltida färdbeskrivning från Utlången till Reval*. Ph.D. dissertation (Stockholm, 2006).
- Breusing 1876: A. Breusing, Das Seebuch in nautischer Beziehung. In: K. Koppmann (ed.), *Das Seebuch*. Niederdeutsche Denkmäler 1, (Bremen, 1876), 35-53.
- Briffa et al. 1990: K. R. Briffa, T.S. Bartholin, D. Eckstein, P.D. Jones, W. Karlén, F.H. Schweingruber and P. Zetterberg, A 1,400-year tree-ring record of summer temperatures in Fennoscandia. In: *Nature* 346, 1990, 434-439.
- Briffa et al. 1999: K.R. Briffa, P.D. Jones, R.B. Vogel, F.H. Schweingruber, M.G.L. Baillie, S.G. Shiyatov and E.A. Vaganov, European tree rings and climate in the 16th century. In: *Climate Change* 43, 1999, 151-168.
- Bronstein 2005: J. Bronstein, *The Hospitallers and the Holy Land. Financing the Latin East 1187-1274* (Woodbridge, 2005).
- Brown & Pluskowski 2013: A. Brown and A. Pluskowski, Medieval Landscape Transformation in the Southeast and Eastern Baltic: Palaeoenvironmental Perspectives on the Colonisation of Frontier Landscapes. In: *Archaeologia Baltica* 20, 2013, 24-46.
- Brumme 2010: C. Brumme, *Das spätmittelalterliche Wallfahrtswesen im Erzstift Magdeburg, im Fürstentum Anhalt und im sächsischen Kurkreis*. Europäische Wallfahrtsstudien 6, (Frankfurt a.M., 2010).
- Byström 1996: G. Byström, *Utö bergslagsområde: en sammanställning över de bergshistoriska lämningarna i Dalarö, Djurö, Muskö, Nämndö, Ornö, Tyresö, Utö,*



*Västerhaninge och Österhaninge socknar*. Atlas över Sveriges bergslag. Jernkontorets bergshistoriska utskott 104 (Stockholm 1996).

Cappers *et al.* 2000: R.T.J. Cappers, E. Mook-Kamps, S. Bottema, B.O. van Zanten and K. Vlierman, The analysis of caulking material in the study of shipbuilding technology. In: *Palaeohistoria* 39/40, 1997/98, 577-590.

Caune 1994: A. Caune, Die rigische Kogge. In: *Zeitschrift für Ostforschung* 43.4, 1994, 481-495.

Caune 1996a: A. Caune, Kaianlagen des Rigaer Hafens im 12.-13. Jahrhundert. In: *Slowianszczyzna w Europie sredniowiecznej* 2, 1996, 97-102.

Caune 1996b: A. Caune, Steinburgen des 12.-13. Jahrhunderts im Dünamündungsgebiet. In: *Castella Maris Baltici* 2, 1996, 19-28,

Caune 2004: A. Caune, Archäologische Zeugnisse über die Kaianlagen des ersten Rigaer Hafens im 12.-17. Jahrhundert. In: *About Hillfort and Town / Linnusest ja linnast*. Research into ancient times / Muinasaja teadus 14, (Tallinn/ Tartu 2004), 57-75.

Cederlund 1990: C.-O. Cederlund, The Oskarshamn cog, Part I. Development of investigations and current research. In: *The International Journal of Nautical Archaeology and Underwater Exploration* 19, 1990, 193-206.

Cederlund 1995: C.-O. Cederlund, Ledung ships, cogs and other medieval ship types in northern Europe. In: C.-O. Cederlund (ed.), *Medieval Ship Archaeology*. Stockholm Marine Archaeological Reports 1 (Stockholm, 1995), 11-25.

Celarek 1991: A. Celarek, Barkas – Die letzten rahbesegelten Arbeitsboote Europas. In: *Alte Schiffe* 4, 1991.

Čepelev 2002: V. Čepelev: Ein Fund der russischen Polarschiffahrt des 17. Jahrhunderts. In: *Skjyllis* 5.1, 2002, 70-75.

Christensen 1985: A. E. Christensen, Boat finds from Bryggen. In: A. E. Herteig (ed.), *The Archaeological Excavations at Bryggen, The German Wharf, in Bergen 1955-68*. Bryggen Papers Main Series I (Bergen, 1985), 47-278.

Christensen 1989: A. E. Christensen, Hanseatic and Nordic Ships in Medieval Trade. Were the Cogs Better Vessels? In: C. Villain-Gandossi, S. Busutil and P. Adam (eds.), *Medieval Ships and the Birth of Technological Societies* (Valetta, 1989), 17-24.

Christensen 2002: A. E. Christensen, Review of McGrail, 2002. In: *The International Journal of Nautical Archaeology* 31.2: 300.

Christiansen 1997: E. Christiansen, *The Northern Crusades*, (London 1997).

Chroust 1928: A. Chroust, *Quellen zur Geschichte des Kreuzzuges Kaiser Friedrichs*, (Berlin, 1928).

Constable 2008: G. Constable, *Crusaders and Crusading in the Twelfth Century* (Farnham/Burlington, 2008).

Cooke *et al* 2002: B. Cooke, C. Christiansen, L. Hammarlund, Viking woolen square-sails and fabric cover factor. In: *The International Journal for Nautical Archaeology* 31.2, 2002, 202-210.

Cröger 1870: C. Cröger, *Geschichte Liv- Ebst- und Kurlands 1346-1561*, 2 (St. Petersburg, 1870).

Crumlin-Pedersen 1980: O. Crumlin-Pedersen, Kyholm 78 — A joint archaeological-geological investigation around a 13th century wreck at Kyholm, Samsø, Denmark. In: *The International Journal for Nautical Archaeology and Underwater Exploration* 9.3, 1980, 193-216.

Crumlin-Pedersen 1983: O. Crumlin-Pedersen, Schiffe und Seehandelsrouten im Ostseeraum 1050-1350. In: *Lübecker Schriften zur Archäologie und Kulturgeschichte* 7, 1983, 229-237.

Crumlin-Pedersen 1984: O. Crumlin-Pedersen, Aspects of Wood Technology in Medieval Shipbuilding. In: O. Crumlin-Pedersen and M. Vinner (eds.), *Sailing into the Past*, (Roskilde, 1984), 138-149.

Crumlin-Pedersen 1997: O. Crumlin-Pedersen, *Viking Age Ships and Shipbuilding in Hedeby/Haithabu and Schleswig*. Ships and Boats of the North 2., (Schleswig/Roskilde, 1997).

Crumlin-Pedersen 2000: O. Crumlin-Pedersen, To be or not to be a cog. The Bremen Cog in perspective. In: *The International Journal of Nautical Archaeology* 29.1, 2000, 26-38.

Crumlin-Pedersen 2010: O. Crumlin-Pedersen, *Archaeology and the Sea in Scandinavia and Britain*. Maritime Culture of the North 3, (Roskilde, 2010).

Curry 2012: A. Curry, Crusader Crisis: How the Conquest Transformed Northern Europe. In: *Science* 338, 2012, 1144-1145.

Daly 2007a: A. Daly, *Timber, Trade and Tree-rings. A dendrological analysis of structural oak timber in northern Europe, c. AD 1000 to c. AD 1650*. Ph.D. dissertation, (Esbjerg, 2007).

Daly 2007b: A. Daly, The Karschau Ship, Schleswig-Holstein: Dendrological Results and Timber Provenance. In: *The International Journal of Nautical Archaeology* 36.1, 2007, 155-166.

- Daly 2011: A. Daly, *Dendro-geography. Mapping the Northern European historic timber trade*. In: P. Fraiture (ed.), *Tree Rings, Art, Archaeology*, (Brussels, 2011), 107-123.
- Daly 2013: A. Daly, *Dendrological analysis of samples from two shipwrecks, Matsalu and Lootsi, Estonia* (unpublished).
- Daly 2015: A. Daly, Dendrochronological analysis of medieval cargo ships from Danish waters. In: A. Englert (ed.), *Large Cargo Ships in Danish Waters 1000-1250*. Ships and Boats of the North 7 (Roskilde 2015), 356-374.
- Daly & Nymoen 2007: A. Daly and P. Nymoen, The Bøle Ship, Skien, Norway —Research History, Dendrochronology and Provenance. In: *The International Journal of Nautical Archaeology* 37.1, 2007, 153–170.
- Deforce *et al.* 2014: K. Deforce, L. Allemeersch, H. Stieperaere, and K. Haneca, Tracking ancient ship routes through the analysis of caulking material from shipwrecks? The case study of two 14th century cogs from Doel (northern Belgium). In: *Journal of Archaeological Science* 43, 2014, 299-314.
- Dokkedal 1996: L. Dokkedal, *Koggen i Nordeuropa fra 1150-1450 e. Kr.* Ph.D. Dissertation, (Copenhagen, 1996).
- Dollinger 1970: P. Dollinger, *The German Hansa*, (London, 1970).
- Dubrowin 1997: G. E. Dubrowin, Kalfatklammern als Indikatoren in der norddeutschen und Nowgoroder Schiffbautradition im Mittelalter. In: *Deutsches Schifffahrtsarchiv* 20, 1997, 445-458.
- Eckstein & Wrobel 2007: D. Eckstein and S. Wrobel, Dendrochronological proof of origin of historic timber — retrospect and perspectives. In: K. Haneca, A. Verheyden, H. Beekmann, H. Gärtner, G. Helle and G. Schleser, *TRACE - Tree Rings in Archaeology, Climatology and Ecology* 5, 2007, 8-20.
- Ekman 1996: M. Ekman, A consistent map of the postglacial uplift of Fennoscandia. In: *Terra Nova* 8, 1996, 158-165.
- Ellmers 1972: D. Ellmers, *Frühmittelalterliche Handelschiffahrt in Mittel- und Nordeuropa*, (Neumünster, 1972).
- Ellmers 1979: D. Ellmers, Schiffsarchäologie. In: H. Jankuhn & R. Wenskus (eds) *Geschichtswissenschaft und Archäologie. Untersuchungen zur Siedlungs-, Wirtschafts- und Kirchengeschichte*, (Siegmaringen, 1979), 485-518.
- Ellmers 1984: D. Ellmers, *Frühmittelalterliche Handelschiffahrt in Mittel- und Nordeuropa*. Offa-Bücher 28, (Neumünster, 1984).
- Ellmers 1985a: D. Ellmers, Bodenfunde und andere Zeugnisse zur frühen Schiffahrt der Hansestadt Lübeck. Teil 1: Bauteile von Koggen. In: *Lübecker Schriften zur Archäologie und Kulturgeschichte* 11, 1985, 155-162.
- Ellmers 1985b: D. Ellmers, Die Entstehung der Hanse. In: *Hansische Geschichtsblätter* 103, 1985, 3-40.
- Ellmers 1986: D. Ellmers. Die mittelalterlichen Stadtsiegel mit Schiffsdarstellung an der südlichen Ostseeküste. In: H. bei der Wieden (ed.), *Schiffe und Seefahrt in der südlichen Ostsee* (Cologne/Vienna, 1986), 41–88.
- Ellmers 1992: D. Ellmers, Bodenfunde und andere Zeugnisse zur frühen Schiffahrt der Hansestadt Lübeck. Teil 2: Bauteile und Ausrichtungsgegenstände von Wasserfahrzeugen aus den Grabungen Alfstrasse 38 und an der Untertrave/Kaimauer. In: *Lübecker Schriften zur Archäologie und Kulturgeschichte* 18, 1992, 7-21.
- Ellmers 2003: D. Ellmers, Alltag auf Koggen – nach Bildern, Funden und Texten. In: G. Hoffmann and U. Schnall (eds.), *Die Kogge – Sternstunde der deutschen Schiffsarchäologie* (Bremerhaven/Hamburg, 2003), 162-193.
- Ellmers 2005: D. Ellmers, Hansische Selbstdarstellung im Siegelbild. In: R. Hammel-Kiesow (ed.), *Das Gedächtnis der Hansestadt Lübeck* (Lübeck, 2005), 413-425.
- Ellmers 2006: D. Ellmers. Hansischer Handel mit Schiffsbauholz. Ein Beitrag zur Wörter- und Sachen-Forschung. In H.-P. Baum, R. Leng and J. Schneider (eds.), *Wirtschaft, Gesellschaft, Mentalitäten im Mittelalter*. Festschrift zum 75. Geburtstag von Rolf Sprandel (Stuttgart, 2006), 63-78.
- Ellmers 2010: D. Ellmers, Koggen kontrovers. In: *Hansische Geschichtsblätter* 128, 2010, 113-140.
- Ellmers 2014: D. Ellmers, Kogge und Holk als Schiffe der Hanse. In: M. Hundt and J. Lokers (eds.), *Hanse und Stadt: Akteure, Strukturen und Entwicklungen im regionalen und europäischen Raum — Festschrift für Rolf Hammel-Kiesow zum 65. Geburtstag*, (Lübeck, 2014). 53-67
- Elmshäuser 2003: K. Elmshäuser, Bremen und seine Kaufleute – Konflikte und Kämpfe. In: G. Hoffmann and U. Schnall (eds.), *Die Kogge – Sternstunde der deutschen Schiffsarchäologie* (Bremerhaven/Hamburg, 2003), 206-233.

- Endres 1888: M. Endres, *Die Waldbenutzung vom 13. bis Ende des 18. Jahrhunderts. Ein Beitrag zur Geschichte der Forstpolitik*, (Tübingen, 1888).
- Engberg *et al.* 2015: N. Engberg, V. Etting, J. Frandsen, F. O. Sonne Nielsen and D. Wille-Jørgensen, Hammershus – korsfarer- eller ærkebispesborg? In: *Nationalmuseets Arbejdsmark*, 2015, 154-167.
- Englert 2000: A. Englert, *Large Cargo Vessels in Danish Waters AD 1000-1250*. Ph.D. dissertation (Roskilde/Kiel 2000).
- Englert 2015: A. Englert, *Large Cargo Ships in Danish Waters 1000-1250*. Ships and Boats of the North 7 (Roskilde, 2015).
- Englert & Kühn 2015: A. Englert and H. J. Kühn, The Karschau ship. In: A. Englert (ed.), *Large Cargo Ships in Danish Waters 1000-1250*. Ships and Boats of the North 7, (Roskilde, 2015), 191-228.
- Englert & Trakadas 2009: A. Englert and A. Trakadas, *Wulfstan's Voyage — The Baltic Sea Region in the Early Viking Age as Seen from Shipboard*. Maritime Culture in the North 2, (Roskilde, 2009).
- Englisch 2002: B. Englisch, *Ordo orbis terrae. Die Weltansicht in den Mappae mundi des frühen und hohen Mittelalters*, (Berlin, 2002).
- Eriksen 2001: O. H. Eriksen, *Dendrokronologisk undersøgelse af tommer fra skibsvrag fundet på Dokøen, København*. Nationalmuseets Naturvidenskabelige Undersøgelser rapport 23/2001, (Copenhagen, 2002).
- Eriksson 2010: N. Eriksson, Between clinker and carvel: aspects of hulls built with mixed planking in Scandinavia between 1550 and 1900. In: *Underwater Archaeology in the Baltic Region*. Archaeologia Baltica 14, 2010, 77-84.
- Etting 2004: V. Etting, *Queen Margrete I (1353-1412) and the Founding of the Nordic Union*, (Leiden/Boston, 2004).
- Ewe 1972: H. Ewe, *Schiffe auf Siegelin* (Rostock, 1972).
- Falk 1912: H. Falk, Altnordisches Seewesen. In: *Wörter und Sachen* 4, (Heidelberg, 1912).
- Fliedner 1964: S. Fliedner, Der Fund einer Kogge bei Bremen im Oktober 1962. In: *Bremer Jahrbuch* 49: 7-10.
- Fliedner 1969: S. Fliedner, 'Kogge' und 'Hulk'. Ein Beitrag zur Schiffstypengeschichte. In: *Die Bremer Hanse-Kogge* (Bremen, 1969), 39-121.
- Fliedner 2003: S. Fliedner, Ein Jahrhundertfund in der Weser. In: G. Hoffmann & U. Schnall (eds.), *Die Kogge — Sternstunde der deutschen Schiffsarchäologie*. Schriften des Deutschen Schifffahrtsmuseums 60, (Hamburg, 2003), 44-51.
- Fliedner & Pohl-Weber 1968: S. Fliedner and R. Pohl-Weber, *Die Bremer Kogge*. Hefte des Focke-Museums 19, (Bremen, 1968).
- Friel 1995: I. Friel, *The Good Ship. Ships, Shipbuilding and Technology in England 1200-1520*, (Baltimore, 1995).
- Förster & Jöns 2003: T. Förster and H. Jöns, Finds: cargo and personal effects. In: C. O. Cederlund (ed.), *MoSS Newsletter* 2, 2003, 14-15.
- Fonnesberg-Schmidt 2007: I. Fonnesberg-Schmidt, *The Popes and the Baltic Crusades 1147-1254*. Northern World (Leiden / Boston 2007).
- Fraesdorff 2005: D. Fraesdorff, *Der barbarische Norden. Vorstellungen und Fremdeitskategorien bei Rimbart, Thietmar von Merseburg, Adam von Bremen und Helmold von Bosau*, (Berlin, 2005).
- Frahm & Wiethold 2004: J. P. Frahm and J. Wiethold, Die Moosflora des Mittelalters und der Frühen Neuzeit in Mitteleuropa nach archäologischen Funden zusammengestellt. In: *Herzogia* 17, 2004, 303-324.
- Franklin 1985: C. A. Franklin, *Caulking techniques in northern and central European ships and boats: 1500 B.C. - A.D. 1940*. Masters thesis, (College Station, 1985).
- Fredholm 2006: M. Fredholm, *Medeltid längs Kung Valdemars segelled. Medeltida fornlämningar och skriftliga källor från Svärdsund, Ekholmen, Yxlösund, Vitsgarnssund, Gälö, Dalarö, Baggensstället och Sveriges holme*. Unpublished Masters thesis, (Stockholm, 2006).
- Friedman 1994: J. B. Friedman, Cultural conflicts in medieval world maps. In: S. B. Schwartz (ed.), *Implicit Understandings. Observing, Reporting, and Reflecting on the Encounters Between Europeans and Other Peoples in the Early Modern Era*, (Cambridge, 1994), 64-95.
- Gaimster 1997: D. Gaimster, *German Stoneware 1200-1900 — Archaeology and Cultural History*, (London, 1997).
- Gaimster 1999a: D. Gaimster, Der Keramikmarkt im Ostseeraum 1200 bis 1600: Exportkeramik als Indikator für Fernhandelsbeziehungen und die Wanderung des hansischen Handwerks und der Wohnkultur. In: M. Gläser (ed.), *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum II — Der Handel*, (Lübeck, 1999).
- Gaimster 1999b: D. Gaimster, The Baltic ceramic market c. 1200-1600: An archaeology of the Hanse. In: *Fennoscandia Archaeologica* XVI, 1999, 59-69.

- Gaimster 2005: D. Gaimster, A parallel history: the archaeology of Hanseatic urban culture in the Baltic c. 1200-1600. In: *Historical Archaeology* 37.3, 2005, 408-423.
- Gallén 1993: J. Gallén, *Det "Danska itinerariet."* *Franciskansk expansionsstrategi i Östersjön* (Helsingfors, 1993).
- Gamble, C. 2004. *Archaeology - the basics*, (London, 2004).
- Gassowska 2006: M. Gassowska, Der Anteil der Bürger aus den norddeutschen Städten an den Pilgerreisen nach Riga im 13. Jh. In: D. Doležal and H. Kühne (eds.), *Wallfahrten in der europäischen Kultur*, (Frankfurt a.M., 2006), 147-166.
- Georges 1918/1998: K. E. Georges, *Ausführliches lateinisch-deutsches Handwörterbuch* (Hanover 1918 / Darmstadt 1998).
- Gibbins & Adams 2001: D. Gibbins and J. Adams, Shipwrecks and Maritime Archaeology, in: *World Archaeology* 32.3, 2001, 279-291.
- Gläser 2009: M. Gläser, The emergence of Lübeck as a medieval metropolis. In: N. Engfberg, A. N. Nørgaard Jørgensen, J. Kieffer-Olsen, P. K. Madsen and C. Radtke (eds.), *Archaeology of Medieval Towns in the Baltic and North Sea Area*. PNM Studies in Archaeology & History 17, (Copenhagen, 2009), 79-92.
- Glasheen 2006: C. R. Glasheen, Provisioning Peter the Hermit: from Cologne to Constantinople. In: J.H. Pryor (ed.), *Logistics of Warfare in the Age of the Crusades*, (Aldershot/Burlington, 2006), 119-130.
- Glete 2007: J. Glete, Cities, state formation and the protection of trade in northern Europe, 1200-1700. In: H. Brand & L. Müller (eds.), *The Dynamics of Economic Culture in the North Sea- and Baltic Region*, (Hilversum 2007), 13-23.
- Godal 1995: J. B. Godal, The use of wood in boatbuilding. In: O.Olsen, J. Skamby Madsen and F. Rieck (eds.), *Shipshape — Essays for Ole Crumlin-Pedersen*, (Roskilde, 1995), 271-282.
- Goodburn 1991: D. M. Goodburn, New Light on Early Ship- and Boatbuilding in the London Area. In: G. L. Good, R. H. Jones and M. W.Ponsford (eds.), *Waterfront Archaeology*, (London, 1991), 105-115.
- Goodburn 2003: D. Goodburn, Rare fragments of a 13th century clinker galley found in London and the use of the Irish wildwoods for shipbuilding. In: C. Beltrame (ed.), *Boats, Ships and Shipyards*. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000, (Oxford, 2003), 289-295.
- Gould 2000: R. A. Gould, *Archaeology and the Social History of Ships*, (Cambridge, 2000).
- Gøthche 1985: M. Gøthche, „Sandskuder“ - vessels for trade between Norway and Denmark in the 18th and 19th century. In: C. O. Cederlund (ed.), *Postmedieval Boat and Ship Archaeology* Proceedings of the International Symposium on Boat and Ship Archaeology in Stockholm 1982, (Oxford, 1985), 299-314.
- Gøthche & Høst-Madsen 2001: M. Gøthche and L. Høst-Madsen, Medieval wrecks at Dock Island, Copenhagen. In: *Maritime Archaeology Newsletter from Roskilde, Denmark* 17, 2001, 28–33.
- Grassel 2011: P. Grassel, *Mittelalterliche Schiffszelzfunde aus einem Gebäudebefund des 14. Jh. vom Fundplatz Stralsund-Frankenbof*. Unpublished M.A. Thesis (Kiel, 2011).
- Grundvad 2010: B. Grundvad, *Converted clinker vessels from the 16th - 17th century. A case study of the Ostsee Bereich IV, Fischland, FPL 77*, (Esbjerg, 2010).
- Grundvad 2011: B Grundvad, A clinker-vessel converted. In: *Maritime Archaeology Newsletter from Denmark* 26, 2011, 24-27.
- Guard 2013: T. Guard, *Chivalry, Kingship and Crusade. The English Experience in the Fourteenth Century*, (Woodbridge, 2013).
- Guido & Moreira 2014: L. F. Guido and M. Moreira, Malting. In: R. de Pinho Ferreira Guiné and P. M. dos Reis Correia (eds.), *Engineering Aspects of Cereal and Cereal-Based Products* (Boca Raton, 2014), 51-70.
- Håkanson *et al.* 2003: L. Håkanson, L.-C. Lundin, O. Savchuk, V. Ionov, S. Musielak, K. Furmanczyk, The Baltic Sea. In: L. Rydén, P. Migula and M. Andersson (eds.), *Environmental Science*, (Uppsala, 2003), 120-147.
- Hänger 2001: C. Hänger, *Die Welt im Kopf. Raumbilder und Strategie im römischen Kaiserreich*, (Göttingen, 2001).
- Härlin 1942: A. Härlin, Vår äldsta seglingsbeskrivning. In: *Till Rors* 10, 1942.
- Hammel-Kiesow 1999: R. Hammel-Kiesow, Grain, fish and salt. Written sources and architectural evidence for the trade with bulk commodities in Lübeck harbour in medieval and early modern times. In J. Bill and B. L. Clausen (eds.), *Maritime Topography and the Medieval Town*, (Copenhagen, 1999), 87-94.
- Hammel-Kiesow 2002: R. Hammel-Kiesow, Lübeck and the Baltic Trade in Bulk Goods for the North Sea Region 1150-1400. In: L. Berggren, N. Hybel and A. Landen (eds.), *Cogs, Cargoes, and Commerce: Maritime*

- Bulk Trade in Northern Europe, 1150-1400*, (Toronto, 2002), 53-91.
- Hammel-Kiesow 2015: R. Hammel-Kiesow, The Early Hansas. In: D. J. Harrel (ed.), *A Companion to the Hanseatic League*, (Leiden/Boston, 2015), 15-63.
- Haneca *et al.* 2005: K. Haneca, T. Ważny, J. van Acker, H. Beeckman, Provenancing Baltic timber from art historical objects: success and limitations. In: *Journal of Archaeological Science* 32, 2005, 261-271.
- Haneca *et al.* 2009: K. Haneca, K. Čufar, H. Beeckman, Oaks, tree-rings and wooden cultural heritage: a review of the main characteristics and applications of oak dendrochronology in Europe. In: *Journal of Archaeological Science* 36, 2009, 1-11.
- Haneca 2015: K. Haneca, Historisch bouwhout uit Vlaanderen: import uit noodzaak? Dendrochronologisch onderzoek als bron voor houthandel en -gebruik. In: *Bulletin KNOB* 114, 2015, 158-169.
- Harff *et al.* 2005: J. Harff, R. Lampe, W. Lemke, H. Lübke, F. Lüth, M. Meyer and F. Tauber, The Baltic Sea – A Model Ocean to Study Interrelations of Geosphere, Ecosphere, and Anthroposphere in the Coastal Zone. In: *Journal of Coastal Research* 21.3, 2005, 441-446.
- Harpster 2013: M. Harpster, Shipwreck Identity, Methodology, and Nautical Archaeology. In: *Journal of Archaeological Method and Theory* 20.4, 2013, 588-622.
- Harwood 2006: J. Harwood, *To the Ends of the Earth. 100 Maps That Changed the World* (Hong Kong, 2006).
- Hasslöff 1970: O. Hasslöff, Huvudlinjer i skeppsbyggnadskonstens teknologi. In: O. Hasslöff, H. Henningsen, A.E. Christensen (eds), *Sømand, fisker, skib og værft. Introduktion til maritim etnologi*. (Copenhagen 1970), 28-73.
- Hasslöff 1972: O. Hasslöff, Main Principles in the Technology of Ship-Building. In: O. Hasslöff, H. Henningsen A. E. Christensen (eds.), *Ships and Shipyards — Sailors and Fishermen*, (Copenhagen, 1972), 27-72.
- Heide 2008: E. Heide, Viking, week, and widsith. A reply to Harald Bjorvand. In: *Arkiv för nordisk filologi* 123, 2008, 23-28.
- Heinsius, P. 1986. *Das Schiff der hansischen Frühzeit*, (Cologne/Vienna, 1986).
- Henning 1928: R. Henning, *Abhandlungen zur Geschichte der Schifffahrt*, (Jena, 1928).
- Herrmann 1995: R. Herrmann, Lübeck und die Päpste (1201-1267). In: *Zeitschrift des Vereins für Lüneburger Geschichte und Altertumskunde* 75, 1995, 9-52.
- Heußner 1999: K.-U. Heußner, Wieviel fehlt? - Ein Beitrag zur Genauigkeit von dendrologischen Datierungen. In: E. Cziśla, T. Kersting and S. Pratsch (eds.), *„Den Bogen spannen...“*. *Festschrift für Bernhard Gramsch* (Weissbach, 1999), 523-525.
- Heußner, K.-U. 2009a. report 12.02.2009 (unpublished).
- Heußner, K.-U. 2009b. report 17.03.2009 (unpublished).
- Heußner, K.-U. 2009c. report 17.12.2009 (unpublished).
- Hirsch 1858: T. Hirsch, *Danzigs Handels- und Gewerbsgeschichte unter der Herrschaft des Deutschen Ordens* (Leipzig, 1858).
- Hocker 2004: F. M. Hocker, Bottom-based shipbuilding in northwestern Europe. In F. M. Hocker and C. A. Ward (eds.), *The Philosophy of Shipbuilding. Conceptual approaches to the study of wooden ships*, (College Station, 2004), 65-93.
- Hocker & Daly 2006: F. M. Hocker and A. Daly, Early cogs, Jutland boatbuilders, and the connection between East and West before AD 1250. In L. Blue, F. Hocker and A. Englert (eds.), *Connected by the Sea. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology Roskilde 2003*, (Oxford, 2006), 185-194.
- Hocker & Vlierman 1996: F. M. Hocker and K. Vlierman, *A small cog wrecked on the Zuiderzee in the early fifteenth century*. NISA excavation report 19. Flevovericht 408, (Lelystad, 1996).
- Hörberg 1995: P. U. Hörberg, Nuts, Bricks and Pewter — preliminary notes on three new ship-finds in Scania, Sweden. In O. Olsen (ed.), *Shipsshape — Essays for Ole Crumlin-Pedersen*, (Roskilde, 1995), 123-126.
- Hoffmann 1976: E. Hoffmann, *Königsverhabung und Thronfolgeordnung in Dänemark bis zum Ausgang des Mittelalters*, (Berlin/New York, 1976).
- Hoffmann 1980: E. Hoffmann, Beiträge zur Geschichte der Stadt Schleswig und des westlichen Ostseeraumes im 12. und 13. Jahrhundert. In: *Zeitschrift der Gesellschaft für Schleswig-Holsteinische Geschichte* 105, 1980, 27-76.
- Hoffmann 1989: E. Hoffmann, Lübeck und die Erschließung des Ostseeraums. In: J. Bracker (ed.): *Die Hanse – Lebenswirklichkeit und Mythos*, (Hamburg, 1989), 32-41.

- Hoffman 2008: R. Hoffmann, Medieval Europeans and their Aquatic Ecosystems. In: B. Herrmann (ed.), *Beiträge zum Göttinger Umwelthistorischen Kolloquium 2007-2008*, (Göttingen, 2008), 45-64.
- Hucker 1988: B. U. Hucker, Zur Datierung der Ebсторfer Weltkarte. In: *Deutsches Archiv* 44, 1988, 510-538.
- Ilves 2002: K. Ilves, Merenduslik kultuurmaastik ja Maasi laev kui selle element. In: *Eesti Arheoloogia Ajakiri* 6.2, 2002, 134-149.
- Ilves 2012: K. Ilves, Do Ships Shape the Shore? An Analysis of the Credibility of Ship Archaeological Evidence for Landing Site Morphology in the Baltic Sea. In: *The International Journal for Nautical Archaeology* 41.1, 2012, 94-105.
- Ilves 2015: K. Ilves, Sea and seafaring in the Chronicles. In: S. von Arbin, P. Nymoen, F.-A. Hedlund Stylegar, M. Sylvester, A. Gutehall and P. Skanse (eds.), *Tjop tjop! Vänbok till Christer Westerdahl* (Skärhamn, 2015), 205-218.
- Jagielska & Urbański 2014: I. Jagielska and W. Urbański, Conservation of the Copper Ship's hull and cargo. In: W. Ossowski (ed.), *The Copper Ship — A medieval shipwreck and its cargo / Miedzioniec — Wrak średniowiecznego statku i jego ładunek*. Badania Archeologiczne Narodowego Muzeum Morskiego w Gdańsku 2. (Gdańsk, 2014), 121-142.
- Jahnke 1997: C. Jahnke, Die Malmöer Schonenzollliste des Jahres 1375. In: *Hansische Geschichtsblätter* 115, 1997, 1-108.
- Jahnke 2000: C. Jahnke, *Das Silber des Meeres. Fang und Vertrieb von Ostseehering zwischen Norwegen und Italien (12.-16. Jahrhundert)*, (Cologne, 2000).
- Jahnke 2006: C. Jahnke, „... und er verwandelte die blühende Handelsstadt in ein unbedeutendes Dorf“ – Die Rolle Schleswigs im internationalen Handel des 13. Jahrhunderts. In: G. Fouquet, M. Hansen, C. Jahnke and J. Schlürmann (eds.), *Von Menschen, Ländern, Meeren*, (Tönning, 2006), 251-268.
- Jahnke 2008: C. Jahnke, Zur Interpretation der ersten Lübecker Schiffssiegel. In: *Zeitschrift des Vereins für Lübeckische Geschichte und Altertumskunde* 88, 2008, 9-24.
- Jahnke 2009: C. Jahnke, The Influence of the Hanseatic League on the Cities in the North-Sea and Baltic-Sea Area – Some Reflections on the Triad “Trade – Cities – Hanseatic League. In N. Engberg, A. Norgaard, J. Kiefer-Olsen, P. K. Madsen and C. Radtke (eds.), *Archaeology of Medieval Towns in the Baltic and North Sea Area*. Publications of the National Museum Studies in Archaeology & History 17, (Copenhagen, 2009), 51-64.
- Jahnke 2011: C. Jahnke, Koggen und kein Ende: Anmerkungen zu den Thesen von Reinhard Paulsen und Detlev Ellmers. In: *Verein fuer Luebeckische Geschichte und Altertumskunde. Zeitschrift* 91, 2011, 305-320.
- Jahnke 2013: C. Jahnke, The City of Lübeck and the Internationality of Early Hanseatic Trade. In: J. Wubs-Mrozewicz and S. Jenks (eds.), *The Hanse in Medieval and Early Modern Europe*, (Leiden/Boston, 2013), 37-58.
- Jahnke 2015: C. Jahnke, The Baltic Trade. In: D. J. Harreld (ed.), *A Companion to the Hanseatic League* (Leiden/Boston, 2015), 194-240.
- Jahnke & Englert 2015: C. Jahnke and A. Englert, Historical research on merchant seafaring in Danish waters and in the western Baltic Sea. In A. Englert (ed.), *Large Cargo Ships in Danish Waters 1000-1250. Ships and Boats of the North 7* (Roskilde, 2015), 17-54.
- Jakobsson 1980: S. Jakobsson, *Osilia-Maritima 1227-1346. Studier kring tillkomsten av svenska bosättningar i Balticum i synnerhet inom biskopsstiftet Ösel-Wiek*. Acta Universitatis Upsaliensis 112, (Stockholm, 1980).
- Jankuhn 1986: H. Jankuhn, *Haithabu – Ein Handelsplatz der Wikingerzeit*, (Neumünster, 1986).
- Jenks 2012: S. Jenks, *Das Danziger Pfundzollbuch von 1409 und 1411. Quellen und Darstellungen zur hansischen Geschichte* LXIII (Cologne/Weimar/Vienna, 2012).
- Jenks, forthcoming: S. Jenks, Interdisciplinary? Who are we kidding? In: N. Mehler, M. Gardiner (eds.), *Germans in the North Atlantic 1400-1700: Interdisciplinary Perspectives*. Northern World, (Leiden, forthcoming).
- Jensen 2001: C. S. Jensen, Urban Life and the Crusades in Northern Germany and the Baltic Lands in the Early Thirteenth Century. In: A. V. Murray (ed.), *Crusade and Conversion on the Baltic Frontier 1150-1500*, (Aldershot, 2001), 75-94.
- Jensen et al. 2001: C. S. Jensen, K. V. Jensen und J. Lind, Communicating Crusades and Crusading Communications in the Baltic Region. In: *Scandinavian Economic History Review* 49. 2, 2001, 8-14.
- Jensen 2000: J. M. Jensen, Danmark og den hellige krig. En undersøgelse af korstogsbevægelsens indflydelse på Danmark ca. 1070-1169. In: *Historisk Tidsskrift* 100, 2000, 285-328.
- Jensen 2007: J. M. Jensen, *Denmark and the Crusades, 1400-1650*, (Leiden, 2007).

- Jensen 2000: K. V. Jensen, Saxos grænser. Dehumaniseringen af Venderne. In: C. S. Jensen, K. V. Jensen and J. Lind (eds.), *Venderne og Danmark*. Mindre skrifter udgivet af Center for Middelalderstudier, Syddansk Universitet 20, (Odense, 2000), 6–12.
- Jensen 2009: K. V. Jensen, Sacralization of the Landscape: Converting Trees and Measuring Land in the Danish Crusades against the Wends. In: A. V. Murray (ed.), *The Clash of Cultures on the Medieval Baltic Frontier* (Farnham/Burlington 2009), 141-150.
- Jensen 2011: K. V. Jensen, Bigger and Better: Arms Race and Change in War Technology in the Baltic in the Early Thirteenth Century. In: M. Tamm, L. Kaljundi, C. S. Jensen (eds.), *Crusading and chronicle writing on the medieval Baltic frontier: a companion to the Chronicle of Henry of Livonia* (Burlington/Farnham 2011), 245-264.
- Jevrejeva 2001: S. Jevrejeva, Severity of winter seasons in the northern Baltic Sea between 1529 and 1990: reconstruction and analysis. In: *Climate Research* 17, 2001, 55-62.
- Jevrejeva et al. 2001: S. Jevrejeva, A. Rüdja and J. Mäkinen, Postglacial rebound in Fennoscandia: new results from Estonian tide gauges. In: Sideris (ed.), *Gravity, Geoid, and Geodynamics 2000*. International Association of Geodesy Symposia 123, (Berlin/Heidelberg, 2001).
- Johansen 1933: P. Johansen, *Die Estlandliste des Liber Census Daniae* (Copenhagen/Tallinn, 1933).
- Johansen 1955: P. Johansen, Umriss und Aufgaben der hansischen Siedlungsgeschichte und Kartographie. In: *Hansische Geschichtsblätter* 73, 1955, 1-106.
- Johansen 1961: P. Johansen, Rocamadour et la Livonie. In: *Annales du Midi : revue archéologique, historique et philologique de la France méridionale* 73.54, 1961, 230-231.
- Jones et al. 1998: P. D. Jones, K. R. Briffa, T. P. Barnett and S. F. B. Tett, High-resolution palaeoclimatic records for the last millenium: interpretation, integration and comparison with General Circulation Model control-run temperatures. In: *The Holocene* 8.4, 1999, 455-471.
- Kålund 1916: K. Kålund, *Arne Magnusson. Brevveksling med Torfæus (Dormódur Torfason)*, (Copenhagen/Kristiania, 1916).
- Kapfenberger 2003: D. Kapfenberger, *Holz und Holzhandel in Preußen von 1399 - 1409*. Unpublished Masters thesis, (Erlangen, 2003).
- Katajala 2011: K. Katajala, Maps, Borders and State-building. In: M. Lamberg, M. Hakonen and J. Haikari (eds.), *Physical and Cultural Space in Pre-Industrial Europe* (Lund, 2011), 58-91.
- Kattinger 2001: D. Kattinger, Lübeck, Visby und Riga in der Handelsdiplomatie des "Gemeinen Kaufmanns" im 13. Jahrhundert. In: N. Angermann (ed.), *Fernhandel und Handelspolitik der baltischen Städte in der Hansezeit*, (Lüneburg, 2001), 9-40.
- Kedar 2006: B. Z. Kedar, Reflections on maps, crusading, and logistics. In: J.H. Pryor (ed.), *Logistics of Warfare in the Age of the Crusades*, (Aldershot/Burlington, 2006), 159-184.
- Köster 1983: K. Köster, *Pilgerzeichen und Pilgermuscheln von mittelalterlichen Santiagostraßen*. Ausgrabungen in Schleswig – Berichte und Studien 2, (Neumünster, 1983).
- Kohrtz Andersen 1983: P. Kohrtz Andersen, *Kollerupkroggen*, (Thisted, 1983).
- Kiesselbach 1901: T. Kiesselbach, Grundlage und Bestandteile des ältesten Hamburgischen Schiffrechts. Ein Beitrag zur Geschichte des norddeutschen Seehandels und Seerechts. In: *Hansische Geschichtsblätter* 28, 1901, 49-93.
- Krapiec & Krapiec 2014: M. Krapiec and P. Krapiec, Dendrochronological analysis of the copper ship's structural timbers and timber cargo. In: W. Ossowski (ed.), *The Copper Ship — A medieval shipwreck and its cargo / Miedzioniec — Wrak średnio-wiecznego statku i jego ładunek*. Badania Archeologiczne Narodowego Muzeum Morskiego w Gdańsku 2, (Gdańsk, 2014), 143-160.
- Kreem 2002: J. Kreem, Maasilinna foogt ja mereteed. In: *Eesti Meremuuseumi Toimetised* 3, 2002, 23-30.
- Kreem 2007: J. Kreem, Der Gehorsam der Gebietiger gegenüber dem livländischen Meister im 16. Jahrhundert. In: R. Czaja & J. Sarnowsky (eds.), *Die Ritterorden als Träger der Herrschaft : Territorien, Grundbesitz und Kirche*, (Toruń, 2007), 115-125.
- Kreem 2009: J. Kreem, Living on the edge: Pirates and the Livonians in the fifteenth and sixteenth centuries. In: G. Jaritz & J. Kreem (eds.), *The Edges of the Medieval World*. CEU Medievalia 11, (Budapest/Tallinn, 2007), 70-81.
- Kreem 2011: J. Kreem, Seasonality of transport network in the Eastern Baltic. In: H. Houben and K. Toomaespoeg (eds.), *Towns and Communication 2: Communication between towns*, (Galatina, 2011), 259–269.
- L'Hour & Veyrat 1994: M. L'Hour and E. Veyrat, The French Medieval Clinker Wreck from Aber Wrac'h. In: C. Westerdahl (ed.), *Crossroads in Ancient*

- Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde 1991, (Oxford, 1994), 165-180.
- Lahn 1992: W. Lahn, *Die Kogge von Bremen. Band 1: Bauteile und Bauablauf*. Schriften des Deutschen Schiffahrtsmuseum (Hamburg, 1992).
- Larson 1917: L.M. Larson, *The King's Mirror. Speculum regale - Konungs skuggsjá*. Scandinavian Monographs 3, (New York, 1917).
- Lehmdahl *et al.* 1995: G. Lemdahl, M. Aronsson and L. Hedenäs, Insekter från ett medeltida handelsfartyg. In: *Entomologisk Tidskrift* 116.4, 1995, 169-174.
- Lemée 2006a: C. Lemée, Kravelbyggeriet i historisk perspektiv: på sporet af kravelbygningsteknologien og dens spredning til Danmark set ud fra de historiske kilder. In: *Maritim Kontakt* 28, 2006, 7-41.
- Lemée 2006b: C. Lemée, *The Renaissance Shipwrecks from Christianshavn*. Ships of the North, (Roskilde, 2006).
- Lepp 1995: H. Lepp, Domberget i Tallinn. In: G. Flink (ed.), *Kung Valdemars segelled* (Stockholm, 1995), 143-148.
- Lieb 1974: H. Lieb, Zur Herkunft der Tabula Peutingeriana. In: *Die Abtei Reichenau. Neue Beiträge zur Geschichte und Kultur des Inselklosters* 20, 1974, 31-34.
- Lind *et al.* 2006: J. H. Lind, C. Selch Jensen, K. Villads Jensen, A. L. Bysted, *Danske korstog — Krig of mission i Østersøen*, (Copenhagen, 2006).
- Lind 2009: J. H. Lind, The Importance of Varangian Traditions for East-West Collaboration and Confrontation in the 12<sup>th</sup>-13<sup>th</sup> centuries. In: B. Floe Jensen (ed.), *Expansion - Integration? : Danish-Baltic contacts 1147 - 1410 AD*, (Vordingborg, 2009), 27-37.
- Lindström 2011: J. Lindström, Kvarnholmen runt. In: *Sjöhistoriska Museet Arkeologisk Rapport* 2011:2, (Stockholm, 2011).
- Litwin 1985: J. Litwin. The Copper Ship of Gdansk Bay; recent discoveries from the wreck, cargo and site. In: J. Heermann, *5th International Congress of Maritime Museums Proceedings 1984* (Hamburg, 1985), 42-49.
- Litwin 2014: J. Litwin, Medieval Gdańsk – centre of shipbuilding and maritime trade on the Baltic. In: W. Ossowski (ed.), *The Copper Ship — A medieval shipwreck and its cargo*, (Gdańsk, 2014), 15-56.
- Loewen & Delhaye 2006: B. Loewen and M. Delhaye, Oak growing, hull design and framing style. The Cavalaire-sur-Mer wreck, c. 1479. In: L. Blue, F. Hocker and A. Englert (eds.), *Connected by the Sea*. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology, (Oxford, 2006), 99-104.
- Lübber 1888: A. Lübber, *Mittelniederdeutsches Handwörterbuch* (Leipzig 1888 / reprinted in Darmstadt 1980).
- Lund 1997: N. Lund, Is Leidang a Nordic or a European phenomenon? In: A. Norgard Jorgensen/B. L. Clausen, *Military Aspects of Scandinavian Society in a European Perspective, AD 1-1300*, (Copenhagen 1997), 195-199.
- Lund 2009: N. Lund, Leding and crusading. In: B. Floe Jensen (ed.), *Expansion - Integration? : Danish-Baltic contacts 1147 - 1410 AD*, (Vordingborg, 2009), 39-43.
- Maarleveld 1994: T. Maarleveld, Double Dutch Solution in Flush-Planked Shipbuilding: Continuity and Adaption at the Start of Modern History. In: C. Westerdahl (ed.), *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde 1991, (Oxford, 1994).
- Maarleveld 1995: T. Maarleveld, Type or technique. Some thoughts on boat and ship finds as indicative of cultural traditions. In: *The International Journal for Nautical Archaeology* 24.1, 1995, 3-7.
- Mägi 2011: M. Mägi, Ösel and the Danish Kingdom: Revisiting Henry's Chronicle and the Archaeological Evidence. In: M. Tamm, L. Kaljundi and C. S. Jensen (eds.), *Crusading and Chronicle Writing on the Medieval Baltic Frontier. A Companion to the Chronicle of Henry of Livonia*, (Burlington/Farnham, 2011), 317-341.
- Mäesalu 2011: A. Mäesalu, Mechanical Artillery and Warfare in the Chronicle of Henry of Livonia In: M. Tamm, L. Kaljundi, C. S. Jensen (eds.), *Crusading and chronicle writing on the medieval Baltic frontier: a companion to the Chronicle of Henry of Livonia* (Burlington/Farnham 2011), 265-290.
- Mäss 1991: V. Mäss, Prospects for Underwater Archaeology in the Eastern Baltic. In: *The International Journal of Nautical Archaeology* 20.4, 1991, 313-320.
- Mäss 1994a: V. Mäss: Underwater Archaeology in Estonia. In: *Proceedings of the Estonian Academy of Sciences* 43, 1994, 97-100.
- Mäss 1994b: V. Mäss: A Unique 16th Century Estonian Ship Find. In: C. Westerdahl (ed.), *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde 1991, (Oxford 1994), 189-194.
- Mager 1960: F. Mager, *Der Wald in Altpreussen als Wirtschaftsraum II* (Cologne, 1960).



- Magnus 1555: O. Magnus, *Historia de gentibus septentrionalibus* (Rome 1555).
- Marchenko 2012: N. Marchenko. *Russian Arctic Seas. Navigational conditions and accidents.* (Berlin/Heidelberg, 2012).
- Marsden 1996: P. Marsden, *Ships of the Port of London.* English Heritage Archaeological Report 5 (London, 1996).
- Martin 2001: C. Martin, De-particularizing the particular: approaches to the investigation of well-documented post-medieval shipwrecks. In: *World Archaeology* 32.3, 2001, 383-399.
- McGrail 1993: S. McGrail, *Medieval Boat and Ship Timbers from Dublin* (Dublin, 1993).
- McGrail 1998: S. McGrail, *Ancient Boats in North-West Europe. The Archaeology of Water Transport to AD 1500*, (London/New York, 1998).
- McGrail 2004: S. McGrail, To Clench or to Rivet: That is the Question. In: *The International Journal for Nautical Archaeology* 33.1, 2004, 149-153.
- Mehler 2009: N. Mehler, The Perception and Interpretation of Hanseatic Material Culture in the North Atlantic: Problems and Suggestions. In: *Archaeologies of the Early Modern North Atlantic.* Journal of the North Atlantic – special volume 1, 2009. 89-108.
- Meyer 1848: E. Meyer, *Die Livländische Reimchronik* (Tallinn 1848).
- Mickwitz 1938: G. Mickwitz, *Aus Revaler Handelsbüchern. Zur Technik des Ostseehandels in der ersten Hälfte des 16. Jahrhunderts*, (Helsinki, 1938).
- Militzer 2001: K. Militzer, Handelsbeziehungen zwischen den livländischen Städten und dem Rheinland. In: N. Angermann (ed.), *Fernhandel und Handelspolitik der baltischen Städte in der Hansezeit* (Lüneburg, 2001), 71-95.
- Milne 2004: G. Milne, The fourteenth-century merchant ship from Sandwich: a study in medieval maritime archaeology. In: *Archaeologia Cantiana* 124, 2004, 227–264.
- Modéer 1937: I. Modéer, Något om namnformerna i Kung Valdemars Jordebok. Namn og bygd. In: *Tidskrift för nordisk ortnamnsforskning* 25 (Uppsala, 1937).
- Möller-Wiering 2001: S. Möller-Wiering, Karschau, Haderslev und Lynæs: Kalfat aus mittelalterlichen Schiffen als Ausdruck einer nordeuropäischen Schiffbautradition. In: *Archäologie in Schleswig* 9, 2001, 151-163.
- Morcken 1983: R. Morcken, *Old Norse Distance Tables in the Mediterranean Sea.* In: Sjöfartshistoriske artiklar 20 (1983).
- Muckelroy 1978: K. Muckelroy, *Maritime Archaeology* (Cambridge, 1978).
- Mührenberg 2003: D. Mührenberg, Die Dänenzeit in Lübeck im Überblick · Danskertiden i Lübeck – et overblik. In: M. Gläser and D. Mührenberg (eds.), *Dänen in Lübeck / Danskere i Lübeck · 1203 · 2003*, (Lübeck, 2003), 42-44.
- Müller 2002: U. W. Müller, Innovation und Tradition handwerklicher Tätigkeiten in den Hansestädten der Ostseeküste. In: *Mitteilungen der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit* 13, 2002, 11-21.
- Müller et al. 2014: U. Müller, F. Rösch and M. Schimmer, Von Haithabu nach Schleswig – Aktuelle Forschungen zur Gründung einer Metropole zwischen Wikinger- und Hansezeit. In: *Gründung im archäologischen Befund.* Mitteilungen der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit 27, 2014, 25-36.
- Müller-Wille 1974: M. Müller-Wille, Boat-Graves in Northern Europe. In: *The International Journal of nautical Archaeology and Underwater Exploration* 3.2, 1974, 187-204.
- Myrhøj, 2000: H. M. Myrhøj, The late medieval wreck from Vedby Hage, Denmark. In: J. Litwin (ed.), *Down the River to the Sea, Eight International Symposium on Boat and Ship Archaeology, Gdańsk 1997*, (Gdańsk, 2000), 229-234.
- Nævestad 1998: D. Nævestad, Lokaliserte middelaldervrak i Øst-Norge. In: *Norske Sjøfartsmuseum Årsbok* 1998, 159-208.
- Nakoinz 1998: O. Nakoinz, Das mittelalterliche Wrack von Schuby-Strand und die Schiffsbautraditionen der südlichen Ostsee. In: *Archäologisches Korrespondenzblatt* 28, 1998, 311–322.
- Nedkvitne 1993: A. Nedkvitne, Fishing, whaling, ad seal hunting. In: P. Pulsiano, K. Wolf, P. Acker, D. K. Fry (eds.), *Medieval Scandinavia – An Encyclopedia*, (New York/ London, 1993), 194-196.
- Nedkvitne 2005: A. Nedkvitne, Why Did Medieval Norsemen Go on Crusades? In: T.M.S. Lehtonen, K. Villads Jensen, J. Malkki and K. Ritari (eds.), *Medieval History Writing and Crusading Ideology.* Studia Fennica Historica 9. (Helsinki, 2005), 37-50.
- Nielsen, X., forthcoming, *Dock Island's Wreck 3: hull description and comparative analysis of a 15th century clinker*

*built vessel, with a review of its documentation methodology.* Master's thesis (Esbjerg, forthcoming).

Nørøxe 2009: K. S. Nørøxe, *Danske konger i pavens krig. De danske kongers rolle i korstogsbevægelsen fra 1168-1219*. Ph.D. dissertation, (Copenhagen, 2009).

Norman 1995: P. Norman, *Sjöfart och fiske: De kustbundna näringarnas lämningar*. Fornlämningar i Sverige 3 (Stockholm, 1995).

Norman 2006: P. Norman, Bebyggelseutveckling i östra Södermanland under sen järnålder och medeltid. In: S. Lilja (Hrsg.), *Människan anpassaren – människan överskridaren* (Huddinge 2006), 47-94.

O'Brien & Lyman 2009: M. J. O'Brien and R. L. Lyman, Darwinism and Historical Archaeology. In: T. Majewski & D. Gaimster (eds.) *International Handbook of Historical Archaeology*, (New York, 2009), 227-252.

Olearius 1656: A. Olearius, *Vermehrte neue Beschreibung der muscovitischen und persischen Reyse* (Schleswig, 1656).

Olechnowitz 1960: K.-F. Olechnowitz, *Der Schiffbau der hansischen Spätzeit. Eine Untersuchung zur Sozial- und Wirtschaftsgeschichte der Hanse*. Abhandlungen zur Handels- und Sozialgeschichte 3, (Weimar, 1960).

Ossowski 2006: W. Ossowski, Two double-planked wrecks from Poland. In: L. Blue, F. Hocker, E. Englert (eds.), *Connected by the Sea (= Proceedings of the 10th International Symposium on Boat and Ship Archaeology, Roskilde 2003)*, Oxford 2006, 259-265.

Ossowski 2009: W. Ossowski, The Origin of Flat-bottomed River Craft on the Odra and Vistula Catchments. In: R. Bockius (ed.), *Between the Seas. Transfer and Exchange in Nautical Archaeology*. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology, Mainz 2006, (Mainz, 2009), 177-188.

Ossowski *et al.* 2005: W. Ossowski, E. Szychowska-Krapiec, M. Krapiec, Archeologia na plaży. Badania dwóch wraków z podwójnym poszyciem. In: H. Paner i M. Fudziński (eds.), *XIV Sesja Pomorzoznawcza - Od wczesnego średniowiecza do czasów nowożytnych Vol. 2*, (Gdańsk, 2005), 339-354.

Overmeer 2006: A. Overmeer, Searching for the missing link? A research on clinker built ships in the 15th and 16th centuries. In: *SOJA-bundel* 2006, 63-72.

Overmeer 2008: A. Overmeer. Schepen van verre kusten? Overnaadse schepen in Nederland in de 15de en 16de eeuw. In: R. Oosting and J. van den Akker (eds.), *Boomstamkano's, overnaadse schepen en tuigage*. Inleidingen gehouden tijdens het tiende Glavimans Symposium, Lelystad 2006 (Amersfoort, 2008).

Overmeer 2009: A. Overmeer, *Scheepswrak aan het Wrakkenpad. Waardstellend onderzoek van scheepswrak B 36, gemeente Nordoostpolder, Grondsporen*. Opgravings- en onderzoeksrapporten van het Groninger Instituut voor Archeologie 5 (Groningen, 2009).

Overmeer forthcoming: A. Overmeer. *Dutch clinker-built ships in the 15th and 16th centuries*. Ph.D. dissertation (Groningen, forthcoming).

Panckoucke *et al.* 1786: Panckoucke, *Encyclopédie Méthodique Marine*, (Paris, 1786).

Paravicini 1989: W. Paravicini, *Die Preußenreisen des europäischen Adels* 1, (Siegmaringen, 1989).

Parve 2010: A. Parve, Koguva maavabad Liivimaa vasalliteenistuse ja 16. sajandi sõdade kontekstis. In: *KVÜÖA toimetised* 13, 2010, 93-122.

Paulsen 2010: R. Paulsen, Die Koggendiskussion in der Forschung. In: *Hansische Geschichtsblätter* 128, 19-112.

Paulsen 2016: R. Paulsen, *Schiffahrt, Hanse und Europa im Mittelalter. Schiffe am Beispiel Hamburgs, europäische Entwicklungslinien und die Forschung in Deutschland*. Ph.D. dissertation (Cologne/Weimar/Vienna, 2016).

Pāvulāne 1975: V. Pāvulāne, *Rīgas tirdzniecība ar mežu materiāliem XV-II-XVIII gs.* (Rīga, 1975).

Paysen 2009: A. Paysen, *Nachhaltige Energiewirtschaft? Brenn- und Koblholznutzung in Schleswig-Holstein im Mittelalter und früherer Neuzeit*. Ph.D. dissertation (Kiel, 2009)

Pedersen 1976: H.N. Pedersen, *Limfjordsjagten* (Esbjerg, 1976)

Peets 2013; J. Peets, Revealing a grim cargo of elite Viking warriors, in: *Current World Archaeology* 58, 2013, 18-24.

Peil 1999: T. Peil, Settlement history and cultural landscapes on Osmussaar. In: *Estonia Maritima* 4, 1999, 5-38.

Pelc 2003: O. Pelc, Lübeck unter der Herrschaft Waldemars II von Dänemark · Lübeck under Valdemar II af Danmark. In: M. Gläser and D. Mührenberg (eds.), *Dänen in Lübeck / Danskere i Lübeck · 1203 · 2003*, (Lübeck, 2003), 45-50.

Pettersson 1969: S. S. Pettersson, *Roslagsjakter*, (Stockholm, 1969).

Pfister & Brázdil 1999: C. Pfister and R. Brázdil, Climatic variability in sixteenth-century Europe and its social dimension: A synthesis. In: *Climate Change* 43, 1999, 5-53.

- Postan 1987: M. M. Postan, The Trade of Medieval Europe: the North. In: M. M. Postan and E. Miller (eds.), *Trade and Industry in the Middle Ages II* (Cambridge, 1987), 168-300.
- Prenzlau-Enander 2003: G. Prenzlau-Enander, King Valdemar's sailing route - the oldest sailing route in the Baltic Sea Route. In: J. Litwin (Hrsg.), *Baltic Sea Identity. Common Sea - Common Culture?* (Gdańsk 2003), 177-182.
- Pryor 1982: J. H. Pryor, Transportation of horses by sea during the era of the crusades: Eighth century to 1285 AD. Part II: 1228-1285. In: *The Mariner's Mirror* 68.2, 103-125.
- Pryor 2006: J. H. Pryor, Introduction: modelling Bohemond's march to Thessalonikē. In: J. H. Pryor (ed.), *Logistics of Warfare in the Age of the Crusades*, (Aldershot/Burlington, 2006), 1-24.
- Pukiene 2002: R. Pukiene, Oak annual radial growth chronology covering 1208–1408. In: *Dendrologia Lithuaniae* VI, 2002, 102–107.
- Radkau 2012: J. Radkau, *Wood: A History*, (Cambridge/Malden 2012).
- Radtke 2004: C. Radtke, Der Prahm "Haithabu IV" in seinem historischen Kontext: Schleitransit, Fährstation, Überlandwege und die Kirche von Haddeby. In: K. Brandt (ed.), *Der Prahm aus dem Hafjen von Haithabu. Beiträge zu antiken und mittelalterlichen Flachbodenschiffen*, (Neumünster, 2004), 17-41.
- Radtke 2007: C. Radtke, Schleswig ca. 1000-1250 – Systemtheoretische Skizzen eines Urbanisierungsprofils. In: S. Burmeister, H. Derks, J. von Richthofen (eds.), *Zweihundvierzig : Festschrift für Michael Gebühr zum 65. Geburtstag*. Internationale Archäologie. Studia honoraria 25, (Rahden/Westfalen, 2007), 317-338.
- Ratas & Ratas 2012: A. Ratas and J. Ratas, *Matsalu vraki joonised ja fotod* (unpublished).
- Reinders 1985a: R. Reinders, Recent developments in ship and boat archaeology in the Netherlands. In: C. O. Cederlund (ed.), *Postmedieval Boat and Ship Archaeology*. British Archaeological Reports - International Series 256, (Oxford, 1985), 399-412
- Reinders 1985b: R. Reinders, *Cog finds from the IJsselmeerpolders*. Flevovericht 248, (Lelystad, 1985).
- Reinders & Aalders 2007: H. R. Reinders and Y. Aalders, Frisian Traders and the Clinker Technique. In: T. Arisholm, K. Paasche and T. L. Wahl (eds.), *Klink og seil - Festskrift til Arne Emil Christensen*. (Oslo, 2007), 109-122.
- Reinders & Oosting 1989: H. R. Reinders and R. Oosting, Mittelalterliche Schiffsfunde in den IJsselmeerpoldern In: W. H. Zimmerman and L. Spath (eds.), *Ländliche und städtische Küstensiedlungen im 1. und 2. Jahrtausend*. Wilhelmshavener Tage 2, 1989, 107-122.
- Reisnert 2009: A. Reisnert, The Danish Crusade against Estonia 1219-1346. In: B. Fløe Jensen (ed.), *Expansion - Integration? : Danish-Baltic contacts 1147 - 1410 AD*, (Vordingborg, 2009), 53-65.
- Richards 2002: N. Richards, *Deep Structures: An Examination of Deliberate Watercraft Abandonment in Australia*. Doctoral dissertation, (Adelaide, 2002).
- Richards 2013: N. Richards, Abandoned Ships and Ship Graveyards: Exploring Site Significance and Research Potential. In: N. Richards and S. K. Seeb (eds.), *The Archaeology of Watercraft Abandonment*, (New York, 2013), 1-16.
- Riis 2003: T. Riis, *Das mittelalterliche dänische Ostseeimperium*. Studien zur Geschichte des Ostseeraumes 4, (Odense 2003).
- Riis 2010: T. Riis, Die dänischen Knudsgilden als Handelsorganisation. In: M. Krieger and J. Krüger (eds.), *Regna firmat pietas – Staat und Staatlichkeit im Ostseeraum*. Festgabe zum 60. Geburtstag von Jens E. Olesen, (Greifswald, 2010), 33-46.
- Riley-Smith 1977: J. Riley-Smith, *What were the Crusades?* (London, 1977).
- Robinson & Aaby 1994: D. Robinson and B. Aaby, Pollen and plant macrofossil analyses from the Gedesby ship — a medieval shipwreck from Falster, Denmark. In: *Vegetation History and Archaeobotany* 3, 1994, 167-182.
- Rönby 1996: J. Rönby, Kronholmskoggen – Om ett skeppsfynd och dess tolkningsmöjligheter. In: H. Ranheden, E. Hyenstrand, M. Jakobsson, J. Rönby and A. Nilsson (eds.), *Metodstudier & tolkningsmöjligheter*. Avdelningen för arkeologiska undersökningar 20, (Stockholm, 1996).
- Rönby 2014: J. Rönby, The Archaeological Interpretation of Shipwrecks. In J. Adams and J. Rönby, *Interpreting Shipwrecks: Maritime Archaeological Approaches*. Southampton Monographs in Archaeology New Series 4 (Southampton: Highfield Press), 9-24.
- Rönby 2015: J. Rönby, Maritima duréer. In: S. von Arbin, P. Nymoen, F.-A. Hedlund Stylegar, M. Sylvester, A. Gutehall and P. Skanse (eds.), *Tjop tjop! Vänbok till Christer Westerdahl* (Skärhamn, 2015), 271-290.

- Rönby & Zerpe: J. Rönby and L. Zerpe, *Kronbolmskoggen*. UV Visby Rapport 36, (Stockholm, 1995).
- Rösch 2014: F. Rösch, Das Schleswiger Hafenviertel. Feuchtbodenarchäologie zwischen Wikingern und Hanse. In: F. Huber and S. Kleingärtner (eds.), *Gestrandet – Versenkt – Versunken: Faszination Unterwasserarchäologie*, (Neumünster, 2014) 242-259.
- Roio 2006: M. Roio, The Investigation of Underwater Heritage in Estonia. In: *Archaeological Research in Estonia 1865-2005*. Estonian Archaeology I, 2006, 301-310.
- Rosby & Miller 2003: H. T. Rosby and P. Miller, Ocean Eddies in the 1539 Carta Marina by Olaus Magnus. In: *Oceanography* 16.4, 2003, 77-88.
- Rowell 2000: S. C. Rowell, Baltic Europe. In: M. Jones (ed.), *The New Cambridge Medieval History* 6 (Cambridge, 2000), 697-734.
- Rußwurm 1855: C. F. W. Rußwurm, *Eibofolke oder die Schweden an den Küsten Ebstlands und auf Runö*, (Gallin, 1855).
- Sauer 1992: A. Sauer, Die Bedeutung der Küste in der Navigation des Spätmittelalters. In: *Deutsches Schiffsarchiv* 15, 1992, 249-278.
- Sauer 1996: A. Sauer, *Das „Seebuch“ — Das älteste erhaltene Seehandbuch und die spätmittelalterliche Navigation in Nordwesteuropa*. Schriften des Deutschen Schifffahrtsmuseums 44 (Hamburg, 1996).
- Sayers 2006: W. Sayers, The use of quicklime in medieval naval warfare. In: *The Mariner's Mirror* 92.3, 2006, 262-269.
- Schimanke *et al.* 2011: S. Schimanke, G. Strandberg, H.E.M. Meier (eds.), *A regional climate model simulation over the Baltic Sea region for the last Millenium*. Oceanography 111. (Norrköping 2011).
- Schmidt 2009: P. Schmidt, Materialität, Medialität und Autorität des vervielfältigten Bildes. Siegel und andere Bildmedien des Mittelalters in ihren Wechselwirkungen. In: M. Späth (ed.), *Die Bildlichkeit korporativer Siegel im Mittelalter*, (Cologne/Weimar/Vienna, 2009), 89-112.
- Schnall 2003: U Schnall: Navigation nach Sicht und Sand. In: G. Hoffmann und U. Schnall (Hrsg.): *Die Kogge — Sternstunde der deutschen Schiffsarchäologie*. Schriften des Deutschen Schifffahrtsmuseums 60, (Hamburg, 2003), 34-41.
- Schwarzwälder 1994: H. Schwarzwälder, Bremen als Hansestadt im Mittelalter. In: *Hansische Geschichtsblätter* 112, 1994, 1-38.
- Seibertz, J. S., 1853, Walther von Plettenberg, Herrmeister des deutschen Ordens in Livland. In: *Zeitschrift für vaterländische Geschichte und Alterthumskunde* 14 (Münster).
- Seinä & Palosuo 1996: A. Seinä and E. Palosuo, The classification of the maximum annual extent of ice cover in the Baltic Sea 1720–1995. In: *Meri – Report Series of the Finnish Institute of Marine Research* 27, 1996, 79–91.
- Siegloff 2004: E. Siegloff, *Studien zu den Sintelfunden an der Schleswiger Landenge*. Ph.D. thesis, (Kiel, 2004).
- Siegloff 2012: E. Siegloff, Maritimes Kulturgut der Wikingerzeit und des Mittelalters aus Hollingstedt. In: K. Brandt (ed.), *Hollingstedt an der Treene: ein Flusshafen der Wikingerzeit und des Mittelalters für den Transitverkehr zwischen Nord- und Ostsee*. (Neumünster, 2012), 115-248
- Simek 1990: R. Simek, *Altnordische Kosmographie: Studien und Quellen zu Weltbild und Weltbeschreibung in Norwegen und Island vom 12. bis zum 14. Jahrhundert*. Ergänzungsbände zum Reallexikon der Germanischen Altertumskunde 4, (Berlin/New York, 1990).
- Skyum-Nielsen 1981: N. Skyum-Nielsen, Estonia under Danish Rule. In: N. Skyum-Nielsen and N. Lund (eds.), *Danish Medieval History – New Currents*, (Copenhagen, 1981), 112–135.
- Sorokin 2006: P. Sorokin, Staraya Ladoga: a seaport in medieval Russia. In: L. Blue, F. Hocker, A. Englert (eds.), *Connected by the Sea*. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology Roskilde 2003, (Oxford, 2006), 157-162.
- Staniforth 2003: M. Staniforth, *Material Culture and Consumer Society. Dependent Colonies in Colonial Australia*, (New York, 2003).
- Steen 2012: K. Steen, *Dronning Eufemiasgate Sorenga 8*. Arkeologisk Rapport 8, (Oslo, 2012).
- Steffy 1994: J.R. Steffy, *Wooden Shipbuilding and the Interpretation of Shipwrecks*, (College Station, 1994).
- Stenholm 1995: L. Stenholm, Ut- och inblickar från In- och Utlången. Några reliktioner kring Torhamns skärgård. In: G. Flink (ed.), *Kung Valdemars Segelled*, (Stockholm 1995) 55–66.
- Stenholm 2009: L. Stenholm, *Berättelsen om Blekinge. Gränser i ett gränsland* (Vekerus, 2009).

- Striegler 2012: S. Striegler, Die "littauischen Wegeberichte". Kognitive Karten und die Kommunikation geografischen Wissens im Mittelalter. In: E. Włodarczyk (Hrsg.), *Studia Maritima* XXV, (Szczecin, 2012), 205-218.
- Tamm 2009: M. Tamm, Communicating Crusade. Livonian Mission and the Cistercian Network in the Thirteenth Century. In: *Ajalooline Ajakiri* 3.4, 2009, 341–372.
- Tapper 2014: H. Tapper, *Equine Lore - Healthy Horses Holistically*, (Singapore, 2014).
- Tegengren 1965: H. Tegengren, Hunters and Amazons. Seasonal Migrations in Older Hunting and Fishing Communities. In: H. Hvarfner (ed.), *Hunting and Fishing. Nordic Symposium on Life in a Traditional Hunting and Fishing Milieu in Prehistoric Times up to the Present Day*, (Luleå, 1965), 427-492.
- Teisen 1994: M. Teisen, A Medieval Clinker-Built Wreck at Hundevika, Norway. In: C. Westerdahl (ed.), *Crossroads in ancient shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde, 1991, (Oxford, 1994), 73–76.
- Tevali 2010: R. Tevali, *Fancy jugs for everyone! Stoneware from the Egelskäär wreck 1996-2007*. Unpublished M.A. Thesis (Helsinki, 2010).
- Thier 2013: K. Thier, *Old English Sea Terms*, (Ely, 2013).
- Thomsen 2002: M. Thomsen, *The Shipwreck from Vejby Strand*. Ph.D. Thesis, (Copenhagen, 2002).
- Tinniswood 1949: J.T. Tinniswood, English Galleys 1272—1377: In: *The Mariner's Mirror* 35.4, 1949, 276 - 315.
- Tossavainen 1994: J. Tossavainen, *Dutch Forest Products' Trade in the Baltic from the Late Middle Ages to the Peace of Munster in 1648*. Unpublished master's thesis, (Jyväskylä, 1994).
- Tuuling *et al.* 2011: I. Tuuling, H. Bauert, S. Willmann and G. E. Budd, *The Baltic Sea – geology and geotourism highlights*, (Tallinn, 2011).
- Tuulse 1941: A. Tuulse, *Die Burgen in Estland und Lettland*, 1941 (Wolfenbüttel, 2008 reprinted from 1941).
- Tyerman 1998: C. Tyerman, *The Invention of the Crusades* (Basingstoke 1998).
- Thowsen 1965: A. Thowsen, Foldrøyskipet: Et middelaldersk skipsfunn fra Vest-Norge. In: *Sjøfartshistorisk Årbog*, 1965, 38–57.
- Unger 2006: R. Unger, The Northern Crusaders: the logistics of English and other Northern Crusader fleets. In: J.H. Pryor (ed.), *Logistics of Warfare in the Age of the Crusades*, (Aldershot/Burlington, 2006), 251-274.
- Van Holk 2003: A. F. L. Van Holk, Clenched lapstrake boat finds from the Netherlands, between 1200 and 1600. In: C. Beltrame (ed.), *Boats, Ships and Shipyards*. Proceedings of the ninth International Symposium on Boat and Ship Archaeology, Venice 2000, (Oxford, 2003), 296-305.
- Varenius 1989: B. Varenius, *Båtarna från Helgeandsbolmen*. Stockholm 1989.
- Varenius 1995: B. Varenius, The Baltic Itinerary of Codex Holmiensis A 41. A Conceptual Approach. In: O. Olsen, J. Skamby Madsen and F. Rieck (eds.), *Shipsape — Essays for Ole Crumlin-Pedersen*, (Roskilde, 1995), 189–194.
- Vlierman 1996: K. Vlierman, *Kleine bootjes en middeleeuws scheepsbout met constructiedetails*. *Scheepsarcheologie* 2. Flevobericht 404 (Lelystad, 1996).
- Van de Moortel 1991: A. Van de Moortel, *A cog-like Vessel from the Netherlands*. Flevobericht 331, (Lelystad, 1991).
- Van de Moortel 2011: A. Van de Moortel, Medieval boats and ships of Germany, the Low Countries, and northeast France – archaeological evidence for shipbuilding traditions, shipbuilding resources, trade, and communication. In: *Siedlungs- und Küstenforschung im südlichen Nordseegebiet / Settlement and Coastal Research in the Southern North Sea Region* 34, 2011, 67-104.
- Ventegodt 1982: O. Ventegodt, Skibe og sjøfart i danske farvande i det 12.–14. århundrede. *Maritim Kontakt* 3, 1982, 47–92.
- Vermeersch & Haneca 2015: J. Vermeersch and K. Haneca, Construction Features of Doel 1, a 14th-Century Cog found in Flanders. In: *The International Journal for Nautical Archaeology* 44.1, 2015, 111-131.
- Vermeersch *et al.*, forthcoming: J. Vermeersch, K. Haneca and A. Daly, Doel 2: a second 14th-century cog wrecked in the Deurganck, Doel, Belgium. In: *The International Journal for Nautical Archaeology*.
- Vogel 2002: V. Vogel, Archäologische Belege für Fernkontakte der Stadt Schleswig im 11.-13. Jahrhundert. In: K. Brandt, M. Müller-Wille and C. Radtke (eds.), *Haithabu und die frühe Stadtentwicklung im nördlichen Europa*. Schriften des Archäologischen Landesmuseums 8, (Neumünster, 2002), 367-398.
- Von Arbin 2012: S. Von Arbin, A 15th-Century Bulk Carrier, Wrecked off Skaftö, Western Sweden. In: N. Günsenin (ed.), *Between Continents*. Proceedings of the

- Twelfth Symposium on Boat and Ship Archaeology, Istanbul 2009, (Istanbul, 2012), 67-74.
- Von Arbin 2014: S. Von Arbin, *Skaftövraket — ett senmedeltida handelsfartyg* (Uddevalla, 2014).
- Von den Brincken 1968: A. D. von den Brincken, Mappa mundi und Chronographie. In: Deutsches Archiv für Erforschung des Mittelalters 24, 1968, 118-186.
- Vunk 2002: A. Vunk, Eesti arheoloogilised palverändurimärgid. In: *Eesti Arheoloogia Ajakiri* 6.1, 2002, 25-49.
- Wagner 1984: P. Wagner, Wood Species in Viking Age Shipbuilding. In O. Crumlin-Pedersen and M. Vinner (eds.), *Sailing into the Past*. The International Ship Replica Seminar, Roskilde 1984, (Roskilde, 1984), 130-137.
- Walton 1988: P. Walton 1988, Caulking, cordage and textiles. In: C. O'Brien, L. Bown, S. Dixon and R. Nicholson (eds.), *The Origins of the Newcastle Quayside*. Monography Series 3, (Newcastle upon Tyne, 1988), 78-85.
- Watkins 1994: D. R. Watkins, *The Foundry Excavations on Poole Waterfront 1986/7*. Dorset Natural History and Archaeological Society Monograph Series 14 (Dorchester, 1994).
- Ważny 1990: T. Ważny, *Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen*. Ph.D. dissertation (Hamburg, 1990).
- Ważny 2002: T. Ważny, Baltic timber in Western Europe – an exciting dendrochronological question. In: *Dendrochronologia* 20.3, 2002, 313-320.
- Ważny 2005: T. Ważny, The origin, assortment and transport of Baltic timber. In: C. van de Velde, J. van Acker, H. Beeckman and F. Verhaeghe (eds.), *Constructing Wooden Images*, (Brussels, 2005), 115-126.
- Ważny & Eckstein 1987: T. Ważny and D. Eckstein, Der Holzhandel von Danzig/ Gdansk - Geschichte, Umfang und Reichweite. In: *Holz als Roh- und Werkstoff* 45, 1987, 509-513.
- Weibull 1966: C. Weibull, Lübecks sjöfart och handel på de nordiska rikena 1368 och 1398-1400. Studier i Lübecks pundtullböcker. In: *Scandia* 32, 1966, 1-123.
- Weidinger 2002: U. Weidinger, Die Entstehung der Schlachte als mittelalterliche Hafenanlage Bremens. In: K. Elmshäuser (ed.), *Häfen — Schiffe — Wasserwege. Zur Schifffahrt des Mittelalters*. Schriften des Deutschen Schiffahrtsmuseums 58 (Hamburg, 2002), 116-132.
- Weski 1999: T. Weski, The IJsselmeer type: some thoughts on Hanseatic cogs. In: *The International Journal for Nautical Archaeology* 28.4, 1999, 360-379.
- Weski 2002: T. Weski, Anmerkungen zur spätmittelalterlichen Schifffahrt auf Nord- und Ostsee. In: K. Elmshäuser (ed.), *Häfen Schiffe Wasserwege — Zur Schifffahrt des Mittelalters*. Schriften des Deutschen Schiffahrtsmuseums 58, (Hamburg, 2002): 143-159.
- Weski, T. 2006. Wurde wirklich eine Kogge gefunden? Spätmittelalterliche Funde der Schiffsarchäologie in Nord- und Ostsee. In: *Antike Welt — Zeitschrift für Archäologie und Kulturgeschichte* 1, 2006 91-96.
- Wessman 2007: S. Wessman, Ship Fragments on the Seafloor – What Do We Know about Medieval Seafaring in Finland? In: V. Immonen, M. Lempiäinen, U. Rosendahl (eds.), *Hortus Novus. Fresh Approaches to Medieval Archaeology in Finland* (Turku, 2007), 140-150.
- Westerdahl 1978: C. Westerdahl, Medeltida sjöleder och ortnamn. In: *Tjustbygdens kulturhistoriska förenings årsbok* 1978, 21-48.
- Westerdahl 1992: C. Westerdahl, The maritime cultural landscape. In: *The International Journal for Nautical Archaeology* 21.1, 1992, 5-14.
- Westerdahl 1995a: C. Westerdahl, Transportvägar – Itinerariet och forntida transportsystem. In: G. Flink (Hrsg.), *Kung Valdemars Segelled*, (Stockholm, 1995), 24–32.
- Westerdahl 1995b: C. Westerdahl, Stone maze symbols and navigation. A hypothesis on the origin of coastal stone mazes in the north. In: *The International Journal for Nautical Archaeology* 24.2, 1995, 267-277.
- Westerdahl 2005: C. Westerdahl, Seal on Land, Elk at Sea: Notes on and Applications of the Ritual Landscape at the Seaboard. In: *The International Journal for Nautical Archaeology* 34.1, 2005, 2-23.
- Westerdahl 2006a: C. Westerdahl, The Relationship Between Land Roads and Sea Routes in the Past - Some Reflections. In: *Deutsches Schiffahrtsarchiv* 29, 2006, 59–114.
- Westerdahl 2006b: C. Westerdahl, On the Significance of Portages. A survey of a new research theme. In: C. Westerdahl (ed.), *The Significance of Portages*, (Oxford 2006), 15-51.
- Westerdahl 2009: C. Westerdahl, The horse as a liminal agent. In: *Archaeologia Baltica* 11, 2009, 314-327.
- Westerdahl 2010: C. Westerdahl, Ancient Sea Marks – A Social History from a North European Perspective. In: *Deutsches Schiffahrtsarchiv* 33, 2010, 71–155.

- Westerdahl 2011a: C. Westerdahl, Ancient Sea Marks. A Social History from a North European Perspective. In: *Deutsches Schifffahrtarchiv* 33, 2011, 71-155.
- Westerdahl 2011b: C. Westerdahl, The Ritual Landscape of the Seaboard in Historical Times: Island Chapels, Burial Sites and Stone Mazes — A Scandinavian Example. Part I: Chapels and Burial Sites. In: *Deutsches Schifffahrtarchiv* 34, 2011, 259-370.
- Westerdahl 2013: C. Westerdahl, Medieval Carved Ship Images Found in Nordic Churches: the poor man's votive ships? In: *The International Journal of Nautical Archaeology* 42.2, 2013, 337-347.
- Whitwell & Johnson 1926: R. J. Whitwell and Johnson, 'The "Newcastle" galley, AD 1294. In: *Archaeologia Aeliana* 4.2, 1926, 142-196.
- Wilke 2001, J. Wilke, *Die Ebstorfer Weltkarte*. Veröffentlichungen des Instituts für Historische Landesforschung der Universität Göttingen 39, (Bielefeld, 2001).
- Wille-Jørgensen 2003: D. Wille-Jørgensen, Das Ostseeimperium der Waldemaren. Dänische Expansion 1160-1227 / Valdemarernes Østersøimperium. Dansk ekspansion 1160-1227. In: M. Gläser and D. Mührenberg (eds.), *Dänen in Lübeck / Danskere i Lübeck · 1203 · 2003*, (Lübeck, 2003), 26-35.
- Wittstock 1984: J. Wittstock, Pilgerzeichen in Lübeck. Alte und neue Funde. In: *Lübecker Schriften zur Archäologie und Kulturgeschichte* 8, 1984, 15-21.
- Wolf 1988: A. Wolf, Neues zur Ebstorfer Weltkarte, Entstehungszeit – Ursprungsort – Autorenschaft. In: K. Jaitner and I. Schwab (eds.), *Das Benediktinerkloster Ebstorf im Mittelalter*, (Hildesheim, 1988), 75-109.
- Wolf 1986: T. Wolf, *Tragfähigkeiten, Ladungen und Maße im Schiffsverkehr der Hanse vornehmlich im Spiegel Revaler Quellen*. Quellen und Darstellungen zur hansischen Geschichte (Neue Folge) 31, (Cologne/Vienna, 1986).
- Woodward 1985: D. Woodward, Reality, Symbolism, Time and Space in Medieval World Maps. In: *Annals of the Association of American Geographers* 75, 1985, 510-521.
- Woodward 1987: D. Woodward, Medieval Mappaemundi. In: J.B. Harley and D. Woodward (eds.), *The History of Cartography*, (Chicago, 1987), 286-370.
- Wright 1925: J. K. Wright, *The Geographical Lore at the Time of the Crusades: A Study in the History of Medieval Science and Tradition in Western Europe* (Dover 1965 reprint of 1925).
- Wright 2001: C. M. Wright, *The maze and the warrior: symbols in architecture, theology, and music*, (Cambridge MA, 2001).
- Žulkus 2011: V. Žulkus, Settlements and piracy on the eastern shore of the Baltic Sea: The Middle Ages to Modern Times. In: *Archaeologia Baltica* 16, 2011, 58-71.
- Zunde 1998/99: M. Zunde, Timber export from Old Riga and its impact on dendrochronological dating in Europe. In: *Dendrochronologia* 16/17, 1998/99, 119-130.
- Zunde 2015: M. Zunde, The historical waterfront revetments of Rīga in the light of dendrochronological dating. In: *Archaeologia Baltica* 21/22, 2015, 148-162.
- Zwick 2008: D. Zwick, Das Beluga-Schiff vom Bremer Teerhof. Vorläufige Untersuchungsergebnisse. In: *Bremer Archäologische Blätter* 7, 2008, 145-151.
- Zwick 2010: D. Zwick, Neues vom 'Beluga Schiff' – ein Bremer Klinkerwrack aus dem 15. Jahrhundert. In: *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 16, 2010, 62-71.
- Zwick 2012: D. Zwick, Variationen in der mittelalterlichen Schiffbautechnik anhand von Wrackfunden in Bremen, Holzbau in Mittelalter und Neuzeit. In: *Mitteilungen der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit* 24, 2012, 283-298.
- Zwick 2014: D. Zwick, Auf den Spuren des ältesten See-Itinerars der Ostsee: eine archäologische Zeitreise. In: F. Huber & S. Kleingärtner (eds.), *Gestrandet – versenkt – versunken: Faszination Unterwasserarchäologie*, (Neumünster, 2014), 192-215.

## 11. APPENDIX

### 11.1. Transcription of King Valdemar's Itinerary (Utlängan-Tallinn)

The place-name identification and transcription was done by Härlin (1942), translated into English by this author. The original division is retained.

- A** *De utlengi usque calmare X ukæsiø. Deinde usque skægge nes II ukæsiø. Hinc usque waldø IV et si placet ire per latus terre potest ire de waldø usque runø. Queque distat a waldø ad I ukæsiø. Inde usque klinesskær, uel diuræholtstnub I. Inde usque geishammer I. Inde usque roxhammer I. Inde usque æfra. Inde usque winø I.* *From Utlängan to Kalmar 10 ukæsiø. From there to Skäggenäs 2. From there to Vällö 4 and when one follows the coast one can go from Vällö to Runø. The distance from Vällö is 1 ukæsiø. From there to Klämmaskær or Djurbultsnabb 1. From there to Fittjehammar 1. From there to Utthammar 1. From there to Avrö 1. From there to Vinö 1.*
- B** *De kalmare usque dyur IX. Hinc usque winø III. Hinc usque sporæ III. Hinc usque hambrae II et unum cum hambrae. Hinc usque askø I et per askø I et de askø usque quetnæ I. Hinc usque orsund II. Hinc usque wæggi I et per wæggi I. Inde usque ulfsund I. Hinc usque rotæsund I. Inde usque alrecki II. Hinc usque brawic I. Brawic durat in longum VI ukæsiø.* *From Kalmar to Djur 9. From there to Vinö 3. From there to Spårö 3. From there to Halmare 2 and one past Halmare. From there to Askö 1 and past Askö 1 and from Askö to Kvädö 1. From there to Barösund 2. From there to Vägögn 1 and past Vägögn 1. From there to Olsösund 1. From there to Rotsundet 1. From there to Arkö 2. From there to Bräviken 1. Bräviken takes 4 in time.*
- C** *Primo cum pertransitur trans brawic occurrit quedam insula winterclassæ nomine, et tunc alor. Deinde rugø. Deinde ringø. Deinde leckæ. Deinde askø. Deinde raueskiær. Deinde thora. Deinde haribhammar. Deinde usque mæthelstein II. Inde usque alæsnap II. Inde usque gardø II. Inde usque windø I et cum windø II et windø uersus austrum iacet rudmi.* *After having crossed Bräviken one passes an island called Vinterklasen, and then Ålö. And then Rågö. And then Ringsö. And then Lacka. And then Askö. And then Revskiær. And then Torö. And then Herrhamra. And then to Mellsten 2. And then to Ålmsnabben 2. And then to Gälö 2. And then to Vindö 1 and by passing Vindö 2 and in the south of Vindö lies Runmarö.*
- D** *Inde uthøi. Deinde mæthelsten. Deinde nutarn. Deinde olæ. Deinde ornæ. Deinde neffø. Deinde rudmi.* *Then Utö. And then Mellsten. And then Nätarö. And then Ålö. And then Ornö. And then Nämmdö. And then Runmarö.*
- E** *Inde strømsø. Inde eldo. Inde sandø. Inde brunso.* *Thence Berghamn. Then St. Jällö. Then Stavsunda. Then Träskö-Storö.*
- F** *Inde enkø. Inde bæro. Inde steflø. Inde myghi.* *Then Eknö. Then Harö. Then Steflo [either Lökaö or Bockö]. Then Mjöja*
- G** *Inde særsør. Inde busarn. Inde enlang. Inde lincer. Inde sicmar. Inde finør. Inde øslæ. Inde boxhals. Inde widør. Inde ræfsnes. Inde arnholm.* *Then Särsö. Then Husarö. Then Östra Lagnö. Then Linken. Then Sikmarö. Then Blidö. Then Yxlan. Then Oxhalsö. Then Sidö. Then Rännäs. Then Arholma.*
- H** *Et ultra brawic usque fimersund II. Inde usque orschac, usque rugø I. Inde usque stendor sund. Inde usque sinia sund. Inde usque hafø I. Inde usque fifang I. Inde usque swether sund I. Inde usque ekiholm I. Inde usque aslæsund I et per aslæsund I. Inde usque ikernsund I. Inde usque gardø I. Inde usque dalernsund I. Inde usque baricstik I. Inde usque litle swethiuthæ I. Inde usque stokholm I.* *From inside Bräviken to Femöresund 2. From there to Örsbacken, to Rågö 1. From there to Västra Stendorren. From there to Sävsundet 1. From there to Hafø [?] 1. From there to Fifång 1. From there to Svärdsundet 1. From there to Ekholmen 1. From there to Yxlösund 1 and to Aslæsund 1. From there to Ikernsund [Vitgarncsund or Märsgarncsund] 1. From there to Gälö 1. From there to Dalarö Ström 1. From there to Baggenstäket 3. From there to Sveriges Holme 1. From there to Stockholm 1.*



- K** *De litte swethintha usque wirasund I. Inde usque malægstagk I. Inde usque krampe sund III. Inde usque weddesund I. Inde usque arnholm II. Atque notandum est quod processus de utlengi uersus arnholm magis hebeat se ad aquilonem quam ad orientem.*
- L** *De arnholm transmare aland usque lynaböte VI. Inde usque thýckækærl VIII. Notandum est quod inter thýckækærl et lynaböte multe iacent insule fýghelde nomine. Inde usque aspæsund VI et ibi sunt tres insule quarum una est aspæ, secunda reþholm, III:a malmo et iurima iacet ultima ab eis uersus australem plagam et proxima mari. De aspæ usque orsund VI. Inde usque hangethe III. Et notandum est quod de arnholm usque lynaböte itur medio inter orientem et aquilonem et si prosper est uentus ab occidente potest uelificari directa linea de arnholm usque hangethe et de hangethe que finnice dicitur cumiue usque lowicsund II. Inde usque karienkaška I. Inde usque iuxarö II. Inde horinsaræ quod danice dicitur bestö II. Inde usque þurkal III et ad hanc insulam de hangethe itur uersus orientem et aliquantulum tamen uersus aquilonem. Item de þurkal usque narigeth ultra mare estoniam VI. Inde usque karlsö I et dimidia. Inde usque ræuelsburg dimidia. Et notandum quod de þurkala usque ræuelsburg uelificandum est inter australem plagam et orientalem.*
- M** *Pretera notandum est quod si placet potest uelificari de hangethe usque botbensholm cum uento aquilonis uersus australem plagam et orientalem. Atque ibi habet mare VIII ukæsiö.*

*From Sveriges Holme to wirasund [Tenösund?] 1. From there to Ståksund 1. From there to Nenningsundet 3. From there to Vätö Sund 1. From there to Arbolma 2. One notices that the route from Utlängen to Arbolma goes more to the north than to the east.*

*From Arbolma over the sea to Ålands Hav to Lemböte 4. From there to Kökar 8. It can be noted that between Kökar and Lemböte there are many islands called Föglö. From there to Aspösund 4 and there are three island of which one is Aspö, the other reþholm [Björkö?] and the third malmo and Jurmo is the most southerly nearest to the open sea. From Aspö to Orsund [Kyrkosund i Hitis] 4. From there to Hangö 3. It should be noted that the course from Arbolma to Lemböte goes north-east, and one could, if there is a favourable wind from west, sail a direct line from Arbolma to Hangö, which is called in Finnish cumiue to Tvärminne 2. From there to Hästö-Busö 1. From there to Jussarö 2. Then Horinsaari [Korþholm] 2. From there to Porkkala 3. And to this island take the course from Hangö to the east but a little to the north. From Porkkala across the Gulf of Finland to Narvö 6. From there to Karlö 1½. From there ½ to Tallinn. It ought to be noted that from Porkkala to Tallinn it could be sailed in a south-east direction.*

*It should be noted that one could, if wished so, sail from Hangö to Odensholm with a northerly wind to south east. And this has 8 ukæsiö at sea.*

## 11.2. Naval warfare in the Chronicles of Henry of Livonia

The most vivid account of naval warfare in the Chronicles of Henry of Livonia is provided for the year 1215, when Henry – who might have been even an eye-witness himself – describes an episode, which deserves to be reproduced in full length. 9 German crusader cogs were on their way back from Riga and forced to seek shelter in a natural harbour on Ösel/Saaremaa during a storm. The Estonians managed to summon a large fleet and army within a short period of time, encircled the Germans in superior numbers, blocked the harbour entrance and propelled fire-ships – or rather fire-rafts – onto the crusader's fleet, whose cogs seem to have granted them the only kind of protection in combination with the crossbowmen (*ballistarii*), who managed to fend off attacks. Due to adverse weather and the narrowness of the inlet, the crusaders had great difficulty to escape, but managed to do so by bringing out anchors in their skiffs, in which they were more exposed to attacks and suffered the greatest losses. This manœuvre is known as kedging (German: *warpen*):

*Episcopus autem Raceburgensis cum episcopo Estiensi Theoderico festinans ad concilium Romanum, cum peregrinis euntibus in Theuthoniam mari se committens Gothlandiam properat cum novem coggonibus. Et nocte sequenti factus est ventus contrarius eis cum tonitru; et per totam diem passi tempestatem magnam, depulsi sunt tandem in portum novum in Osilia. Quos ut cognoverunt Osiliani de Riga venisse, comminabantur eis bellum. Et mittentes per totam Osiliam congregaverunt exercitum magnum navalem. Et alii in equis venientes in litore maris structuras lignorum edificabant, implentes eas lapidibus, portum, cuius aditus strictus erat,*

*The bishop of Ratzeburg and Bishop Theodoric of Esthonia hurried to the Roman council. They embarked by sea with pilgrims who were going to Germany and sailed to Gothland with nine cogs. On the following night there was a contrary wind and thunder and they suffered a great storm through the whole day. At last they were forced into the new port on Oesel. When the Oeselians learned that they came from Riga, they threatened them with war. They sent throughout Oesel and gathered a large naval force. Others of them came on horseback and built structures of wood on the seashore. These they filled with rocks, seeking to block off the harbour,*

obstruere nitentes, ut concluso portu caperent omnes et interficerent. Theuthonici vero in cymbis suis, id est minoribus navibus, exeuntes ad litus segetes per agros gladiis suis metebant, nescientes exercitum in vicino littore; et in alio littore per singulos dies idem faciebant. Tandem Osilienses positus insidiis octo ex eis comprehenderunt et alios occisis alios captivos deduxerunt et cimbam unam abstulerunt. Unde nimium confortati miserunt ad omnes provincias Estonie, dicentes se episcopum Rigensem cum omni exercitu suo comprehendisse. Et venerunt omnes cum exercitu magno. Et facto diluculo in primo mane totum mare contra nos tenebrorum apparuit, pyratibus ipsorum repletum. Et pugnaverunt contra nos per totam diem. Et quidam ex eis estructuras lignorum et liburnas veteres adducentes miserunt in profundum et lapidibus impleverunt et aditum portus nobis obstruxerunt. Unde timore magno perterriti putabamus manus eorum non evadere.

Alii quoque ex eis ducebant ignes maximos tres ex siccis lignis et pinguedine animalium incensos et super estructuras arborum magnarum compositos. Et primus ignis, qui erat super alios magis ardens, pellebatur supra mare et appropinquabat ad nos, et ventus australis fortis vehementi impulsione pellebat eum super nos. Et Estones in pyratibus suis circueuntes ignem custodiebant eum et in directo ducebant eum super medios cogones. Erantque cogones omnes in unum colligati, ut facilius nos ab inimicis defenderemus, tantoque magis ignem evadere non posse timebamus. Et cum iam ignis idem, altior cogonibus omnibus, flammam suam ad nos extenderet, evocavimus episcopum de camerula sua, in qua erat orans die ac nocte. Et venit et vidit, quod non erat consilium et auxilium nobis, nisi divinum. Et elevans oculos suos et manus utrasque ad celum orabat ab igne presenti liberari. Et vidimus omnes, et ecce subito ventus australis conversus est in orientalem, et ventus ab oriente convertit ventilogium, quod erat in velo, in contrarium et removit ignem a nobis, et cum omni mansuetudine depellebat eum circum cogones retro nos in mare. Et benediximus omnes Dominum, eo quod visibiliter liberavit nos ab incendio presenti. Et pellebant secundum ignem et tertium, contra quos diu pugnantes et aquam fundentes multum laboravimus, quos etiam tandem ventus removit a nobis. Interim alii Estones erant remigantes circa nos et lanceis et sagittis suis vulnerantes plures ex nostris, et alii, redeuntes iterum eadem via circum nos, lapidibus et pedis suis iactantes super nos. Et erant timores nobis tam de portu clauso, quam de bellorum incommodis.

Et ait Albertus Sluc, nauta noster: „Si“, inquit, „patienter obtemperare volueritis, liberabit nos Dominus a periculis presentibus. Cum“, inquit, „naves nostre non sint onuste sed vacue et modica sufficit eis profunditas, alia via poterimus exire, si cymbas intraveritis fortes viri et armati et anchoras deducentes proieceritis in profundum, per medium hostium revertentes iterum ad nos, ceterique funibus anchoris alligatis cogones trabendo subsequantur, donec in profunditatem maris perveniamus.“ Et obedimus omnes et traximus, donec transitis difficultatibus in mare magnum et spatiosum pervenimus. Qui vero in cymbis anchoras deduxerunt milites et servi, sevissimam impugnationem passi lanceis et sagittis

whose entrance was narrow, so that when the port was closed off, they might capture the Germans and kill them. The Germans, who were unaware that the army was on the shore nearby, went off to shore in their skiffs, or small boats, and reaped the crops with their swords. They did the same on another shore each day. The Oselians set an ambush and at last they caught eight of the Germans, some of whom they killed, and took others captive, and they seized one skiff. They were too greatly encouraged by this, for they sent to all the provinces of Esthonia to say that they had captured the bishop of Riga and his whole army. All of the Esthonians came with a large army. At the first light of dawn the sea opposite us looked black with their pirate ships and they fought against us throughout the day. Some of them brought out the wooden structures and their old brigantines, which they filled with rocks and sent to the bottom, and so they closed off the entrance of the port to us. We were greatly frightened at this and thought that we could not escape their clutches.

Some of them launched three big fires, kindled from dry wood and animal fat, and set upon structures made of huge trees. The first fire, which burned more fiercely than the others, was impelled over the sea toward us and a strong south wind gave it a big push and thrust upon us. The Esthonians circled around the fire in their pirate ships and kept it going. They steered it straight toward the midst of our ships. Our ships were all gathered together, so that we feared all the more that we could not escape the fire. When the flames of this fire, which was taller than all of the ships, reached out toward us, we called the bishop from his cabin, where he was praying day and night. He came and saw that there was no counsel or help for us save in God. He raised his eyes and both hands to heaven and prayed to be saved from the present fire. We all watched, and suddenly the wind changed from south to east. The east wind turned the weathervane on the sails around and took the fire away from us. It gently forced the fire around the ships and behind us out to sea. And we all blessed the Lord, for He had visibly freed us from this present fire. The Esths launched the second and third fires and we worked for a long time fighting them and pouring water on them and at last the wind removed them from us. Other Esthonians, meanwhile, were rowing around us and they wounded many of our men with their lances and arrows. Still others returned, took the same route around us, and threw their stones and staves at us. Our people were afraid, both because of the fact that the harbour was closed and because of the mishaps of the war.

Our skipper, Albert Sluc, said: "If you will be patient and obedient, the Lord will free us from these present dangers. For", said he, "our ships are light and are not heavily loaded and scant depth is enough for us. We can get out by another channel if you strong armed men will get into the skiffs and take the anchors and throw them overboard. You will then return to us again through the midst of the enemy and the rest will follow, pulling the ships along by the ropes attached to the anchors, until we come to the deep sea." We all obeyed and pulled until, after the difficulties, we came into the great open sea. The knights and servants who had taken the anchors out in the skiffs had suffered a very severe attack and

*ipsorum nec non et lapidum iactibus graviter sunt vulnerati. Qui tandem tollentes secum ferrum recurvum vel unicum ferreum, quod in aliquam pyraticearum proicerent et taliter apprehenderent, et iactantes in unam, iam eam attrahere putabant. Sed Estones vehementi remigatione fugientes ab eis alias pyraticeas obvias habuerunt. Et cum esset eadem hora hec oratio episcopi ad beatam Virginem: „Monstra te esse matrem, monstra te esse matrem“, revera monstravit se esse matrem. Nam illa pyraticea fugiens, que magna erat et multis viris repleta, forti pulsu vecta super aliam scissa est cum sonitu magno per medium et repleta est aquis, et viri ceciderunt in mare et submersi sunt. Et confusi sunt alii omnes. Et videntes nos profunditatem maris iam comprehendisse, congregaverunt se in littore maris. Et erant ex eis multa milia, qui tam eques quam pedes convenerant de tota Estonia et in pyraticeis fere ducentis. Et irati sunt valde in invicem clamore magno simul et verberibus, eo quod duarum ebdomadarum laboribus nichil profecerunt et multos ex suis in mari submersos et plures a balistaris nostris interfectos perdidit. Et sustollentes vela sua dispersi sunt in mari et abierunt unusquisque in viam suam. Et sequuti sunt nostri post eos in cymbis suis et abstulerunt eis pyraticeam unam maiorem, quam in Godlandiam secum deduxerunt. Et liberavit nos in illa die beata Virgo, sicut et omnes Lyvonenses hactenus liberavit ab omnibus angustiis suis usque in hodiernum diem. (HCL XIX 5, ed. Bauer 1975, 192ff.)*

*they were gravely wounded by lances, arrows, and stone missiles. At last they took with them an iron hook, or grappling iron, which they might throw into one of the pirate ships and so catch it. Throwing it into one of the ships, they thought they could drag it alongside, but the Estonians rowed violently away and headed toward the other pirate ships. Since the bishop at this very moment was praying to the Blessed Virgin: “Show Thyself a mother, show Thyself a mother,” She did indeed show Herself a mother. For, as that pirate ship, which was large and full of men, fled, it ran with great violence into another one. It split down the middle with a great noise and all of the others were confounded. Seeing that we had now reached the seep ocean, the Estonians gathered on the seashore. There were many thousands of them, both cavalry and infantry, who had come from all parts of Estonia, and there were about two hundred pirate ships. They raged violently at one another with a good deal of noise and blows too, since they had gained nothing from two weeks of work and had lost many of their men who had drowned in the sea, and more who had been killed by our ballistarii. They raised their sails and dispersed on the sea and each of them went away by his own route. Our men followed after them in the skiffs and took from them a large pirate ship, which they brought along to Gotthland. The Blessed Virgin freed us that day, as She has freed the Livonians from all their troubles up to the present day. (Brundage 2003, 149f.)*

### 11.3. Caulking material from the Kuggmaren wreck

The initial investigation has revealed that the Kuggmaren wreck’s plank seams were caulked with moss (*sphagnum*) retained with laths and caulking cramps (Adams & Rönby 2002, 176), a technique that is most commonplace at the southern coast of the North Sea but also spread into the Baltic Sea. It was now possible to determine the sub-species of the caulking material, which appears to be *sphagnum cuspidatum* — i.e. long-leaved floating bog-moss (Ingo

Feeser, pers. comm.) — contaminated with weed seeds and heath leaves (Tab. 4-3). *Sphagnum cuspidatum* occurs in oligotrophic bogs, thus a good cue on provenance. Although contaminants trapped in the main mass may provide further cues of provenance (cf. Deforce et al. 2014, 300), the contaminants listed here are commonplace in heathland or moorland, thus consistent with the vegetation of *sphagnum cuspidatum*.

Taxon	Category	English	German	Quantity
<i>Sphagnum cuspidatum</i>	plant	toothed peat moss	Spieß-Torfmoos	mass
<i>Spergula arvensis</i>	seed	corn spurrey	Ackerspörgel	2
<i>Calluna vulgaris</i>	leaf	common heather	Besenheide	1
<i>Erica tetralix</i>	leaf	cross-leaved heath	Glockenheide	1
<i>Solanum</i>	seed	nightshade	Nachtschatten	1

Tab. 4-3. Analysis of caulking material sample from the Kuggmaren wreck. Due to the small size of the sample, the caulking material may have also included other taxa.

In connection to ship-finds, *sphagnum cuspidatum* has been hitherto detected only in the early 14<sup>th</sup> century shipwrecks of Gedesby together with cow hair (Robinson & Aaby 1994, 182), and the two Doel wrecks from Belgium (Deforce et al 2014, 302), on a medieval plank recovered from the harbour area of Stralsund and a boat of the Rhine (Frahm & Wiethold 2004, 305). Further high and late medieval finds — unrelated to wrecks — include Leeuwarden in the Netherlands, Rostock and Stralsund (Frahm & Wiethold 2004, 312f).

What is the distinction between *sphagnum cuspidatum* and other *sphagnum* species and what can be inferred? There is not a large difference, as *sphagnum* mosses describe variances of aquatic moss species. For this reason, and the often severely fragmentation of samples, it has been deemed problematic to determine *sphagnum* subspecies (Cappers et al 2000, 578). However, of all the aquatic moss species, *sphagnum cuspidatum* appears to be the most aquatic and therefore is better preserved than other mosses in moist environments and is more absorbent and

acidic, thus arguably the best suited subspecies. Although the use of this species as caulking material could be conditioned by the ready availability in some areas, medieval shipbuilders may have consciously recognised its advantages and deliberately collected these mosses, as a case study from the Netherlands suggests.

This case study has shown that there is a marked shift in the mid 13<sup>th</sup> century from heterogenic mosses collected in woods and sandy soils like dunes, to more homogenic mosses collected from wetter environments like peatbogs and heathlands (Cappers *et al.* 2000, 584). *Sphagnum cuspidatum* belongs to the latter and the mid-13<sup>th</sup> century shift might be significant with regard to the early 13<sup>th</sup> century dating of the Kuggmaren wreck. The shift may reflect a change in the sub-supplier network, where the collection and transportation of larger quantities of moss became a trade of its own, and not necessarily collected in the immediate vicinity of a shipbuilding site.



Fig. 4-18. Moorland with a *sphagnum cuspidatum* vegetation in the Nationaal Park Drents-Friese Wold, the Netherlands (Photo: Dominicus Johannes Bergsma).

The present distribution of *sphagnum cuspidatum* displayed above (Fig. 4-19) is not exhaustive and does not correlate to medieval vegetation levels, but it gives a very vague impression on which regions are — and most likely were — favourable for this moss species. Particularly large areas in the coastal plain of Belgium, the Netherlands and Germany were covered with raised bogs, where *sphagnum cuspidatum* occurred. These are all gone now caused by marine transgressions, drainage and peat extraction (Koen Deforce, pers. comm.).

*Sphagnum* mosses as a whole are highly represented in the medieval and early post-medieval archaeological material, arguably because they had been more widely distributed, often even at the immediate outskirts of towns (Frahm & Wiethold 2004, 317).

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There was — for instance — a long tradition of moss collection from the forests around Stockholm by the poor for the use as caulking material of ships built at

the Swedish Naval dockyards (Franklin 1985, 19), so the shift could be explained in socio-economic terms. The collection and processing of moss could have been a trade in its own right, as has been demonstrated by the reconstruction of the “Kampen Cog”: It took one month for two people to produce 1850-2000 litres of caulking material needed for this vessel, which measures 20 metres in length (Cappers *et al.* 2000, 585). Another explanation for the high representativeness could be that mosses are commonly found in water-logged conditions, and aquatic mosses would have simply survived longer.

As mentioned earlier, the use of *sphagnum* as caulking material is often primarily attributed to the southern North Sea coast, particularly the Netherlands with its extensive moor and heathlands. The choice of material is often associated with a ‘cultural imprint’, as the use of animal hair is seen typical for ships from Scandinavia (Möller-Wiering 2001) or the British Islands (cf. Allen *et al.* 2005, Walton 1988).

Sometimes they may also indicate differences on a more regional level, as the use of animal hair was seen as diagnostic for Rani and moss for Pomeranian shipbuilding (Nakoinz 1998). Both Rani and Pomeranians were Western Slavonic tribes, and although their respective choice may indeed be attributed to a discrete shipbuilding tradition, it could be also attributed to their very different environments: The Rani where the inhabitants of the Island of Rügen and the Pomeranians inhabited the boggy and forested area south of the Baltic Sea.

However, the regional attribution is not as clear, as some finds may suggest. Moss was also used in regions where shipbuilders normally relied on animal hair as the primary caulking material from an early stage. On the British Islands, moss was used since the Bronze Age (McGrail 1998, 65f.). In case of the Doel wrecks *sphagnum cuspidatum* was the main caulking material used, while other species were likely to have been inserted later (Deforce *et al.* 2014, 305). Apart from the already known — almost stereotypical — pattern of most clinker-built vessels being waterproofed with animal hair and most bottom-based vessels with moss, no finer-grained tendencies can be inferred at this point, as the data is not yet representative enough (Tab. 4-3). However, this stresses the requirement to take many samples from different parts of the hull, like lands, scarfs and repair patches.

While the Beluga case study (paper D) has stressed that a pattern has emerged in the way many clinker-built vessels are waterproofed — animal hair in the lands, but (!) moss in the scarfs, the above table shows that mixtures can also occur in non-clinker built vessels.



Fig. 4-19. Present distribution pattern of sphagnum cuspidatum in northern Europe. The map is incomplete and does not include all areas, e.g. northern Germany, historically one of the major areas for sphagnum cuspidatum (cf. Deforce et al 2014, 311). (Map accessed on 15/04/2015, <http://eol.org/pages/926613/maps> based on data from the Global Biodiversity Information Facility).

Tab. 4-3. This overview shows more detailed patterns of caulking, taking also secondary and later instances into account. There is not yet enough comparative material to infer any meaningful patterns, but this table demonstrates the potential for more consistent sampling and analysis, as the use of different materials can be regarded as the rule, rather than exception.

Wreck	date	1 <sup>st</sup> prov.	2 <sup>nd</sup> prov.	faunal			floral			Reference
				Animal hair	sheep wool	cow hair	Sphagnum	Sphagnum cuspidatum	other moss species	
Kuggmaren	1215	Jutland						LFS		Adams & Rönby 2002
Gedesby	1320	DK						C		Robinson & Aaby 1994
Doel 1	1326	NW-Germany	Baltic		D		D	C		Deforce et al 2014, 305
Doel 2	1328	N-Poland			D		D	C		Deforce et al 2014, 305
Beluga	1396+	Baltic	NW-Germany		C					paper C
Gdansk W-5	1399	N-Poland		C			S			Litwin 1980

Key: ■ main mass ■ secondary species ■ repair / later caulking  
 Used in the seams between clinker (C), lapstrake (L) or flush-laid (F) planks, or was driven-in (D) later, or used in the scarfs (S).






## 12. CURRICULUM VITAE

- **1980:** Born in Hamburg, Germany.
- **2000:** *Abitur* at the *Kooperative Gesamtschule Elmshorn* (A-levels at the Cooperative Comprehensive School Elmshorn).
- **2002-2002:** Undergraduate studies in Classical Archaeology and other subjects at the University of Hamburg.
- **2002-2004:** B.A. in Archaeology, University of Southampton, passed with an *upper second* (2.1). Fieldwork project participation: 'Krogen Project' – an underwater survey of 19<sup>th</sup> century shipwrecks in the Stockholm Archipelago, Sweden; fieldsurvey of an Anglo-Saxon graveyard in Breamore, England.
- **2004:** Trainee at the excavation project 'Monastic Activities at Skriðuklaustur', Iceland.
- **2004-2005:** M.A. in Maritime Archaeology, University of Southampton, passed with a *distinction* (1). Fieldwork project participation: airlift and waterlift underwater training at the Royal Navy facility on Horsea Island, England; CYSUCH Underwater Survey, Cyprus; shipwreck excavation in Axemouth, England; ethnographic boat recording in Eyemouth, Scotland.
- **2005-2009:** Honorary Secretary and member of the executive committee of the *Deutsche Gesellschaft zur Förderung der Unterwasserarchäologie e.V.* (DEGUWA = German Society for the Promotion of Underwater Archaeology).
- **2006:** Archaeologist at the Irish branch of Headland Archaeology Ltd. (now Rubicon Heritage) on rescue excavations near Carlow, Ireland.
- **2006:** Volunteer at the 'Viking Unst Project' of NAS-Scotland, an underwater and foreshore survey of a fish-trap in Uyeasound on the Shetland Isles, Scotland.
- **2007:** Internship at the German Maritime Museum, Bremerhaven.
- **2007:** Freelance maritime archaeologist at the rescue excavation 'Teerhof BA1' in Bremen, Germany, responsible for the documentation, study and publication of the 15<sup>th</sup>-century "Beluga Ship".
- **2007:** Crew member of the historic research vessel *Grönland* (1868) on a voyage to Bergen, Norway.
- **2007-2008:** Archaeologist at the Museum of London Archaeology Service (MoLAS) for the 'Bath-Southgate SO-SGT-06' rescue excavation.
- **2008:** Volunteer at the 'Schwedenschanze' excavation of an early medieval ringwall and associated maritime archaeological finds near Stade, Germany.
- **2008-2016:** Ph.D. candidate at the University of Kiel's Graduate School 'Human Development in Landscapes', with research affiliations to the University of Southern Denmark, Odense, and the Viking Ship Museum, Roskilde. DFG excellence initiative stipendary at the Graduate School 'Human Development in Landscapes' (2008-2011). Fieldwork project participation: total station survey on *Vasa's* (b. 1628) orlop-deck, Stockholm (2009); UNESCO Underwater Archaeology workshop in Gdansk, Poland (2010); underwater survey of Flensburg's medieval sea barrier (2011).
- **2009-2010:** Freelance co-editor for English-language contributions to the conference volume "*Lübecker Kolloquium zur Stadtarchäologie im Hanseraum Band VII. Die Befestigungen*".
- **2012:** Freelance consultant for the European Hanse Museum, Lübeck, providing a research report on medieval shipbuilding and seafaring for the showroom "*An der Neva um 1193*".
- **2013-2014:** Freelance maritime archaeologist, recording re-used ship-timbers and caulking cramps for the Archaeological Museum of Hamburg.
- **2014:** Scientific Diver Training at the Institute of Geosciences, University of Kiel.
- **2016:** Internship at the State Archaeological Department of Schleswig-Holstein.
- **2016:** Ph.D. in Pre- and Protohistoric Archaeology, University of Kiel, passed with a *magna cum laude* (1.3).

## 13. CUMULATIVE PAPERS

In the following, the five publications on which this cumulative dissertation is based are reprinted. Three have been already published in 2013, 2014 and 2016, respectively, and are included as copies. The remaining two papers — marked as ‘forthcoming’ — have been submitted to the editors and accepted. The page and footnote numbers as well as the layout does not correspond to the respective publications, but are aligned to this volume. The content remains the same.

Please consider that the forthcoming manuscripts are still subject to editorial change. The formatting and reference system is geared towards the author’s guidelines of the respective publications and are therefore not consistent to the rest of this dissertation.

	Year	Title	Editors	Publication	Publisher	1	2	3	Words	%
<b>A</b>	2013	<b>Dynamics for Cultural Change in the Baltic Sea Region in the Age of the Northern Crusades – a maritime archaeological perspective</b>	S. Kleingärtner T. Newfield S. Rossignol D. Wehner	<b>Landscapes and Societies in Ancient and Medieval Europe East of the Elbe / Papers in Mediaeval Studies 23</b>	 Toronto: Pontifical Institute of Mediaeval Studies (PIMS)	M S	C P	P R	17,000	21,25
<b>B</b>	2014	<b>Conceptual Evolution in Ancient Shipbuilding: An Attempt to Reinvigorate a Shunned Theoretical Framework</b>	J. Adams J. Rönnby	<b>Interpreting Shipwrecks: Maritime Archaeological Approaches / Southampton Monographs in Archaeology New Series 4</b>	 Southampton: Highfield Press	M S	C P	P R	18,000	22,50
<b>C</b>	Forthcoming	<b>A 15<sup>th</sup>-century shipwreck with Scandinavian features from Bremen, Germany</b>	B. van Tilburg	<b>Ships and Maritime Landscapes / Proceedings of the 13<sup>th</sup> International Symposium on Boat and Ship Archaeology 8-12 October 2012, Amsterdam</b>	 Groningen: Barkhuis	M S	C P	P R	6,000	7,50
<b>D</b>	Forthcoming	<b>Interpreting a Scandinavian-built shipwreck from Bremen in the context of late medieval clinker constructions and northern European timber trade</b>	E. Elvestad M. Gardiner N. Mehler	<b>German Trade in the North Atlantic 1400-1700: Interdisciplinary Perspectives</b>	 Arkeologisk Museum Stavanger Skrifter	M S	C P	P R	18,000	22,50
<b>E</b>	2016	<b>Bayonese cogs, Genoese carracks, English dromons and Iberian carvels: Tracing technology transfer in late medieval Atlantic shipbuilding</b>		<b>Itsas Memoria. Revista de Estudios Marítimos del País Vasco 8</b>	 San Sebastián: Museo Naval	S J	R A	A B	21,000	26,25
Key	[1] MS = monographic series / NL = newsletter / PS = popular scientific / SJ = scholarly journal [2] CP = conference proceedings / RA = regular article [3] AB = reviewed by advisory board / PR = anonymous peer-review									





## Paper A

Zwick 2013: D. Zwick, Dynamics for Cultural Change in the Baltic Sea Region in the Age of the Northern Crusades – a maritime archaeological perspective. In: S. Kleingärtner, S. Rossignol, D. Wehner (eds) *Landscapes and Societies in Medieval Europe East of the Elbe / Papers in Mediaeval Studies 23*, Toronto: Pontifical Institute of Mediaeval Studies.

“Dynamics for Cultural Change in the Baltic Sea Region in the Age of the Northern Crusades: A Maritime Perspective,” was originally published in *Landscapes and Societies in Medieval Europe East of the Elbe: Interactions Between Environmental Settings and Cultural Transformations*, ed. Sunhild Kleingärtner, Timothy P. Newfield, Sébastien Rossignol, and Donat Wehner, *Papers in Mediaeval Studies 23* (Toronto: Pontifical Institute of Mediaeval Studies, 2013), 329–376, and is reprinted here by permission of the publisher. © Pontifical Institute of Mediaeval Studies; all rights reserved.



# DYNAMICS FOR CULTURAL CHANGE IN THE BALTIC SEA REGION IN THE AGE OF THE NORTHERN CRUSADES. A MARITIME PERSPECTIVE

## 1. Introduction

The *limes Saxoniae* alongside the Elbe River as natural boundary remained a stable cultural frontier zone until the year 1147, when Danish and German princes subdued Slavic lands east of the Elbe with a joint maritime-terrestrial campaign. This was the first papally authorized crusade “contra Sclavos ceterosque paganos habitantes versus Aquilonem”, which mandate remained fairly inexplicit about the actual aims, aside from the conversion of the Slavs.<sup>27</sup> This *expeditio* – the Wendish Crusade – set a precedent for ensuing campaigns against the pagan Slavic, Prussian and Baltic peoples. The once fluvial frontier zone became a maritime one, the Baltic Sea divided as much as connected the now emerging Catholic overseas enclaves amidst the pagan lands of the east. Not only routes across the Baltic Sea, but also river transport had always been of paramount importance in these densely forested and boggy lands, presenting the most viable means of access into the hinterlands, to the riches of Russia and the Orient.

In spite of the high relevance of its material culture, the field of maritime archaeology – particularly the study of shipwrecks – is often perceived as an isolated sub-discipline.<sup>28</sup> This perception is not wholly unjustified, considering the preoccupation of maritime archaeologists on questions of a technical and methodological nature. Nonetheless, there is a latent potential for maritime archaeology to add to our knowledge about medieval Europe in a wider sense. This potential is typically ignored, as for instance reflected by the remark of one eminent scholar that “we should not look into waters, but into the affairs of men”.<sup>29</sup> To be fair, this was meant metaphorically, yet the implication as to how maritime evidence is regarded is literally true. This paper aims to demonstrate that the affairs of men are

to a certain extent better reflected – and indeed preserved – in waters. Not least because shipwrecks allow for incomparable glimpses into landscapes and communication, for there are no comparable finds of wagons or carts and their cargoes in a terrestrial context.<sup>30</sup> While land archaeologists generally trace innovation and change through the representativeness and novelty of a type of artefact in a given location, maritime archaeologists study ‘fossilized action’, the vehicles of the agents of the past who brought about change and facilitated cross-cultural communication.

## 2. Shipwrecks in the Archaeological Record

Before assessing how cultural change becomes manifest in concrete maritime contexts, it is worthwhile to consider how watercrafts have entered the archaeological record. Apart from its relevance for statistical evaluation, this question delves onto intercultural maritime networks and contemporary societal practises. Watercrafts enter the archaeological record basically in three ways: (1) by accidental loss, (2) by intentional deposition, and (3) by the re-use of ship timbers.

### 2.1. Accidental Loss

The first case is typically associated with shipwrecks. Roughly ten years after the Wendish Crusade of 1147, a contemporary chronicler vividly described a distress at sea:

*Valdemar set sail with his followers at night, after he had been supplied with arms and provisions [...]; but a storm suddenly blew up and he met unusually heavy seas. His warriors were soaked in the spray of enormous waves, and even they were filled with such fear that their bodies were altogether numbed, and were unable to manage the sail. And the storm strained the mast so violently that it snapped and sank under the waves, and the ship took on as much rain as seawater. The steersman let ocean rule; as he had no idea where to steer, he abandoned the rudder and let the wind take her at will. And the sky blazed with continuous flashes of contending lightning and echoed with the mighty thunder of the clouds. Finally they were driven off course by the terrible raging of the elements to some island, and since their anchor would not hold, they dragged the*

<sup>27</sup> From a letter of Pope Eugene, 11 April 1147 (*Patrologia latina*, vol. 180, col. 1203-1204). See Iben Fonnesberg-Schmidt, *The Popes and the Baltic Crusades 1147-1254* (Leiden and Boston, 2007), p. 37.

<sup>28</sup> David Gibbins and Jonathan Adams, “Shipwrecks and Maritime Archaeology,” *World Archaeology* 32.3 (2001): 279-291.

<sup>29</sup> Nils Blomkvist, “Culture Clash or Compromise? The Medieval Europeanisation Process of the Baltic Rim Region (1100-1400 AD). Problems for an International Study,” in *Culture Clash or Compromise?*, ed. Blomkvist, Acta Visbyensia XI (Visby, 1998), p. 12.

<sup>30</sup> Christer Westerdahl, “The Relation between Land Roads and Sea Routes in the Past – Some Reflections,” *Deutsches Schifffahrtsarchiv* 29 (2006), p. 60.

*ship from the water and made it fast by twisting the branches of the surrounding trees through the port-holes, to stop her sliding and breaking up.*<sup>31</sup>

Although this excerpt raises the question to what extent the hardship and endurance of King Valdemar and his men was glorified by the chronicler, there is no reason to doubt the authenticity of the nautical details: while the vessel was not manoeuvrable and took on water, it stayed afloat even in a wrecked state. When cargo and ballast is timely jettisoned, wooden constructions tend to stay afloat. Lee shores posed the most serious threat. For this reason the ship in the above excerpt was moored to stop it from breaking up. Thus, most accidental losses are more likely to be found close to the coast, maybe even in reasonably sheltered conditions, where a foundering vessel was manoeuvred for initiating a controlled grounding. At first glance, the Kuggmaren wreck<sup>32</sup> from ca. 1215 (Fig. 1) found in the Stockholm archipelago could be such a case, for it was discovered in sheltered conditions just 1.5 m below the present sea level,<sup>33</sup> roughly 4.7 m below the sea-level of the early thirteenth century.<sup>34</sup> In contrast, the fourteenth-century Egelskär wreck in the Finnish archipelago most likely sank *en route*, as the presence of ballast indicates that it sank immediately. Moreover, the site where it foundered appears to be situated precisely on a route described in the thirteenth-century Danish Itinerary,<sup>35</sup> on a direct line

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<sup>31</sup> Saxo Grammaticus, *Danorum regum heroumque historia* Vol. 2, ed. Eric Christiansen, British Archaeological Reports International Series 118.1 (Oxford, 1981), 14.19.2, p. 410.

<sup>32</sup> Actually, the excavators referred to this wreck as the Kuggmaren Cog. For reasons stated in section 3. the type-suffix shall be omitted in order to make an independent evaluation of shipbuilding traditions, unaffected by historical type-names or how they were identified by their excavators. It will be proceeded herein the same manner with all other suffixes, except for the 'Bremen Cog' from 1380, which has become a 'brand.'

<sup>33</sup> Jonathan Adams and Johan Rönby, "Kuggmaren 1: The First Cog Find in the Stockholm Archipelago, Sweden," *The International Journal of Nautical Archaeology* 31.2 (2002), p. 174.

<sup>34</sup> Based on the Swedish National Land Survey of 2003 with the system RH 2000, the post-glacial land rise would be about 3.5 mm per annum at the Kuggmaren site. The extrapolated land rise over a period of 800 years is 2.8 m. In addition to the depth of 1.5 m of the shipwreck, the total depth would amount to ca. 4.3 m. Source: <http://www.lantmateriet.se/>.

<sup>35</sup> In this article it will be referred to as the 'Danish Itinerary' for brevity (Swedish: "det danska itinerariet"). This itinerary is colloquially known as 'King Valdemar's Itinerary' (Swedish: "Kung Valdemars segelled") and in older scholarship it is

between Jurmo (in Latin: *Iurima*) and Kyrkosund on Hitis (in Latin: *Orsund*) (Fig. 11.1).<sup>36</sup> The location of accidentally lost vessels can be very meaningful for the overall interpretation with regard to navigation routes, trade networks and possible ports of origin and destination. The Egelskär wreck even illuminates mercantile matters, as the ship's ballast consisted of whetstones and limestone<sup>37</sup> that were to be sold at its destination.<sup>38</sup>

## 2.2. Intentional Deposition

Intentionally deposited wrecks are primarily ships put out of commission. The most impressive medieval ship cemetery of the Baltic Sea is in Kalmar, where a variety of different ship-types was found.<sup>39</sup> While such vessels ought to occupy a major part of all shipwrecks, it is questionable whether they are adequately represented in the archaeological record, as many decommissioned ships were scrapped. Some constructional components were reused in other structures<sup>40</sup> or simply as heating material. The ready availability of firewood in the densely forested area of the Baltic Sea might explain the survival of the Kalmar wrecks and may indicate that there is significant potential for nautical archaeology in this part of the world.

Disused ships were also scuttled to create underwater barriers in order to block a navigable channel for either defensive purposes, as best exemplified by the

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referred to as *Navigatio ex Dania per mare Balticum ad Estoniam*. It is included in a compilation of inventory lists known as *Liber Census Daniae* or its colloquial name King Valdemar's land register (Swedish: "Kung Valdemars jordebok"), the archival nomenclature being Codex Holmiensis A 41 at the Swedish Royal Library in Stockholm. Cf. Henrik Breide, *Sjövägen till Estland. En medeltida färdbeskrivning från Utlängan till Renal*, Stockholm Marine Archaeology Reports 5 (Stockholm, 2006), p. 52.

<sup>36</sup> Most of the Latinized place names mentioned in the Danish Itinerary were identified by Axel Härlin in 1936 and 1942 according to Breide, *Sjövägen...*, pp. 62-64. His identifications are still considered valid.

<sup>37</sup> Stefan Wessman, "Ship Fragments on the Seafloor – What Do We Know about Medieval Seafaring in Finland?," in *Hortus Novus. Fresh Approaches to Medieval Archaeology in Finland*, ed. Visa Immonen, Mia Lempiäinen and Ulrika Rosendahl, *Archaeologia Medii Aevi Finlandiae XIV* (Turku, 2007), p. 143.

<sup>38</sup> So-called paying-ballast was a common practise to gainfully combine the necessity of carrying ballast to increase stability (by lowering the centre of gravity) with the transport of building materials.

<sup>39</sup> Harald Åkerlund, *Fartygsfynden i den Forna Hamnen i Kalmar* (Uppsala, 1951).

<sup>40</sup> Cf. section 2.3.

eleventh-century Skuldelev ships in Roskilde Fjord<sup>41</sup> (Fig. 2), or to create a collection point for custom duties, as the late fourteenth-century Helgeandsholmen wrecks in Stockholm suggest.<sup>42</sup> As Henry of Livonia describes in his *Chronicle*, in 1215, in the context of the Baltic Crusades, vessels were scuttled to block a channel and entrap nine German cogs in a natural harbour on Saaremaa, which were then hopelessly outnumbered by a force of Estonians;

*At the first light of dawn the sea opposite us looked black with their pirate ships and they fought against us throughout the day. Some of them brought out the wooden structures and their old brigantines, which they filled with rocks and sent to the bottom, and so they closed off the entrance of the port to us. We were greatly frightened at this and thought that we could not escape their clutches. Some of them launched three big fires, kindled from dry wood and animal fat, and set upon structures made of huge trees. The first fire, which burned more fiercely than the others, was impelled over the sea toward us and a strong south wind gave it a big push and thrust it upon us. The Esthoniens (sic) circled around the big fire in their pirate ships and kept it going. They steered it straight toward the midst of our ships.<sup>43</sup>*

Estonians used old vessels to create an *ad hoc* underwater barrier, while old hulls or rafts<sup>44</sup> might have been used to carry that fire. The scuttled hulls would have entered the archaeological record as intentionally deposited vessels, the latter not necessarily. In a way, ships burned by a hostile force would fall into this category. In 1938 the torched remains of a massive oaken shipwreck were discovered in the silted-up Rige, a side arm of River Daugava and the earliest harbour of Riga.<sup>45</sup> Yet it can be only speculated whether this vessel actually fell victim to the frequent pagan attacks on Riga, as so often and vividly described by Henry of Livonia.

<sup>41</sup> Ole Crumlin-Pedersen and Olaf Olsen, *The Skuldelev Ships I*, Ships and Boats of the North 4.1. (Roskilde, 2002).

<sup>42</sup> Anders Ödman, *Stockholms tre borgar. Från vikingatida spärrfäste till medeltida kastellborg* (Stockholm, 1987); Björn Varenius, *Båtarna från Helgeandsholmen*, Riksantikvarieämbetet och Statens Historiska Museer Rapport UV 1989:3 (Stockholm, 1989).

<sup>43</sup> Henry of Livonia, *Chronicon Livoniae*, ed. Leonid Arbusow and Albert Bauer, Monumenta Germaniae Historica. Scriptores rerum Germanicarum in usum scholarum separatim editi 31 (Hannover, 1955) XIX, 5, p. 128; English translation: *The Chronicle of Henry of Livonia*, transl. James Brundage (New York, 2003), XIX, 5, p. 148.

<sup>44</sup> It is conceivable that "the structures made of huge trees" where extended logboats and were used as fire ships.

<sup>45</sup> Andris Caune, "Die rigische Kogge," *Zeitschrift für Ostforschung* 43.4 (1994), p. 484.

Lastly, watercrafts were also ritually deposited. Although the evidence suggests that ritually deposited ships are predominantly connected with Prehistoric and Viking Age customs,<sup>46</sup> it cannot be ruled out for a medieval context, since primeval customs tend to have survived especially amongst seafarers, where pagan rites and superstition outlived Christianization and found expression in a distinctive maritime cultural belief system.<sup>47</sup>

### 2.3. Re-use of Ship Timbers

While accidentally lost and intentionally deposited ships are predominantly found in coastal contexts, reused timber is chiefly represented in urban contexts, where planks and other ship-timbers were re-used in vernacular structures, such as for well and pit cladding, roofing or causeways (Fig. 3).<sup>48</sup> The way planks were worked, fastened and caulked, can give a fairly good idea of shipbuilding traditions. Singular constructional elements can also indicate the predominance of certain types of ships in one harbour. This notion is not insignificant, as the archaeological record seems to be biased by the tendency of ships being scrapped in the homeport. Jan Bill noted that the decision about where to dismantle a ship was "a social practice which may discriminate between different types of ships."<sup>49</sup> For instance, the remains of vessels deemed typically Hanseatic, such as the Bremen Cog,<sup>50</sup> are not represented in the rich maritime material from the Bryggen excavations in Bergen, Norway,<sup>51</sup> despite the

<sup>46</sup> Michael Müller-Wille, "Bestattung im Boot. Studien zu einer nordeuropäischen Grabsitte," *Offa* 25/26 (1968/69): 5-203.

<sup>47</sup> Christer Westerdahl, "Maritime Cosmology and Archaeology," *Deutsches Schifffahrtsarchiv* 28 (2006), p. 9.

<sup>48</sup> Cf. Ralf Bleile, "Maritimes Kulturgut aus Stadtkerngrabungen in Mecklenburg-Vorpommern," *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 4 (1998): 13-16; Damian Goodburn, "Reused Medieval Ship Planks from Westminster, England, Possibly Derived from a Vessel Built in the Cog Style," *The International Journal of Nautical Archaeology* 26.1 (1997): 26-38; Petr Sorokin, "Investigation of Traditional Boatbuilding for the Reconstruction of Medieval Russian Boats," in *Boats, Ships and Shipyards. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000*, ed. Carlo Beltrame (Oxford, 2003), pp. 190-194.

<sup>49</sup> Jan Bill, *Small Scale Seafaring in Danish Waters AD 1000-1600*, doctoral dissertation (University of Copenhagen, 1997), pp. 111-112.

<sup>50</sup> Cf. section 3.2.

<sup>51</sup> Arne Emil Christensen, "Hanseatic and Nordic Ships in Medieval Trade. Were the Cogs Better Vessels?," in *Medieval Ships and the Birth of Technological Societies I. Northern Europe*, ed. Christiane Villain-Gandossi, Salvino Busuttill and Paul Adam (Malta, 1989), p. 18.

fact that the town had been a major destination for Hanseatic ships. On the other hand, the scrapped remains of a late medieval Scandinavian vessel were unearthed in a recent excavation in Bremen, Germany.<sup>52</sup> This raises an important question about whether watercrafts were differentiated on the basis of their construction, size and prestige, or the cultural background of their crew. Thus, re-used ship timbers that encompass different shipbuilding traditions reflect the internationality of a port town, while its absence in the archaeological record is not necessarily a true reflection, but may point to distinctive scrapping procedures, which touches upon issues of ownership and varying social practises across cultures. Thus, places can be linked together; creditably so if backed up by dendrological analyses of ship timbers.

The circumstances of the deposition or re-use of watercraft alone is clearly significant for the assessment of interregional contact. Through an analysis of ship construction in the following section, an even finer-grained dimension is added to the initial impression.

### 3. Shipbuilding Traditions as a Cultural Indicator?

Tracing cultural change through technological features might appear somewhat antiquated since Wendell Oswalt introduced the concept of 'techno-units' in the 1970's as a means of tracing unique structural modularity in hunting gear.<sup>53</sup> Notwithstanding the importance of this concept, it has often been criticized for omitting *ad hoc* adaptive strategies while over-emphasizing a sequential evolutionary line of development. This prioritization of stylistic over functional features has been also criticized, namely in concerns to how diverse modular features in ship construction are forced into rigid typologies.<sup>54</sup> This critique is still very valid.

What seems beyond scrutiny, however, is that advanced technology presented a tremendous advantage. With regard to the Northern Crusades, Christian forces initially had the technological advantage of siege engines and ballistic weaponry, though in 1223 the pagan Estonians caught up by copying and teaching the use of ballistas, which they

had captured from the Sword-Brothers, and employed it in an uprising against their Danish and German occupiers.<sup>55</sup> Whether a comparable technology transfer took place in maritime affairs has been underexplored, partly due to the insufficiency of the archaeological record. While there is much evidence for shipbuilding techniques in the Wendish heartlands,<sup>56</sup> there is barely any for their Estonian and Curonian counterparts, who were – after all – credited for being daredevil pirates. Indirect information extracted from the sources indicates that their vessels – the *pyraticeae* – were open boats, large enough to transport booty and slaves, but with a freeboard considerably lower than cogs and with a great sheer, enabling them to be trimmed so that the bow could project over an enemy's *navicula*.<sup>57</sup>

In this section, the introduction, spread and cross-cultural transfer of a distinctive shipbuilding tradition will be explored. This shipbuilding tradition seems to coincide in both chronological and geographical terms with the Northern Crusades and is not without reason often associated with the emergence of the Germans as new players in the Baltic Sea. The silence of written sources on the constructional particularities of ships has led to much speculation, such as the alleged superiority of the German 'cog'.<sup>58</sup> In recent decades, however, maritime archaeological research has shed a more differentiated light on this issue.

#### 3.1. Theoretical and Source Critical Aspects for Evaluating Ship Construction

It is notable that most changes in pre-industrial shipbuilding are rooted in societal processes, rather than technological progressions in their own right. This makes nautical archaeology<sup>59</sup> a potent tool for tracing the underlying societal forces driving shipbuilding traditions. In periods characterized by stability, traditions tend to be preserved by what

<sup>52</sup> Daniel Zwick, "Neues vom Beluga-Schiff. Ein Bremer Klinkerwrack aus dem 15. Jahrhundert," *Nachrichtenblatt für Untervasserarchäologie* 16 (2010), pp. 67-68.

<sup>53</sup> Wendell H. Oswalt, *An Anthropological Analysis of Food-Getting Technology* (New York, 1976).

<sup>54</sup> Thijs Maarleveld, "Type or Technique. Some Thoughts on Boat and Ship Finds as Indicative of Cultural Traditions," *The International Journal of Nautical Archaeology* 24.1 (1995): 3-7.

<sup>55</sup> Cf. Henry of Livonia, *Chronicon Livoniae*, ed. Arbusow and Bauer, XXVI, 8, p.191; *The Chronicle...*, transl. Brundage, XXVI, 8, p. 210.

<sup>56</sup> Cf. George Indruszewski, *Man, Ship, Landscape. Ships and Seafaring in the Oder Mouth Area AD 400-1400. A Case Study of an Ideological Context*, Publications from the National Museum. Studies in Archaeology & History 9 (Copenhagen, 2004).

<sup>57</sup> Paul Heinsius, *Das Schiff der hansischen Frühzeit, Quellen und Darstellungen zur hansischen Geschichte*. Neue Folge 12 (Weimar, 1986), p. 53.

<sup>58</sup> Cf. Heinsius, *Das Schiff...*, pp. 82-103; Fritz Rörig, *Wirtschaftskräfte im Mittelalter* (Köln and Graz, 1959).

<sup>59</sup> Nautical archaeology is a sub-discipline of maritime archaeology and is focused on the study of shipwrecks and other aspects of navigation. The scope and sub-disciplines of maritime archaeology were first consistently defined by Keith Muckelroy, *Maritime Archaeology* (Cambridge, 1978), pp. 155-247.

evolutionary anthropologists have termed *conformist bias*,<sup>60</sup> *heritage constraint*<sup>61</sup> or *path dependency*.<sup>62</sup> These concepts describe the inherent conservatism of extragenetical traits within hereditary cultural phenomena. This is very much the case in regions and times unmarred by upheaval, where no incentive is posed by outside influences to deviate from tried-and-tested designs, which had become expressions of a cultural identity, aside of their functional merits.<sup>63</sup> Some ancient shipbuilding traditions have survived until the recent past in peripheral, secluded “niches.” Legendary is the longevity of the Scandinavian shipbuilding tradition, as exemplified by vessels still built in rural parts of twentieth-century Scandinavia with features originating from the Iron Age<sup>64</sup> and the Viking Age.<sup>65</sup> Less well known, but more relevant in this context, are the *barkas* from the Vistula lagoon, the last square-rigged working vessels that were still being built up in the early twentieth century. The initial impression that essentially the same type of vessel is represented on medieval seal depictions from this region (Fig. 4) is substantiated by the antiquated method of construction, which has survived in rural areas.<sup>66</sup> While the potential for tracing old shipbuilding traditions in modular features is evident, it becomes all the more interesting when marked changes are observable. The paradigm shift from a highly elaborate and prestigious to a rationalized shipbuilding - that markedly occurred at the turn from the twelfth to the thirteenth century - have been primarily explained in economic terms.<sup>67</sup> Despite an ever growing database of excavated shipwrecks, which ought to render confidence to make assertions solely based on archaeological observations, many maritime archaeologists remain heavily reliant on

historical sources for interpreting shipwrecks. In earlier decades it was considered proper to identify shipwrecks by their supposed historical type name,<sup>68</sup> despite historical sources of the period in question do not specify whether ship-types were distinctive in the constructional sense. The ships depicted on Hanseatic town seals are often referred to as cogs, yet the seals from Stralsund and Elblag (German: Elbing) are very similar to the *barcas* in appearance, while in fact, the size ratio between the helmsman and the boat in the Elblag seal is not necessarily symbolic. It is clear that contemporaries would have never referred to boats of the *barca*-type as cogs, since one of the few things written sources are clear about is that cogs were always large vessels.<sup>69</sup> The problem is that historical and archaeological perspectives are diametrically opposed, in that the historical type is ultimately based on the purpose or size of the vessel, while the archaeological type is based on tradition. Or in other words, it would be inapt to imply that the four Danish cogs that carried King Valdemar II's army to Estonia<sup>70</sup> were similarly constructed as, for instance, the “*duas magnas naves, que koggen appellatur*,” which were granted to Wismar in 1209 by the Holy Roman Emperor.<sup>71</sup> That this was a generic term for large transport ships to distinguish them from smaller vessels is also indicated in an agreement of 1224 for the release of King Valdemar II, which distinguishes between “*naues cockonibus et sneccis*.”<sup>72</sup> While the *snekke* is a prominent name for a small and swift Scandinavian type of vessel, which survived in many toponyms,<sup>73</sup>

<sup>60</sup> Robert Boyd and Peter Richerson, *Culture and the Evolutionary Process* (Chicago, 1985).

<sup>61</sup> Ben Cullen, *Contagious Ideas. On Evolution, Culture, Archaeology and Cultural Virus Theory* (Oxford 2000).

<sup>62</sup> Charles Spencer, “Evolutionary Approaches in Archaeology,” *Journal of Archaeological Research* 5.3 (1997): 209-264.

<sup>63</sup> Cf. Björn Varenus, *Det nordiska skeppet. Teknologi och samhällsstrategi i vikingatid och medeltid*, Stockholm Studies in Archaeology 10 (Stockholm, 1992).

<sup>64</sup> Arne Emil Christensen, “Some Archaic Details of Norwegian Fresh-water Boats,” in *Down the River to the Sea*, ed. Jerzy Litwin, Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997 (Gdańsk, 2000), pp. 163-168.

<sup>65</sup> Gunnar Eldjarn and Jon Godal, *Nordlandsbåten og Åfjordsbåten* (Lesja, 1988).

<sup>66</sup> Aleksander Celarek, “Barkas – Die letzten rahbesegelten Arbeitsboote Europas,” *Alte Schiffe* 4 (1991), p. 47.

<sup>67</sup> Jan Bill, “Getting into Business – Reflections of a Market Economy in Medieval Scandinavian Shipbuilding,” in *Shipshape. Essays for Ole Crumlin-Pedersen*, ed. Olaf Olsen, Jan Skamby Madsen and Flemming Rieck (Roskilde, 1995), 195-202.

<sup>68</sup> Cf. Detlev Ellmers, *Frühmittelalterliche Handelsschiffahrt in Mittel- und Nordeuropa* (Neumünster, 1972), p. 14; Ellmers, “Schiffsarchäologie,” in *Geschichtswissenschaft und Archäologie. Untersuchungen zur Siedlungs-, Wirtschafts- und Kirchengeschichte*, ed. Herbert Jankuhn and Reinhard Wenskus (Sigmaringen, 1979), p. 493.

<sup>69</sup> Carsten Jahnke and Anton Englert, “The State of Historical Research on Merchant Seafaring in Danish Waters and in the Western Baltic Sea 1000-1250,” in *Large Cargo Ships in Danish Waters 1000-1250*, ed. Anton Englert, Ships and Boats of the North (Roskilde, forthcoming).

<sup>70</sup> Cf. Henry of Livonia, *Chronicon...*, ed. Arbusow and Bauer, XXIV, 7, p. 177; *The Chronicle...*, transl. Brundage, XXIV, 7, p. 196.

<sup>71</sup> Cf. Jahnke and Englert, “The State...”

<sup>72</sup> *Diplomatarium Danicum*, ed. Niels Skyum-Nielsen (Copenhagen, 1979), I.6.16., p. 24. See Jahnke and Englert, “The State...”

<sup>73</sup> Cf. Karl-Axel Björkquist, “Vikingahoddorna, hedningakåsar – och Drakarännan,” *Blekingeboken* (1990); Jan Skamby-Madsen, “Fribrodrer. A Shipyard Site from the Late 11th Century,” in *Aspects of Maritime Scandinavia, AD 200-1200. Proceedings of the Nordic Seminar on Maritime Aspects of Archaeology, Roskilde, 13<sup>th</sup>-15<sup>th</sup> March 1989*, ed. Ole Crumlin Pedersen (Roskilde, 1991), pp. 190-191.

its German equivalent is the *schmigge*,<sup>74</sup> albeit probably only in size and purpose, for there is no positive evidence to suggest that Germans built their version of the *snekke* in a Scandinavian technique.

Type names seem to be rather fairly generic terms, by which a classification based on size and purpose was made. These types are to be found mainly in custom rolls, in which loadbearing capacity is mentioned in *lasts*. Vessels would have been classified in relative terms, since capacities fluctuated over time, as ships generally increased in size.<sup>75</sup> What mattered to the custom's officer was an estimate of the loadbearing capacity, according to which the toll could be fixed. He would have hardly crept into the hold to ascertain whether the bottom-planking is carvel or clinker in order to determine the type of ship. Still, several leading scholars insist that the type is sharply defined by a set of inclusive and exclusive constructional properties, which are guided by an underlying theoretical model of what sequences and methods in a shipbuilding tradition were thought to have had a unique character. While this approach in itself is feasible, the often ignored problem is that pictorial, historical and archaeological sources only complement in theory, but in reality there is hardly a contextual overlap. While ship depictions on seals show the general outline above the water-line, archaeologists are dealing in most cases with the scanty remains of the bottom construction of the hull. So, in order to evaluate shipbuilding traditions, an essentially archaeological perspective must be taken, unaffected by the delusive historical type-concept, which attempts to establish a degree of standardization that simply did not exist.

### 3.2. A Novel Shipbuilding Tradition in the Baltic Sea Region

The Baltic Sea region underwent a dramatic change in shipbuilding in the mid twelfth century which coincides chronologically with the early phase of the Northern Crusades. While there is no explicit link, this paper advocates that some of the driving forces which fuelled the crusades are also responsible for the change in maritime affairs.

According to a narrative in the *Miracles of Saint Thomas of Canterbury* from ca. 1175, a rich merchant and citizen of Schleswig commissioned the building of a ship, which had a hull so large that its launching

presented a serious problem.<sup>76</sup> While the author of the *Miracles* remains silent on the cultural origin of the merchant or how the ship was constructed, it would not be unreasonable to link this episode to the general increase in the size of ships and the introduction of a new shipbuilding technology that occurred at around this time in this region. This, at least, would explain why the shipbuilders encountered such an unforeseen problem. The Schleswig region is believed to have played a major role in this transitional phase, since the earliest dating for shipwrecks of this novel technology were likely built in its vicinity, as dendro-provenances demonstrate. The earliest wrecks – the Kollerup wreck (1150) (Fig. 7.3) and the Kolding wreck (1188/89) (Fig. 7.4) – were probably even built in the same shipyard, as the strikingly similar construction of their stern hooks suggests (Fig. 7.5).<sup>77</sup> Generally speaking the construction of these ships was so distinctive from Scandinavian shipbuilding, that this new technique was attributed to a German, possibly Frisian, influence in Schleswig (Fig. 5).<sup>78</sup> This is supported by the notion that there was a migration of Germans to harbour sites in Denmark.<sup>79</sup> There is, in fact, a broad consensus that this new type was very un-Scandinavian and so a Continental – or German – influence has never really been questioned. What characteristics in particular made this type so distinctive, however, is disputed, though it is generally agreed that distinctive features included a stern-rudder, straight up-raking stem- and sternposts notched with a hook in a sharp transition into a plank keel, a very high freeboard with an optional addition of a fore- and aftercastle, a carvel bottom-planking and a clinker side-planking, in some cases protruding cross-beams and large standing knees on top of them, moss as caulking material and the application of *sintels* as cramps to hold the caulking laths in place and, last but not least, double-bent iron nails in plank-to-plank fastenings.<sup>80</sup> These criteria were set up after the

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<sup>76</sup> Cf. Anton Englert, *Large Cargo Vessels in Danish Waters AD 1000-1250*, doctoral dissertation (Universities of Roskilde and Kiel, 2000), p. 1.

<sup>77</sup> Fred Hocker and Aoife Daly, "Early Cogs, Jutland Boat Builders, and the Connection Between East and West Before AD 1250," in *Connected by the Sea. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology, Roskilde 2003*, ed. Lucy Blue, Fred Hocker and Anton Englert (Oxford, 2006), pp. 192-193.

<sup>78</sup> Cf. Ole Crumlin-Pedersen, "Die Bremer Kogge – ein Schlüssel zur Geschichte des Schiffbaus im Mittelalter," in *Die Kogge – Sternstunde der deutschen Schiffsarchäologie*, ed. Gabriele Hoffmann and Uwe Schnall, Schriften des Deutschen Schiffahrtsmuseums 60 (Hamburg, 2003), p. 268.

<sup>79</sup> Karl Pagel, *Die Hanse* (Braunschweig, 1963), p. 68.

<sup>80</sup> Cf. Klaus-Peter Kiedel and Uwe Schnall, *Die Hansekogge von 1380* (Bremerhaven, 1982); Werner Lahn, *Die Kogge von Bremen I. Bauteile und Bauablauf*,

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<sup>74</sup> Cf. Thomas Förster, *Große Handelsschiffe des Spätmittelalters*, Schriften des Deutschen Schiffahrtsmuseums 67 (Bremerhaven, 2009), pp. 268-269.

<sup>75</sup> Thomas Wolf, *Tragfähigkeiten, Ladungen und Maße im Schiffsverkehr der Hanse* (Köln and Wien, 1986), p. 28.



similarities between a cog depicted on the Stralsund seal of 1329 and a shipwreck discovered in Bremen in 1962 were noted. These similarities led the excavator to name the wreck the Bremen Cog.<sup>81</sup> Naturally, not all of the abovementioned characteristics of this new type are shown in the seal, yet it was taken for granted that, thence, cogs should be defined according to all of these criteria.

However, the set of features that defines a type could be quite arbitrary, so the process of establishing which vessels embodied a tradition most splendidly and which vessels only to a lesser degree is, to a certain extent, subjective.<sup>82</sup> It is no coincidence that the Bremen Cog – as the first wreck to be identified as such – is considered as the paradigm example for the cog-type and frequently used for comparisons, as though it was built as a prototype following a blueprint. The fallacy of aligning ship types to historical names becomes quite clear when one considers how the cog would be seen today if the similarities between the Stralsund seal and the Ebersdorf model, for example, had been noted first. This well-preserved model features a surprising amount of detail which leaves no doubt that its builder was a professional who simply interpolated the dimensions while applying his tradition in all details.<sup>83</sup> There are many similar features between the seal and model (Fig. 6). Apart from this, the model features protruding cross-beams, which are not visible on the Stralsund seal itself, but in similar seal depictions. The bulky appearance of the hull on seal depictions was often attributed to artistic liberty, in order to fit the ship into the rounded shape of the seal. Yet it has been suggested that this may actually be a correct representation, since the hull of the Ebersdorf model has an astonishingly small length-to-beam ratio of ca. 2:2.<sup>84</sup> The decisive difference between the Ebersdorf model and the Bremen Cog is thought to be the entirely clinker-planked hull in the former. Thus, in a scenario in which the Ebersdorf

model would have been initially linked to the cog-depicting Stralsund seal, archaeologists would have never dreamt of insisting that only vessels with a carvel bottom planking – built in the so-called bottom-based technique<sup>85</sup> – were cogs. But exactly this assumption has become dogmatic and is defended with fervent zeal by some of the most distinguished maritime archaeologists.<sup>86</sup>

While some believe that this new type could be associated to the historical term cog,<sup>87</sup> others hesitate to apply this label to an archaeological find<sup>88</sup> for very good reason! In order to avoid an inaccurate and biased historical label, it has been suggested that this type should be referred to as the *IJsselmeer type* with regard to its assumed origin,<sup>89</sup> or as the *Kollerup-Bremen type*,<sup>90</sup> or the *bottom-based shipbuilding tradition*.<sup>91</sup> Though these are more neutral names, all have

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<sup>85</sup> Frederick Hocker, "Bottom-based Shipbuilding in Northwestern Europe," in *The Philosophy of Shipbuilding. Conceptual Approaches to the Study of Wooden Ships*, ed. Frederick Hocker and Cheryl Ward (College Station, 2004), 65-93.

<sup>86</sup> Cf. Jan Bill, "Zwischen Kogge und Kraweel. Traditioneller Kleinschiffbau in Südkandinavien in einer Zeit der Wende," in *Zwischen Tradition und Wandel. Archäologie des 15. und 16. Jahrhunderts*, ed. Barbara Scholkmann, Sören Frommer, Christina Vossler and Markus Wolf, Tübinger Forschungen zur historischen Archäologie 3 (Büchenbach, 2009), p. 251; Crumlin-Pedersen, "Die Bremer...", pp. 258-266; Ole Crumlin-Pedersen, *Archaeology and the Sea in Scandinavia and Britain*, Maritime Culture of the North 3 (Roskilde, 2010), p. 118; Hocker, "Bottom-based...", pp. 72-79.

<sup>87</sup> See Ole Crumlin-Pedersen, "Danish Cog Finds," in *The Archaeology of Medieval Ships and Harbours in Northern Europe*, ed. Seán McGrail, British Archaeological Report International Series 66 (Oxford, 1979), 17-34; Ole Crumlin-Pedersen, "To Be or Not to Be a Cog. The Bremen Cog in Perspective," *The International Journal of Nautical Archaeology* 29.1 (2000): 26-38; Detlev Ellmers, "Koggen kontrovers," *Hansische Geschichtsblätter* 128 (2010): 113-140; a more inclusive set of criteria for cogs with special regional forms was suggested by Heinsius, *Das Schiff...*, pp. 55-69; Förster, *Große Handelsschiffe...*, pp. 265-268.

<sup>88</sup> See Timm Weski, "The IJsselmeer Type. Some Thoughts on Hanseatic Cogs," *The International Journal of Nautical Archaeology* 28 (1999): 360-379; Timm Weski, "Anmerkungen zur spätmittelalterlichen Schifffahrt auf Nord- und Ostsee," in *Häfen Schiffe Wasserwege – Zur Schifffahrt des Mittelalters*, ed. Konrad Elmshäuser, Schriften des Deutschen Schiffahrtsmuseums 58 (2002): 143-159.

<sup>89</sup> Weski, "The IJsselmeer...", pp. 360-379.

<sup>90</sup> Englert, *Large Cargo Vessels...*, p. 46.

<sup>91</sup> Hocker, "Bottom-based...", pp. 65-93.

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Schriften des Deutschen Schiffahrtsmuseums 30 (Hamburg, 1992).

<sup>81</sup> Cf. Siegfried Fliedner, "Der Fund einer Kogge bei Bremen im Oktober 1962," *Bremisches Jahrbuch* 49 (1964), pp. VII-X.

<sup>82</sup> This struggle with type-concepts is well reflected by the reference to shipwrecks from the Netherlands as 'cog-like,' in appreciation of the fact that they feature enough details to be attributed to the same tradition as the Bremen Cog, yet differed significantly in size, cf. Reinder Reinders, "Cog Finds from the IJsselmeerpolders," *Flevovericht* 248 (1985), p. 24.

<sup>83</sup> Cf. Wolfgang Steusloff, "Das Ebersdorfer Koggenmodell von 1400," *Deutsches Schiffahrtsarchiv* 6 (1983): 189-207.

<sup>84</sup> Paul Heinsius, "Mecklenburger Schiffsformen des 13./14. Jahrhunderts," in *Schiffe und Seefahrt in der südlichen Ostsee*, ed. Helge bei der Wieden, Mitteldeutsche Forschungen 91 (Cologne, 1986), 89-104.

significant drawbacks,<sup>92</sup> so in this paper this new type will be very generically referred to as the Continental type – for the lack of a better term. While it is distinctive enough to differentiate it from Scandinavian and Slavic shipbuilding traditions to form a typological entity, its constructional features are not homologous enough to formulate a sharp definition. Although one might object that Slavs and to a certain extent Scandinavians are Continentals too, the term gives credit to the fact that this tradition, which appeared in the Baltic Sea area around the mid twelfth century, could be traced back to Roman Age finds from the Rhine. So the admittedly spongy notion of a ‘Continental type’ is not too far-fetched. Its fluvial origin manifests itself in the construction, consisting of a flat bottom of carvel planking. With regard to inland vessels, this Continental tradition has changed little, as is particularly reflected by the longevity of a striking feature: the L-shaped chine girder, the transition plank between bottom and side planking (Fig. 7.1-2). This constructional element was employed in shipbuilding for over a millennium<sup>93</sup> and strengthened the hull longitudinally, while adding some solidity to the critical turn-of-the-bilge. Interestingly, the oldest inland vessels in the Baltic Sea area of the Continental type were also – yet again – discovered in the key region around Schleswig, as the Haithabu IV wreck of 1184<sup>94</sup> and the Egernsund wreck of ca. 1230 show.<sup>95</sup> Barges found in the lower Vistula river, like the Kobyla Kępa wreck (after 1291) or the Elbląg wreck (fourteenth/fifteenth century), feature exactly the same keel-less, flat-bottomed hull with the characteristic *sintels*, moss caulking and L-shaped chine girders as do similar watercraft in Germany and the Netherlands. Consequently, they

<sup>92</sup> The *IJsselmeer-type* is in neither respect a scientifically valid denomination, as correctly summed up by Crumlin-Pedersen, “To Be...,” pp. 26-38. The *Kollerup-Bremen type* would imply a linear development from the earliest to the most prominent shipwreck of its kind, which is not necessarily incorrect, but perhaps unnecessarily omits alternative approaches. And, finally, the *bottom-based tradition* presents an exclusive set of characteristics to claim a “monopoly” on the cog-type. This narrow definition is not supported by direct evidence and is only deduced from written and pictorial sources of contentious validity.

<sup>93</sup> Cf. Karel Vlierman, “Kleine bootjes en middeleeuws scheepshout met constructiedetails,” *Scheepsarcheologie II*, Flevovericht 404 (Lelystad, 1996), pp. 104-105.

<sup>94</sup> Claus von Carnap-Bornheim, Sönke Hartz, Hans Joachim Kühn and Oliver Nakoinz, “Wrack 4 von Haithabu,” *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 9 (2000): 95-98.

<sup>95</sup> Ole Crumlin-Pedersen, *Viking-Age Ships and Shipbuilding in Hedeby/Haithabu and Schleswig*, Ships & Boats of the North 2 (Schleswig/Roskilde, 1997), pp. 300-303.

were thought to be connected to economic developments in the newly established Teutonic Order state in Prussia.<sup>96</sup> Colonists, who arrived in the wake of the conquests, must have brought their own concept of shipbuilding. While these Continental inland types were surprisingly homogeneously built, throughout time and space, their seagoing counterparts (Fig. 7) show more variation and change, especially in the early phase. This is probably not surprising, since seafarers would have travelled further and would have more easily become exposed to – and inspired by – different shipbuilding traditions. The earliest seagoing Continental type – the Kollerup wreck (Fig. 7.3) – seems to have retained some inherited constructional details that might point to a fluvial ancestry, as Ole Crumlin-Pedersen observed.<sup>97</sup> So, the mast-step is integrated in a floor timber rather than a keelson and the position of the mast is in the first third of the vessel. The carvel-laid bottom planking can also be regarded as a favourable constructional feature for river navigation, but this was also actually retained in seagoing vessels throughout the centuries, as it suited the tidal conditions along the Frisian coastline in the Wadden Sea, which was sheltered by a chain of islands where vessels regularly fell dry at low tide. Although this construction was not necessary in the tideless Baltic Sea, some vessels discovered or built here still feature this characteristic: The mid twelfth century Kollerup wreck sets a precedent not only for being the earliest find of its type so far, but for having evidently attempted to sail around the dreaded Skagerrak. While it was built of wood cut in the vicinity of Schleswig, it was perhaps operated there by members of a German mercantile community with connections to the Rhineland: The finding of some Dutch stoneware and Rhenish slates indicate that it could have hailed at ports in the Rhineland at some point.<sup>98</sup> That merchants from the Rhineland would have still continued to trade via Schleswig after merchants from Westphalia and Saxony preferred to trade via Lübeck since its foundation in 1158, supports a Rhenish link.<sup>99</sup> It took a century, however, before the navigation around the Skagerrak became an issue important enough to be formalized in the *umlandsfara*-privileges of 1251, in which the traffic of

<sup>96</sup> Waldemar Ossowski, “The Origin of Flat-bottomed River Craft on the Odra and Vistula Catchments,” in *Between the Seas. Transfer and Exchange in Nautical Archaeology. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology, Mainz 2006*, ed. Ronald Bockius (Mainz, 2009), pp. 182-184.

<sup>97</sup> Crumlin-Pedersen, “Die Bremer...,” p. 266.

<sup>98</sup> Per Kohrtz Andersen, *Kollerupkøkken* (Thisted, 1983), p. 18.

<sup>99</sup> Erich Hoffmann, “Schleswig und Lübeck im 12. und 13. Jahrhundert,” *Beiträge zur Schleswiger Stadtgeschichte* 26 (1981), p. 31.

cogs from the North Sea to the Scanian fairs was regulated.<sup>100</sup>

Another Continental-type wreck from the Baltic Sea with carvel bottom-planking is the Vejby wreck from ca. 1372, which foundered at the coast of North Zealand, Denmark. It was probably built in Gdańsk (German: Danzig) or another port of the Teutonic Order, but was evidently on its homeward voyage from England, as the finding of English gold nobles and ballast-stones from the English Channel or the Atlantic coast indicates.<sup>101</sup> Again, one might ask whether there is intentional coherence between a Baltic-built ship with a carvel-planked bottom and a North Sea destination? As opposed to the Vejby wreck, the early fifteenth-century Copper Wreck that foundered near Gdańsk was entirely clinker-planked and was apparently not required to sail on the North Sea, as it carried only typical commodities from the Baltic Sea such as copper ingots, timber, wax, pitch and iron.<sup>102</sup> Is it possible that both kinds of vessels were built on the same shipyards, and that the differences did not stem from two distinctive shipbuilding traditions, but from a deliberate choice with regard to the shipping routes of the vessel?

In fact, bottom-based ships have strictly speaking structurally more in common with the aforementioned entirely clinker-built ships: though both are essentially constructed shell-first, the carvel-laid strakes gradually overlapped at their hood-ends, as shown in the most formidable example of the “bottom-based tradition” – the Bremen Cog.<sup>103</sup> So the classical division line between bottom-based vessels on the one side and clinker-built vessels on the other side has been over-emphasized. One of the conclusions drawn by Jan Bill – an advocator of this classical division – is that there is an increasing similarity between lapstrake (or clinker-built) vessels and cogs (or bottom-based vessels).<sup>104</sup> The observation is correct, yet if seen from the perspective advocated in this article, the said similarity could also stem from both types being variations on just one theme.

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<sup>100</sup> *Diplomatarium Danicum*, ed. Franz Blatt and Gustav Hermansen (Copenhagen, 1938), II.1.50-52, pp. 50-52. See Jahnke and Englert, “The State...”

<sup>101</sup> Niels Bonde and Jørgen Steen Jensen, “The Dating of a Hanseatic Cog-Find in Denmark,” in *Shipshape. Essays for Ole Crumlin-Pedersen*, ed. Olaf Olsen, Jan Skamby Madsen and Flemming Rieck (Roskilde, 1995), pp. 114-115.

<sup>102</sup> Cf. Jerzy Litwin, “‘The Copper Wreck.’ The Wreck of a Medieval Ship Raised by the Central Maritime Museum in Gdańsk, Poland,” *The International Journal for Nautical Archaeology and Underwater Exploration* 9.3 (1980), p. 219.

<sup>103</sup> Lahn, *Die Kogge...*, p. 34.

<sup>104</sup> Jan Bill, “From Nordic to North European,” in *Between the Seas...*, ed. Bockius, p. 435.

### 3.3. Hybrid Features Reflecting Cultural Transmission?

The term “hybrid” is used somewhat generically to indicate that the modular integrity of a shipwreck consists of a mixture of constructional elements from different cultural influences. While some features only appear to be hybrid because of overly rigid type-concepts, the question remains how genuine examples of cross-cultural influences in shipbuilding become manifest in the archaeological record? Scholars have attempted to establish such cases by ascribing the use of different materials to different cultures. So, for instance, a study on differences within Wendish shipbuilding seems to indicate that the *Rani* used animal hair as caulking material whereas the Pomeranians used moss.<sup>105</sup> While the use of certain materials by habit will have undeniably affected the preference of the shipbuilder, the choice was ultimately restricted to the local availability of materials. Animal hair was perhaps used by the *Rani* for the absence of extensive wetlands on Rügen Island, from where moss could be collected. Although bound by tradition, we should not imagine the medieval ship-builder as unimaginative, rigid and unable to improvise. The same applies in a terrestrial context: though Viking Age longhouses in Norway were built of wood, Norse colonists built them of stone on the Shetland Isles for the scarcity of timber. Yet they were built in the same style and tradition.

So the choice of materials primarily reflects local variances, which is relevant evidence too, but does not necessarily indicate cultural transmission. This however was suggested in the case of the Kronholm wreck from the first half of the thirteenth century, which was discovered in a silted-up former anchorage site in Paviken, Gotland. This vessel was built in the Continental technique with a carvel-laid bottom, but with features that were considered reminiscent of a Scandinavian influence, i.e. fairly slender frames and floor timbers of pine instead of oak.<sup>106</sup> The question was raised whether these muddled characteristics should be interpreted as a gradual assimilation of Scandinavians and northern Germans.<sup>107</sup> This does not seem too far-fetched, considering the strong presence of a German mercantile community in Visby, the provincial capital of Gotland. However,

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<sup>105</sup> Oliver Nakoinz, “Das mittelalterliche Wrack von Schuby-Strand und die Schiffsbautraditionen der südlichen Ostsee,” *Archäologisches Korrespondenzblatt* 28 (1998): 311-322.

<sup>106</sup> Johan Rönby, “Kronholmskoggen – Om ett skeppsfynd och dess tolkningsmöjligheter,” in *Metodstudier & tolkningsmöjligheter*, ed. Håkan Ranheden, Eva Hyenström, Mikael Jakobsson, Johan Rönby and Anders Nilsson, *Avdelningen för arkeologiska undersökningar* 20 (Stockholm, 1996), p. 70.

<sup>107</sup> Rönby, “Kronholmskoggen...,” p. 70.

the local supply of oak was probably shorter than on the continent, since the timberline for oak is further south than for pine. Thus, a local shortage of oak on this island might have induced the shipbuilder to use more readily available timber species, while the technique employed to assemble the ship essentially remained the same.<sup>108</sup>

Not unlike the Kronholm wreck, the Gedesby wreck is also considered an unusual find and has been often referred to as a hybrid construction. At first glance, it (Fig. 8) appears to be a rural vessel, wide and spaciouly built, to carry cattle, as indicated by a layer of dung.<sup>109</sup> It was found in a rural harbour near Gedesby, on the Danish Island of Falster, and was dendro-dated to ca. 1320.<sup>110</sup> In considering the common nature of its cargo, one would not expect to find any innovative constructional details. Yet the excavators were surprised to find Continental details, such as “stem- and sternhook, (...) protruding beams and massive beam knees, the occasional use of moss as luting and the use of sawn planks in the construction, with a broad margin the oldest example of this technique in a clinkerbuilt vessel in Scandinavia.”<sup>111</sup> The only remaining detail considered to be Scandinavian is the T-shaped keel and the entirely clinker-planked hull, but even the long plank scarfs are still quite distinct from the short Scandinavian ones.<sup>112</sup> Mouldings were also absent, which normally decorated the visible edges of planks in Scandinavian watercraft.<sup>113</sup> Were these later changes affected by an outer influence, or was this a development within the tradition? In fact, are there any unmistakably Scandinavian features left at all in the Gedesby wreck? With, alas, no dendrological analyses, one may only speculate how this vessel with its set of essentially Continental features ended up in a small Danish rural harbour? Incidentally, a few decades before the Gedesby ship was built, the Danish King Eric Menved ordered in 1304 that only cogs should be included in the Danish naval defence

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<sup>108</sup> Unfortunately there is no dendro-provenance of the wood yet. A local Gotland building place seems feasible, but has not been verified by hard evidence. The availability of wood species on Gotland at that time is not clear either. The point of this argument is merely to illustrate that other factors – like the local availability or shortage of materials – would have determined the construction and should therefore not be seen as a diagnostic feature for cultural or technological transmission.

<sup>109</sup> Bill, *Small Scale...*, p. 73.

<sup>110</sup> Jan Bill, “Schiffe als Transportmittel im nordeuropäischen Raum,” in *Warentransport im Mittelalter und in der Frühen Neuzeit. Transportwege – Transportmittel – Infrastruktur*, Mitteilungsblatt der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit 14 (2003), p. 14.

<sup>111</sup> Bill, *Small Scale...*, p. 78.

<sup>112</sup> Bill, “Schiffe...,” pp. 14-15.

<sup>113</sup> Bill, *Small Scale...*, p. 66.

– the *leding*.<sup>114</sup> This was owed to the advantage of raised fighting platforms on these high-sided and large ships. This decision must have meant a great turning point, as Denmark’s *leding* still relied on 1100 longships in the thirteenth century.<sup>115</sup> Whether these new cogs were of Continental design or whether there were Danish versions is not clear at present. The Gedesby wreck is neither high-sided nor large and certainly not a cog, but its very presence in a Danish harbour could be seen as a harbinger of a process in which Denmark gradually opened up to a foreign shipbuilding tradition. Though innovative designs are expected to be found in more central regions, a seafaring peasant could have obtained, in this case, a less costly Continental vessel on the opposite shore, a day’s journey from the southern tip of Falster. After all, the Continental types were less elaborately built than Scandinavian vessels and would have been cheaper to construct.<sup>116</sup> When even a king would not insist anymore to have his *leding* ships built in the own prestigious Scandinavian tradition, a peasant would have probably cared little about sailing a less prestigious ship than his forefathers, especially if it smelled of dung.

While it is not entirely clear if – or to what degree – the Gedesby wreck reflects a modular hybridism, the Kalmar I wreck from the second half of the thirteenth century is astonishingly similar (Fig. 9). It has a comparable length-to-beam ratio, a T-shaped keel, was fully clinker-planked, wherein the planks were connected with iron rivets, the hood-ends of the planks overlapped the sternpost, but were notched into the stempost and the hull was strengthened by protruding cross-beams.<sup>117</sup> One may even question whether the reconstructed curvature of the stem of Kalmar I is correct,<sup>118</sup> since only the lowermost portion was preserved, from which a more moderately raking stem – similar to the one from the Gedesby wreck – is feasible. Given the number of shared features, one may wonder whether both wrecks really represent some kind of transient hybrid type, or whether they constitute a class in their own right.

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<sup>114</sup> Niels Lund, *Lid, leding og landeværn* (Roskilde, 1996), pp. 282-283.

<sup>115</sup> Ole Crumlin-Pedersen, “Die Wikinger und die hansischen Kaufleute: 900-1400,” in *Taucher in der Vergangenheit. Untervasser-Archäologen schreiben die Geschichte der Seefahrt*, ed. George H. Bass (Luzern, 1973), p. 190.

<sup>116</sup> Line Dokkedal, *Koggen i Nordeuropa fra 1150-1450 e. Kr. – Definition af skibstypen og diskussion af en mulig årsag til dens anvendelse i nordeuropæisk skibsfart*, doctoral dissertation (University of Copenhagen, 1996), p. 62.

<sup>117</sup> Harald Åkerlund, *Fartygsfynden i den Forna Hamnen i Kalmar* (Uppsala, 1951), pp. 27-33.

<sup>118</sup> The reconstruction which assumes a curved stem is not shown here, cf. Åkerlund, *Fartygsfynden...*, Pl. 7b.

It seems as though archaeologists are ultimately left with little else than details illuminating different manufacturing processes, like iron fastenings. The late medieval Kalmar IV ship is probably one of the few exceptions, where two distinctive shipbuilding traditions manifest more evidently in one vessel. This is shown by the alternating use of rivets (typical Scandinavian) and double-bent nails (typical Continental) for instance.<sup>119</sup> This could indicate that the ship was constructed by shipbuilders of different cultural backgrounds, who introduced their own methods. But not necessarily, since the different plank-to-plank fastenings could have originated from later repairs in which planks were replaced. This would at least indicate that the ship travelled between two different “worlds” in which distinctive concepts of shipbuilding predominated. In the case of Kalmar, these two worlds could have coexisted in one place, since this town was a melting pot of a mixed German-Swedish population. So it is feasible that two distinctive shipbuilding traditions co-existed and that this coexistence lead to the construction of vessels that could neither be attributed exclusively to Scandinavian nor to Continental traditions.

It seems likely that there was a certain extent of collaboration in maritime affairs, primarily between Germans and Scandinavians, possibly also with Slavs. This collaboration, however, was not restricted to shipbuilding alone, but extended to navigation as well, as the following section shows.

#### 4. Decoding Cognitive Maritime Landscapes

Evidently, the logistical achievement of medieval seafarers could not be appreciated if only their ships were studied. What seems very important is the way contemporaries would have perceived their environment. This cognitive maritime landscape could be conceptualized on two levels; the first being a bottom-up perspective of those personally experiencing the sea,<sup>120</sup> certainly mariners and pilots and to a lesser extent also other sea travellers like merchants, crusaders and settlers; the second being a top-down perspective of policy makers,<sup>121</sup> who compile reports from the former and thereby piece together fragmented information. Finally, there is the lost narrative that found neither place in written nor pictorial sources and can be only deduced from fragmented bits of evidence.<sup>122</sup>

<sup>119</sup> Åkerlund, *Fartygsfynden...*, pp. 62-63.

<sup>120</sup> Cf. section 4.1.

<sup>121</sup> Cf. sections 4.2, 4.3 and 4.4.

<sup>122</sup> Cf. section 4.5.

#### 4.1. The Heuristic Conceptualization of Geography

Not unlike shipbuilders who continued the tradition from their forefathers, mariners were to a certain extent literally “path dependent,”<sup>123</sup> frequenting generations-old sea routes (Fig. 11.2).<sup>124</sup> This is well illustrated by the late medieval *Seebuch*, the earliest handbook to contain explicit nautical instructions. The text is a compilation of multiple sources from different periods, a “successive genesis” based on sources from at least as early as the fourteenth century.<sup>125</sup> The compilatory character of the text indicates that the routes and nautical details it describes must have been ingrained in the mental terrain of mariners several generations before it appeared in written form in the late fifteenth century. Perhaps the best known early example of medieval seafarers personally communicating geographical knowledge to officials is captured in the Old English translation of Orosius’ *Historiae adversum Paganos*, in which King Alfred of Wessex had included the late ninth-century reports of Ohthere and Wulfstan, which they delivered at his court.<sup>126</sup> Of course, any first-level narrative will inevitably be filtered by what the chroniclers deemed important. Ohthere’s and Wulfstan’s accounts were subject to the chronicler’s own interpretation and wilful modification.

While scouts drafted from the local population were of eminent importance for the successful outcome of a crusading campaign on land, there is written evidence to suggest that mariners were similarly dependent on pilots. A peace treaty of 1241 between the Teutonic Order in Livonia and the Oselians<sup>127</sup> explicitly included pilots: “If, however, they [the bishop or master of Riga] have not managed to acquire a cog, ships and pilots will be gathered in this area, which are drawn from the Oselians in Riga or

<sup>123</sup> Cf. Spencer, “Evolutionary...,” pp. 209-264.

<sup>124</sup> This concept was also introduced as a *tradition of usage* in a maritime logistical context by Christer Wester Dahl, “The Relationship Between Land Roads and Sea Routes in the Past – Some Reflections,” *Deutsches Schifffahrtsarchiv* 29 (2006), p. 60.

<sup>125</sup> Albrecht Sauer, *Das Seebuch. Das älteste erhaltene Seehandbuch und die spätmittelalterliche Navigation in Nordwesteuropa*, Schriften des Deutschen Schifffahrtsmuseums 44 (Hamburg, 1996), pp. 178-180.

<sup>126</sup> Cf. *Ohthere’s Voyages. A Late 9th-century Account of Voyages Along the Coasts of Norway and Denmark and Its Cultural Context*, ed. Janet Bately and Anton Englert, Maritime Culture in the North 1 (Roskilde, 2007); *Wulfstan’s Voyage. The Baltic Sea Region in the Early Viking Age as Seen from Shipboard*, ed. Anton Englert and Athena Trakadas, Maritime Culture of the North 2 (Roskilde, 2009).

<sup>127</sup> Estonians from the island of Saaremaa, who were the most reputable mariners amongst all Estonians.

the coastal region.”<sup>128</sup> It seems likely that the desired pilots had to be native Osilians. Another incidence that occurred several years earlier in the same area highlights the importance of pilots. A Danish knight Gottschalk was sent by his king to take over control of Riga’s magistracy. The local population was so opposed to the knight

(...) that even the merchants denied him a pilot for his ship either to come from Gotland to Livonia or to go from Livonia to Gotland. Gottschalk went away discomfited from Livonia and came onto the wide and spacious sea. He was going without a pilot in his ship and was tossed about by contrary wind.<sup>129</sup>

This excerpt contains the important notion that not just anyone could go anywhere, even if he was a high ranking individual with the necessary monetary means. Evidently, there were other mechanisms at work to grant or deny individual access to the emerging western overseas enclaves. Although it would be too far-fetched to imply that such groups – be it mercantile confraternities or ethnic communities – exerted a monopoly on sea transport in less well known sea regions by securing the exclusive allegiance of local pilots, it cannot be dismissed that their knowledge must have been deemed a strategic factor. This key role is arguably reflected by the earliest Lübeck seal (Fig. 10), which has been hitherto addressed as depicting some kind of metaphorical proto-Hanseatic confraternity through which the great Central European inland markets were linked to the commodity markets on the Baltic Sea shore, embodied by a *coniuratio* scene between an allegedly Westphalian cross-country merchant and a Frisian mariner.<sup>130</sup> However, it has also been suggested that the seal does not show an oath between two equals, but rather the conclusion of a contract, in which the *stýrimadr* – the steersman or ship-owner – admits the *farþegi* – the guest or merchant – into the shipboard community with an *ecce* sign, which the latter acknowledges by swearing an oath.<sup>131</sup> In a more recent paper it was argued that the *farþegi* was a

<sup>128</sup> “Si vero coggam habere non potuerint, naves et gubernatores in ipsa terra conducent, quae ab ipsis Osilianis in Rigam seu Maritimam deducuntur.” *Liv-, Esth- und Curländisches Urkundenbuch nebst Regesten*, ed. Friedrich Georg von Bunge (Reval, 1953), vol. 1, no. CLXIX, p. 220.

<sup>129</sup> Henry of Livonia, *The Chronicle...*, transl. Brundage, XXV, 2, pp. 197-198; cf. *Chronicon...*, ed. Arbusow and Bauer, XXV, 2, p. 178.

<sup>130</sup> Detlev Ellmers, “Die mittelalterlichen Stadtsiegel mit Schiffsdarstellung an der südlichen Ostseeküste,” in *Schiffe und Seefahrt in der südlichen Ostsee*, ed. Helge bei der Wieden (Köln and Wien, 1986), p. 61.

<sup>131</sup> Carsten Jahnke, “Zur Interpretation der ersten Lübecker Schiffssiegel,” *Zeitschrift des Vereins für Lübeckische Geschichte und Altertumskunde* 88 (2008), pp. 21-23.

pilgrim or crusader rather than a merchant, since self-representations on seal depictions were inherently hierarchical and mercantile activities considered a comparatively mundane act.<sup>132</sup> While both re-interpretations follow the line of the former in that a landlubber collaborates with a mariner, the emphasis has shifted in both cases to, firstly, an altered hierarchy in favour of the mariner, and secondly, on the foreignness of the type of ship depicted, showing several Scandinavian characteristics.<sup>133</sup> Closely interwoven with these revised interpretations is the idea that merchants were reliant on non-German shipping shortly after the foundation of Lübeck.<sup>134</sup> There is indeed positive evidence for this: in 1224, Slavic vessels were hired in Lübeck for transporting herring,<sup>135</sup> and excavations in Lübeck’s earliest harbour have produced mainly Scandinavian material.<sup>136</sup> The attempt of Henry the Lion to attract foreign seaborne merchants to the port of Lübeck, as the Artlenburg privilege shows in particular, also suggests that the population of Lübeck was dependent on foreign ships and mariners, most of whom originated from the Westphalian interior.<sup>137</sup> When Lübeck was forfeited to Denmark in 1203, it benefitted considerably from being included into the extensive Danish maritime network.<sup>138</sup> Only after the

<sup>132</sup> Reinhard Paulsen, “Die Koggendiskussion in der Forschung. Methodische Probleme und ideologische Verzerrungen,” *Hansische Geschichtsblätter* 128 (2010), pp. 93-96.

<sup>133</sup> First noted by Gunnar Bolin, *Stockholms uppkomst. Studier och undersökningar rörande Stockholms förhistoria* (Stockholm, 1933), p. 405. This interpretation is still upheld by most scholars, see Crumlin-Pedersen, “Die Bremer...,” p. 260; Rolf Hammel-Kiesow, *Die Hanse* (München, 2008), p. 30; Jahnke, “Zur Interpretation...,” pp. 19-20. Others maintain that a cog is depicted on the seal, see Heinsius, *Das Schiff...*, p. 63; Ellmers, “Koggen...,” pp. 113-140.

<sup>134</sup> Carsten Jahnke, “The Influence of the Hanseatic League on the Cities in the North-Sea and Baltic-Sea Area – Some Reflections on the Triad ‘Trade – Cities – Hanseatic League,’” in *Archaeology of Medieval Towns in the Baltic and North Sea Area*, ed. Nils Engberg, Anne Nørgaard, Jakob Kieffer-Olsen, Per Kristian Madsen and Christian Radtke, Publications of the National Museum Studies in Archaeology & History 17 (Copenhagen, 2009), p. 53.

<sup>135</sup> *Hansisches Urkundenbuch*, ed. Konstantin Höhlbaum (Halle, 1876), vol. 1, no. 174.

<sup>136</sup> Detlev Ellmers, “Bodenfunde und andere Zeugnisse zur frühen Schifffahrt der Hansestadt Lübeck. Teil 2: Bauteile und Ausrüstungsgegenstände von Wasserfahrzeugen aus den Grabungen Alfstraße 38 und an der Untertrave/Kaimauer,” *Lübecker Schriften zur Archäologie und Kulturgeschichte* 18 (1992), p. 11.

<sup>137</sup> Jahnke and Englert, “The State...”

<sup>138</sup> Rolf Hammel-Kiesow, “Der Handel im Ostseeraum im 12. und 13. Jahrhundert,” in *Dänen in Lübeck 1203 – 2003*, ed. Manfred Gläser, Doris

collapse of the Valdemarian Empire – when Denmark lost Lübeck in the wake of the Battle of Bornhöved in 1227 – did German merchants take over a leading role in Baltic Sea trade as indicated by the *Ummelandfarer* privileges of 1251.<sup>139</sup>

What seems most significant here is not only the alleged dependency on non-German ships in Lübeck under Saxon and Danish rule, but possibly also the presence of foreign maritime intermediaries such as ship-owners or pilots. And this profitable collaboration between autochthonous mariners from the Baltic Sea and the German newcomers, which enabled inland merchants to tap the Baltic commodity markets or crusaders to fulfil their pledge in the overseas territories east of the Elbe, is arguably “advertised” in Lübeck’s earliest seal depiction.

## 4.2. The Narrative Conceptualization of Geography

In order to be less dependent on the goodwill of maritime intermediaries, it became a desideratum for sovereigns to compile geographical information in order to strive for more autarchy in sea transport and communication. This was certainly the case for transport on land, where the rise of feudal principalities went hand in hand with the development of road networks.<sup>140</sup> While the maritime equivalent – navigation marks – are barely testified in the archaeological and historical record, there is a striking similarity in the division of space. In late fourteenth-century Denmark, for instance, royal bailiffs were ordered to build royal inns every 30 km along the *Hærvej* – the army road – which was a day’s travelling distance. Similarly the sea route described in the Danish Itinerary (Fig. 11) was divided into *ukasio* units, the meaning of which is still disputed, but is likely to be a length specification of ca. 8.3 km.<sup>141</sup> While the first was a concrete measure in support of army logistics on land, the existence of the latter testifies an equivalent attempt to conceptualize maritime space in measurable units, which would have been important for fleet logistics and communication. There is a broad consensus, however, that the purpose of the Danish Itinerary – in its written form at least – was not for practical use

as navigational aid.<sup>142</sup> Rather than containing concrete nautical information like the *Seebuch*, the emphasis of the Danish Itinerary lies on the distances between coastal places on a given trajectory along the coast. The coastal trajectories described therein were probably frequented long before the itinerary was written down, as archaeological evidence suggests.<sup>143</sup> So the recording of a pre-existing route with the addition of travelling distances fits well to the inventory character of the compilative *Liber Census Daniae*, in which other inventories connected to crusading activities were also found, such as the Danish possessions in Estonia as well as an itinerary from Ribe to Acre in the Holy Land.<sup>144</sup> Thus, the latter, as well as the itinerary from Utlängan to Tallinn, were understood by contemporaries as basically the same, as a *peregrinatio* to *oriens* and *aquilo*.

While it seems clear that the Danish Itinerary was not meant to be a navigational aid, there is a clear indication that a person with nautical knowledge must have been consulted when it was written down, for it contains an excerpt with a nautical implication: “[...] and it ought to be observed, that you go from Arnholm to Lynaebetæ between east and north and if the wind is favourable from the west, you can sail in a straight line from Arnholm to Hangethe.”<sup>145</sup> This

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<sup>142</sup> Jarl Gallén, *Det “Danska itinerariet.” Franciskansk expansionsstrategi i Östersjön* (Helsingfors, 1993), p. 79; Björn Varenius, “The Baltic Itinerary of Codex Holmiensis A 41. A Conceptual Approach,” in *Shipsshape...*, ed. Olsen, Skamby Madsen and Rieck (Roskilde, 1995), p. 193.

<sup>143</sup> Torsten Edgren, “... De Aspø usque Øresund.vi. Inde usque Hangethe.iii...,” in *Shipsshape...*, ed. Olsen, Skamby Madsen and Rieck, p. 210.

<sup>144</sup> The first to point to a possible crusading connotation was Christer Westerdahl, “Medeltida sjöleder och ortnamn,” *Tjustbygdens kulturhistoriska förenings årsbook* (1978), p. 26. However, he revoked this connotation later on the basis that this itinerary predates the first crusade: cf. Christer Westerdahl, “Transportvägar – Itinerariet och forntida transportsystem,” in *Kung Valdemars segelled*, ed. Gerhard Flink (Stockholm, 1995), p. 25. In this paper, however, it is suggested that one abide by Westerdahl’s initial hypothesis despite that the itinerary to Acre most probably predates the First Crusade in 1096. This might seem paradoxical at first, but the itinerary fulfilled the same basic purpose before 1096 as a pilgrim route, with the only difference that in 1096, and on later occasions, a force of arms became necessary to grant pilgrims access to their holy sites. In fact, the Latin term for pilgrimage is the same as the term for crusade, i.e. *peregrinatio* or *expeditio*, cf. Eric Christiansen, *The Northern Crusades* (London, 1997), pp. 50-58.

<sup>145</sup> “[...] et notandum est quod de Arnholm usque Lynaebetæ iter medio inter orientem et aquilonem et si prosper est uentus ab occidente potest uelificari directa linea de Arnholm usque Hangethe.” Fol. 128r,

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Mührenberg and Palle Birk Hansen, *Ausstellungen zur Archäologie in Lübeck 6* (Lübeck, 2003), p. 39; Ortwin Pelc, “Lübeck unter der Herrschaft Waldemars II. von Dänemark,” in *Dänen in Lübeck...*, ed. Gläser, Mührenberg and Hansen, p. 48.

<sup>139</sup> Carsten Jahnke, *Das Silber des Meeres. Fang und Vertrieb von Ostseebering zwischen Italien und Norwegen, 12. bis 16. Jahrhundert*, Quellen und Darstellungen zur Hansischen Geschichte. Neue Folge 49 (Köln, Weimar and Wien, 2000), pp. 64-90.

<sup>140</sup> Westerdahl, “The Relationship...,” pp. 62-76.

<sup>141</sup> Westerdahl, “The Relationship...,” p. 75.

excerpt describes the precondition for making a direct landfall on Hange the (Fig. 11.3), which should only be risked if the wind was coming from the right direction. While compasses were unknown, latitudinal or near-latitudinal courses could be determined by the course of the sun. To make landfall in known waters it was not only important to establish terrestrial reference points, but to be familiar with the topo- and hydrographic environment.<sup>146</sup> When a landfall was missed, familiar landmarks went out of sight and consequently a crew could face danger for the lack of knowledge of suitable anchorages to provide shelter in storms and of coasts with hostile populations.<sup>147</sup> So the very circumstance of the Danish Itinerary being recorded reflects the attempt of a perhaps royal authority<sup>148</sup> to conceptualize geography in a space-time concept, not graphically, but through a narrative.

But the compilation of geographical information was not only achieved by the recording of oral reports – like that of Ohthere or Wulfstan – but by an intricate system of written correspondence. So, in order to orchestrate the international crusading movement, the papacy aimed to acquire an all-embracing geo-political knowledge through a far-flung information network. The way the geo-political situation was perceived in Rome is mainly reflected in papal letters sent in response to incoming correspondence, so there is only a vague mirror image on how regional knowledge was perceived.<sup>149</sup> One of the main goals

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according to Gallén, *Det "Danska itinerariet"...*, p. 48. Henrik Breide, "A Few Thoughts about 'the Baltic Itinerary,'" in *The Marine Archaeology of the Baltic Sea Area – Conditions in the Present, Possibilities and Problems in the Future*, ed. Marcus Lindström, Södertörns Högskola Research Reports 1 (Stockholm, 1998), p. 45.

<sup>146</sup> The topography is the landscape above the waterline and landmarks served as orientation marks, whereas the hydrography is basically the submerged landscape, which was important to know too for navigable channels, depths, treacherous shoals and suitable anchorages.

<sup>147</sup> Exactly such situations in which ships got into a storm, off course and eventually landed on a hostile coast is described in Henry of Livonia, *Chronicon...*, ed. Arbusow and Bauer, I, 13, p. 7 and XIX, 5, pp. 127-128; *The Chronicle...*, transl. Brundage, I, 13, p. 30 and XIX, 5, p. 147, respectively.

<sup>148</sup> Although the oft-used colloquial name 'King Valdemar's Itinerary' for the Danish Itinerary is regularly regarded with suspicion, it does not seem too far-fetched, as the existence of the itinerary tells of the attempt of a perhaps royal authority to inventory the kingdom's territorial and maritime assets, including the Danish possession in Estonia in the wake of Valdemar's crusades.

<sup>149</sup> Carsten Selch Jensen, Kurt Villads Jensen and John Lind, "Communicating Crusades and Crusading Communications in the Baltic Region," *Scandinavian Economic History Review* XLIX.2 (2001): 8-14.

of the Cistercians in Livonia was to establish a communication network tightly connected with the aims of the crusading movement.<sup>150</sup> But the discrepancy that must have existed between official knowledge, compiled in far away episcopal or secular power centres as narratives, and local knowledge, becomes very clear in how geographical relationships were conceptualized.

### 4.3. The General Conceptualization of Geography: the Baltic Sea

A century before Bishop Meinhard sallied out across the Baltic Sea to establish a Livonian mission at the lower reaches of the Daugava River, this sea appeared as a fairly unknown and mysterious place in Adam of Bremen's *Descriptio Insularum Aquilonis*: "When one has passed the Danish islands, a different world opens up to Sweden and Norway, which are two extensive realms in the north, which have been nearly unknown in our part of the world."<sup>151</sup> The *aquilo* as he and also later chroniclers like Helmold of Bosau perceived it, was a constructed spatial entity that encompassed not only Scandinavia, but also the Slavic lands in the east; the Baltic Sea – *oceanus septentrionalis* – thus formed the centre of this northern hemisphere.<sup>152</sup> Although contemporaries could not have been unaware of this flawed perception, the antagonism between *oriens* and *aquilo* became more symbolic than geographic: the first denominated the light and divine lands in the east with Jerusalem in its centre and the latter the dark and pagan lands in the north.<sup>153</sup> This antagonism is also reflected in the more allegorical than geographical Ebstorf World Map from ca. 1300, in which the lands north of continental Europe were bent to the east by the outer extent of the world (Fig. 12). This map is based on a narrative, in which first

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<sup>150</sup> Marek Tamm, "Communicating Crusade. Livonian Mission and the Cistercian Network in the Thirteenth Century," *Ajalooline Ajakiri* 3/4 (2009): 341-372.

<sup>151</sup> "Transeuntibus insulas Danorum alter mundus aperitur in Sueoniam vel Nortmanniam, quae sunt duo latissima regna aquilonis et nostro orbi adhuc fere incognita." Adam Bremensis, *Gesta Hammaburgensis ecclesiae pontificum*, ed. Bernhard Schmeidler, Monumenta Germaniae Historica. Scriptores rerum Germanicarum in usum scholarum separatim editi 2 (Hannover/Leipzig, 1917), IV, 21, p. 250.

<sup>152</sup> David Fraesdorff, *Der barbarische Norden. Vorstellungen und Fremdbeitkategorien bei Rimbart, Thietmar von Merseburg, Adam von Bremen und Helmold von Bosau*, Orbis Mediaevalis. Vorstellungswelten des Mittelalters 5 (Berlin, 2005), pp. 88-92; Volker Scior, *Das Eigene und das Fremde. Identität und Fremdheit in den Chroniken Adams von Bremen, Helmolds von Bosau und Arnolds von Lübeck*, Orbis Mediaevalis. Vorstellungswelten des Mittelalters 3 (Berlin, 2003), p. 70.

<sup>153</sup> Fraesdorff, *Der barbarische Norden...*, pp. 99-110.



and foremost biblical, mythical and historical motives were geo-referenced. For instance, the depiction of amazons in the remote part of the Baltic Sea could be based on Adam of Bremen's reference to a *terram feminarum* in Finland (Fig. 12.1).<sup>154</sup> While Adam was doubtlessly acquainted with classical mythology and was possibly himself implying this, the "land of the women" in its literal sense could have also been derived from a mariner's literal description of lands with female place-names. Significantly, historical and ethnographic evidence suggests that coastal features bore female names as a warning, for they were considered a taboo amongst superstitious medieval seafarers and shunned.<sup>155</sup> Perhaps it is no coincidence that Finland was still considered to be a mysterious land up to the late Middle Ages with maritime sorcerers as described in Olaus Magnus' *Historia de gentibus septentrionalibus*.<sup>156</sup> Thus, the depiction of amazons might have been indeed a meaningful hermeneutic expression rather than a random decorative element borrowed from classical mythology. While this map cannot be taken at face value, certainly not in a geographical sense, not even by contemporaries, it is possibly a far more revealing source for understanding the mental terrain of medieval man in maritime landscapes. Thus, such representations ought not to be reduced to the fantasy of bored map-making monks, but should be considered as the refined product of landscape perception that passed through various cognitive filters; from the salty sea dog to the silver-haired monastic scholar. The realization that the historical record is a *narratio rerum gestarum* – a controlled and reflected construction based on the perception of segments of the past<sup>157</sup> – arguably applies also to how landscapes were constructed in medieval mindsets: while the land mass and the location of towns in relation to each other are barely recognizable on medieval maps, the sequence of place names along coasts and rivers tend to be more correct. This is owed to the way geographical relationships were constructed from narratives: Holland – for instance – was very literally plotted as an estuarine promontory with the adherent description "The land, reclaimed between the river and the sea, is called Holland".<sup>158</sup> A

<sup>154</sup> Adam Bremensis, *Gesta...*, ed. Schmeidler, IV, 14, 17, 19, pp. 242, 244, 246.

<sup>155</sup> Christer Westerdahl, "Maritime Cosmology and Archaeology," *Deutsches Schifffahrtsarchiv* 28 (2006), pp. 14-15.

<sup>156</sup> Westerdahl, "Maritime Cosmology...", p. 28.

<sup>157</sup> Hans-Werner Goetz, "Constructing the Past. Religious Dimensions and Historical Consciousness in Adam of Bremen's *Gesta Hammaburgensis ecclesiae pontificum*," in *The Making of Christian Myths in the Periphery of Latin Christendom (c. 1000-1300)*, ed. Lars Boje Mortensen (Copenhagen, 2006), p. 18.

<sup>158</sup> "Que nunc est vocata in medio fluminum et oceani, hec regio vocatur Hollant." This and all further descriptive and annotated information was taken from an interactive version of the Ebstorf Map

sequence of places along a reference grid of transport zones such as roads, rivers or coasts was less abstract than the description of a land mass and therefore more accurate, as also the tenth-century map by the Arab merchant At-Tartûshi from Córdoba or the twelfth-century map of the Jewish traveller Al-Idrîsî show (Fig. 13). These exotic travellers must have perceived the Baltic Sea as the fringe of the world, but nevertheless gained a fairly good geographical understanding through a maritime perspective. A "vectorized" sequence can be found in the Danish Itinerary, in which the *ukasio* is the base unit for length and the direction determines the offset. This manner of landscape conceptualization could be regarded as proto-mapping. The first genuine nautical charts – known as *portolan* charts – did not appear before the sixteenth century in the Mediterranean. The term *portolan* had been used since the thirteenth century for descriptions of nautical conditions, mainly harbours, and may be compared to the *Seebuch*. Thus, pictorial representations of geography seem to have generally evolved from narratives. The difficulties inherent in translating geographical descriptions into an image undoubtedly accounts for the distortion of those geographical features in pictorial representations.

#### 4.4. The Particular Graphical Conceptualization of Geography: Livonia

Having demonstrated that there is possibly significant heuristic potential in the Ebstorf map, it is worth taking a closer look at a detail, namely the region that became the foothold of the crusader state of Livonia. As already shown above, the symbiosis between merchants and maritime intermediaries is striking. This impression echoes back from this side of the Baltic Sea in the late thirteenth-century Livonian Rhymed Chronicle,

*Established merchants, rich and prominent in honour and wealth, had decided to seek profit from trade, as many still do today. God led them to employ a man who knew of foreign lands and straightaway he brought them by ship to the Baltic Sea. (...) The Daugava is the name of the river which flows out of Russia. (...) They went home and returned again often to Livonia in large numbers. Whenever the natives observed their arrival, they were received as welcome guests, and they spent many days buying and selling. So well did it go that they travelled thirty miles into the interior where many heathens lived with whom they could trade, and they remained there long enough to build a settlement. With native permission they built a worthy place on a mountain by the Daugava, a castle so large that these traders could remain there in peace and conduct trade*

provided by the Leuphana Universität Lüneburg: <http://weblab.uni-lueneburg.de/kulturinformatik/projekte/ebskart/content/start.html>

for protracted periods of time. It was named Üxküll and stands even today in Livonia.<sup>159</sup>

Contrary to this excerpt, Bishop Meinhard appears to be the initiator of its building according to Henry of Livonia, in order to protect the baptized Livonians from Lithuanian assaults.<sup>160</sup> Henry's emphasis, however, can be doubted on the grounds that Meinhard contributed only to a fifth of the building costs,<sup>161</sup> and that Henry was clearly prejudiced: he portrayed the events from a missionary's perspective and might have negated the influence of other groups. Moreover, the building of Üxküll Castle seemed to be very much in the interest of the mercantile community, as indicated in the Rhymed Chronicle. Perhaps this castle was not incidentally located at an important north-south road which passed the River Daugava and thus connected the interior with the coastal regions.<sup>162</sup> That Bishop Meinhard's presence in Livonia depended on ship-owning merchants, with whom he regularly sailed to the Daugava,<sup>163</sup> also indicates a predominance of mercantile interests, as does the use of stonemasons from Visby for the construction of Üxküll Castle.<sup>164</sup> So this partnership seemed to be a win-win situation: while the merchants provided the necessary maritime logistics, activated resources and manpower, the bishop laid a legal foundation for a Catholic outpost with market rights, from which merchants could venture into the hinterlands, possibly with the aim to tap commodity markets without native middlemen. This insight becomes even more manifest when applied to the Ebstorf map, which appears to be predominantly ecclesiastical at first glance. Not only the depiction of wild game at quite literally the point

from where the Daugava "flows out of Russia" – indicating the importance of fur trade on the Daugava River – reveals an underlying mundane mercantile perspective, but also a telling flaw: Smolensk was erroneously plotted on the Daugava even further downstream from Polotsk. In reality Smolensk is located to the east of Polotsk on the Dnepr River. This "error" did probably not occur by coincidence, as Smolensk was not just any city: peace treaties, which opened up trade with the Russian hinterland, were concluded in Smolensk in 1229 and 1250.<sup>165</sup> So the political dependency on Smolensk, which opened up trade with Polotsk was arguably translated into a virtual dependency on the Ebstorf map, by plotting Smolensk between Riga and Polotsk, as though it could physically block trade on the River Daugava (Fig. 12.2). This error might reflect the sources from which the monks of the Ebstorf monastery gathered geo-political information, i.e. from people who were primarily interwoven into a mercantile logistical network.

Although the merchants appear to be the ones who reaped the immediate and tangible benefits of this joint commitment between *ecclesia* and *mercatura*, the long-term strategy appears to be on the ecclesiastical side: a papally authorized ban on trade in Semigalian harbours is interpreted as a measure to cut its population off from arms trade and other goods vital for warfare, with the ultimate goal to consolidate the newly founded bishopric of Livonia as an uncontested power on the lower Daugava.<sup>166</sup>

#### 4.5. The Untold Geographical Perspective: A Wendish Maritime Network?

Archaeological interpretation is powerfully affected by the spotlights historical sources project on past events. While archaeologists are well aware that historical sources cannot fully illuminate the past and are inherently biased, interpretations of archaeological findings tend to be, nonetheless, dismissed as too imaginative when not supported by written sources. This applies particularly to the reconstructed past of communities without an own written record, which legacy is obscured by the often wilfully unflattering description of outsiders. This is certainly the case with Saxo Grammaticus' partisan glorification of the Danes at the expense of the Wends, who are presented as uncivilized heathens who pose a general threat. Though this was arguably intended to distract from inner Danish disputes by strengthening a sense

<sup>159</sup> Jerry C. Smith and William L. Urban, *The Livonian Rhymed Chronicle* (Bloomington, 1977), pp. 3-4.

<sup>160</sup> Henry of Livonia, *Chronicon...*, ed. Arbusow and Bauer, I, 6, p. 3; *The Chronicle...*, transl. Brundage, I, 6, pp. 26-27.

<sup>161</sup> Raoul Zühlke, "Bischof Meinard von Üxküll: ein friedlicher Missionar? Ansätze zu einer Neubewertung. Ein quellenkundlicher Werkstattbericht," *Hansische Geschichtsblätter* 127 (2009), pp. 112-113.

<sup>162</sup> John H. Lind, Carsten Selch Jensen, Kurt Villads Jensen and Ane L. Bysted, *Danske Korstog – krig of mission i Østersøen* (Copenhagen, 2006), p. 165.

<sup>163</sup> Henry of Livonia, *Chronicon...*, ed. Arbusow and Bauer, I, 2, p. 2; *The Chronicle...*, transl. Brundage, I, 2, pp. 25-26; Arnold of Lübeck, *Chronica Slavorum*, ed. Georg Heinrich Pertz, Monumenta Germaniae Historica. Scriptores rerum Germanicarum in usum scholarum separatim editi 14 (Hannover, 1868), V, 30, pp. 212-217.

<sup>164</sup> Henry of Livonia, *Chronicon...*, ed. Arbusow and Bauer, I, 6, p. 3; *The Chronicle...*, transl. Brundage, I, 6, pp. 26-27. The stonemasons were probably obtained via the Gotlandic contacts of the German mercantile community.

<sup>165</sup> Nils Blomkvist, *The Discovery of the Baltic. The Reception of a Catholic World-System in the European North (AD 1075-1225)* (Leiden and Boston, 2005), pp. 500, 508.

<sup>166</sup> Blomkvist, *The Discovery...*, pp. 529-530.

of patriotism and solidarity,<sup>167</sup> the inherent bias prevailed and was challenged only in recent years, when attention was drawn to the considerable Wendish influence in Denmark's archaeological record and toponyms, which suggest both extensive trade links and a sedentary Wendish population on Danish shores.<sup>168</sup> In a maritime context, one thus has to question whether Saxo's use of *piratae* was to be understood as a generic – possibly intentionally misleading – term for all Wendish mariners?<sup>169</sup> After all, the *piratae* that were interpreted as Wends,<sup>170</sup> whose heads ended up on poles in front of Bishop Absalon's Castle,<sup>171</sup> were not attacking the Danes but were intercepted by them,

*Here he had gone to the bath when he noticed that people were talking outside more loudly about an approaching ship from the north. He soon realized that it had to be a pirate ship, and without finishing washing he called for his clothes, jumped on board the ship, which he had left in the harbor under sail, summoned the crew with a horn signal and set sail.<sup>172</sup>*

<sup>167</sup> Lars Hermanson, "Saxo and the Baltic. Danish Baltic-sea Policies at the End of King Niels' Reign, 1128-1134. Foreign Policy of Domestic Affairs?," in *Saxo and the Baltic Region. A Symposium*, ed. Tore Nyberg (Odense, 2004), p. 112.

<sup>168</sup> Cf. *Zwischen Reric und Bornhöved. Die Beziehungen zwischen den Dänen und ihren slawischen Nachbarn vom 9. bis ins 13. Jahrhundert*, ed. Ole Harck and Christian Lübke (Stuttgart, 2001); Carsten Selch Jensen, Kurt Villads Jensen and John Lind, *Venderne og Danmark. Et tværfagligt seminar*, Mindre skrifter udgivet af Center for Middelalderstudier, Syddansk Universitet 20 (Odense, 2000).

<sup>169</sup> The term *pirata*, however, is ambivalently used by Saxo. In his text it may also carry a very positive connotation or refer to a certain type of ship (Kurt Villads Jensen, personal communication). See also Agnès Guénolé, "Piraticum bellum. Ein möglicher Kulturtransfer in den *Gesta Danorum* von Saxo Grammaticus," in *Mittelalterliche Eliten und Kulturtransfer östlich der Elbe. Interdisziplinäre Beiträge zu Archäologie und Geschichte im mittelalterlichen Ostmitteleuropa*, ed. Anne Klammt and Sébastien Rossignol (Göttingen, 2009), 125-150.

<sup>170</sup> Kurt Villads Jensen, "Saxos grænser. Dehumaniseringen af Venderne," in *Venderne og Danmark. Et tværfagligt seminar*, ed. Carsten Selch Jensen, Kurt Villads Jensen and John Lind, Mindre skrifter udgivet af Center for Middelalderstudier, Syddansk Universitet 20 (Odense, 2000), p. 7.

<sup>171</sup> Saxo Grammaticus, *Gesta Danorum / Danmarkshistorien II*, ed. Karsten Friis-Jensen and Peter Zeeberg, (Copenhagen, 2005), 14.49.4, pp. 430-431.

<sup>172</sup> "Ubi quum munditiarum gratia balneis uteretur, animaduertit cuiusdam nauis e septentrione uenientis mentionem foris stantium collocautione crebrescere. Quam ut piraticam intellexit, semiloto corpore uestem poposcit nauemque, quam in porto uelatam dimiserat, remigibus lituo contractis conscensam in

Thus, one might wonder whether being a Wendish mariner already qualified one – in either Saxo or Absalon's terms – as a pirate? In reality, the division between Danish and Wendish ships was probably not self-evident, not only because of the superficial resemblance of Scandinavian and Slavic longships. Archaeological evidence from a late eleventh-century shipbuilding site in Fribrodrø on the Island of Falster suggests that Wends lived and worked there together with Danes. Some ship-timbers found on this site are considered typically Slavic, particularly the use of treenails in plank-to-plank fastenings.<sup>173</sup> Although treenails were also used to fasten planks-to-frames in Scandinavian shipbuilding, the use of treenails in plank-to-plank fastenings is almost an ideosyncratic Western Slavic or Wendish feature.<sup>174</sup> Local Slavic toponyms and pottery also strongly indicate that these fragments originated not merely from captured Wendish vessels, but a sedentary Wendish population on the island.<sup>175</sup> Of all islands, the Island of Falster was singled out by Saxo as the only one to offer effective resistance against the Wends.<sup>176</sup> While Saxo ascribed this to the bravery of the islanders, it might have actually stemmed from a peaceful local arrangement or familiar bonds between Wends and the Falster-Danes.

The Wendish maritime influence was not restricted to the opposite Danish shores, however, but possibly touched the shores of the Kalmar Sound as well, an important maritime gateway to the North. It was a maritime frontier zone, because here Danish influence ended with the province of Blekinge, meaning 'great calm waters', with many anchorages for vessels waiting to continue their voyage further north through the Kalmar Sound.<sup>177</sup> Not incidentally, the first node of the Danish Itinerary was the island of Utlången at the south-easterly tip of Blekinge. Nils Blomkvist convincingly hypothesized that the joint Danish-Norse expedition of 1123 known as *Kalmarna leidangr* – mentioned in the *Heimskringla*<sup>178</sup> – was directed against a pagan Wendish population in this

altum dirigere curauit." Saxo Grammaticus, *Gesta...*, ed. Friis-Jensen and Zeeberg, 14.49.1, p. 428.

<sup>173</sup> Skamby-Madsen, "Fribrodrø...", pp. 193-196.

<sup>174</sup> Cf. Christer Westerdahl, "Holznägel und Geschichte. Eine schiffsarchäologische Hypothese," *Deutsches Schiffsarchiv* 8 (1985): 7-42.

<sup>175</sup> Skamby-Madsen, "Fribrodrø...", pp. 190-193.

<sup>176</sup> The islanders did not, thus, pay ransom to the Wends. Saxo Grammaticus, *Gesta...*, ed. Friis-Jensen and Zeeberg, 14.15.5, pp. 204-205.

<sup>177</sup> Leif Stenholm, *Berättelsen om Blekinge. Gränser i ett gränsland* (Vekerum, 2009), pp. 61-67.

<sup>178</sup> Cf. Snorre Sturlason, *Heimskringla or the Lives of the Norse Kings*, transl. Erling Mønstad (Whitefish, 2004), "The History of Sigurd the Crusader and His Brothers Eysteinn and Olav," c. 27, pp. 628-629.

region.<sup>179</sup> Moreover, he drew attention to the possibility that the Wendish influence reached beyond the Kalmar region by associating Bulverket with the Wends. This massive pile-dwelling structure in a lake in the north of Gotland was recently re-dated to the early twelfth century; the lake was accessible from the sea and thus could have been an important base of the Wendish maritime network.<sup>180</sup> Significantly, a shipwreck which is likely to be contemporary to the pile structure<sup>181</sup> features the typical Slavic treenails in plank-to-plank fastenings,<sup>182</sup> which supports this hypothesis. Still following Blomkvist, the final leap of the Wendish maritime network could have extended to the proto-settlement of Riga. Here excavations have brought to light four-headed Sventevit idols and net sinkers of Wendish origin in the layers of the late twelfth and early thirteenth centuries.<sup>183</sup> It is still not entirely clear whether these archaeological finds should be associated to Henry of Livonia's reference to a struggling population of Wends in the vicinity of Riga, which had been expelled from Windau.<sup>184</sup> Although it is beyond the scope of this paper to explore the nature of this Wendish maritime network, it seems worth noting that there is probably a much greater connection behind these singular findings than written sources could ever reveal (Fig. 14).

If we conjecture that Wends were a maritime power in their own right, the Danish strategy of emphasising the pagan and hostile status of Wendland – thereby outlawing its mariners as pirates – would have promoted a just cause for conducting naval warfare against a competing power that was not necessarily inherently hostile, but whose maritime links happened to collide with Danish hegemonic interests in the Baltic Sea.<sup>185</sup>

## 5. Final Remarks

While tremendous advances in both medieval history and maritime archaeology have been achieved in recent decades in the Baltic Sea area, the potential for an integrated approach is great, though many methodological problems must be overcome. Section 4.5 in particular has demonstrated that there are still areas where pioneering research may revise how we regard our shared cultural heritage. While, for instance, the Wendish Crusade is commonly regarded as a territorial conquest of German and Danish princes, the maritime gains have not been realized until recently: that the Germans aligned their maritime influence to basically the same nodes of the former Wendish Arc – Lübeck/Lubice, Kalmar/Kalmarsund, Visby/Bulverket, Riga/Windau – is certainly worth more attention. In this light the re-foundation of Lübeck in 1158 as a subsequent settlement of the important Slavic trading place of Lubice and the foundation of Riga in 1201 not far from a supposedly Wendish bridgehead in Livonia are probably not a coincidence and point to a coherency between the various crusades, which makes the umbrella term Northern Crusades such an alluring concept. This maritime network of mercantile importance was frequented by Germans, Scandinavians and Slavs alike, but the creation of a bishopric of Livonia and the ensuing expansion under the cross marked a decisive turning point that had a huge impact not only on the Baltic provinces, but the balance of powers in the entire Baltic Sea region.<sup>186</sup>

<sup>179</sup> Blomkvist, *The Discovery...*, pp. 307-334.

<sup>180</sup> Blomkvist, *The Discovery...*, p. 318.

<sup>181</sup> Björn Varenus, *Bulverket båten – ett gammalt fynd i ny belysning*, Statens Sjöhistoriska Museum Rapport 11 (Stockholm, 1979), p. 11.

<sup>182</sup> Varenus, *Bulverket...*, p. 19.

<sup>183</sup> Andris Caune, "Einige Merkmale der Kulturbeziehungen zwischen den Einwohnern des Dünamündungs- und des südwestlichen Ostseeküstengebiets im frühen Mittelalter," *Archaeologia Baltica* 2 (1997): 60-66.

<sup>184</sup> Henry of Livonia, *Chronicon...*, ed. Arbusow and Bauer, X, 14, p. 44-45; *The Chronicle...*, transl. Brundage, X, 14, pp. 65-67.

<sup>185</sup> Cf. Villads Jensen, "Saxos grænser..." p. 8.

<sup>186</sup> I am indebted to Dr. Anton Englert (Viking Ship Museum, Roskilde), Dr. Kurt Villads Jensen (University of Southern Denmark, Odense) and Prof. Dr. Carsten Jahnke (University of Copenhagen) for their comments on my manuscript. Any inaccuracies resulting from cited sources of contentious validity or from the re-interpretation of shipwrecks do not necessarily reflect the views of the abovementioned and are my own. Last but not least, I wish to thank Dr. Sébastien Rossignol (formerly York University, now Dalhousie University), Dr. Sunhild Kleingärtner and Donat Wehner (both University of Kiel) and their assistants for organizing such an inspiring conference.

## Illustrations



Figure 1. The Kuggmaren wreck with its frames, keelson and mast-step still visible from the surface in its *in situ* position in shallow waters, Stockholm Archipelago, Sweden. After Jonathan Adams and Johan Rönby, "Kuggmaren 1: The First Cog Find in the Stockholm Archipelago, Sweden," *The International Journal of Nautical Archaeology* 31.2 (2002), p. 174, fig. 2.

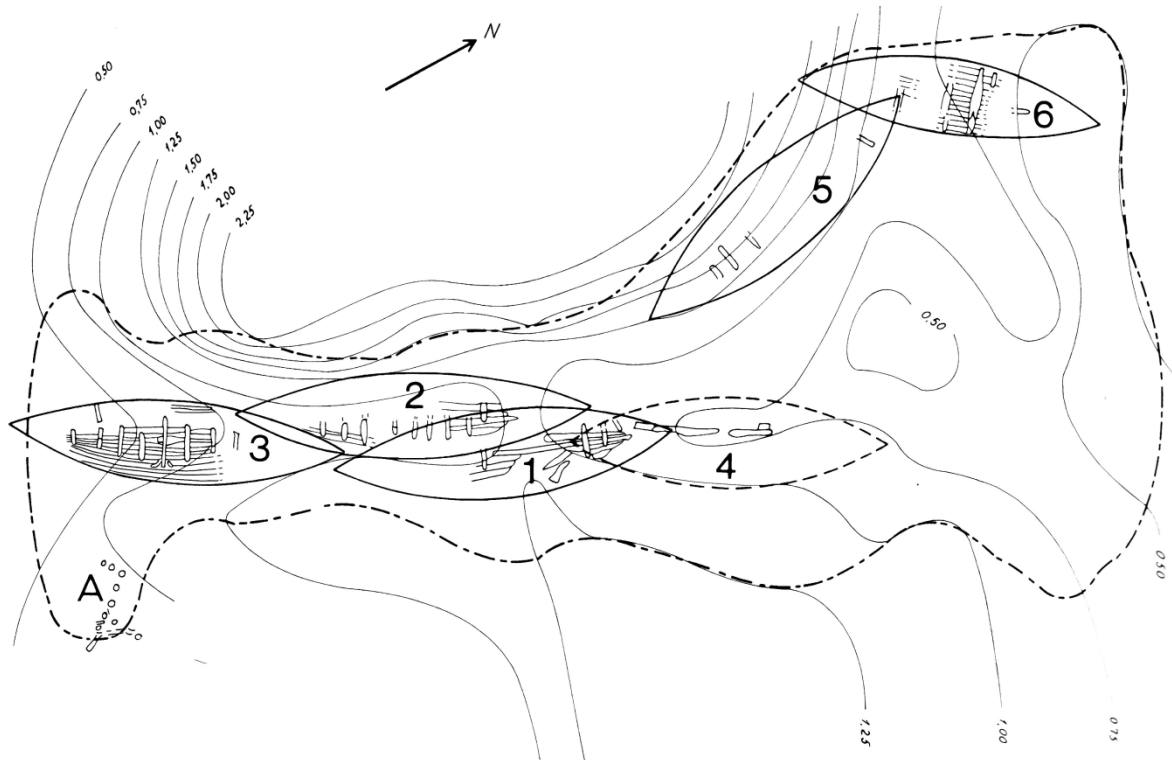


Figure 2. A fairway near Skuldelev was closed off with this eleventh-century barrier of scuttled vessels, Roskilde Fjord, Denmark. This plan was made in the year of excavation, 1959. After Ole Crumlin-Pedersen and Olaf Olsen, *The Skuldelev Ships I, Ships and Boats of the North* 4.1. (Roskilde, 2002), p. 29, fig. 12.



Figure 3. Re-used planks for the construction of a late ninth-century causeway in Staraya Ladoga, Russia. After Petr Sorokin, "Investigation of Traditional Boatbuilding for the Reconstruction of Medieval Russian Boats," in *Boats, Ships and Shipyards. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000*, ed. Carlo Beltrame (Oxford, 2003), p. 190, fig. 29.1.



Figure 4. The *barka* in the Vistula Lagoon: (1) A newspaper excerpt shows a former World War II refugee from Fischhausen (now Primorsk) with a model of a *barka* which he sailed as a youth (Pinneberger Zeitung). (2) This model bears similarity to the Stralsund seal depiction from 1272 in the absence of a sheer. (3) The helmsman-to-ship ratio on the seal of Elbing from 1242 is not necessarily symbolic, as vessels built in this tradition include not only large seagoing ships like cogs, but also small inland craft. After Herbert Ewe, *Schiffe auf Siegeln* (Rostock, 1972), p. 26, p. 38. (4) Ethnographic research confirms the medieval inheritance of twentieth-century *barcas*. Drawing after Aleksander Celarek, "Barkas – Die letzten rahbesegelten Arbeitsboote Europas," *Alte Schiffe* 4 (1991), p. 60, fig. 10.

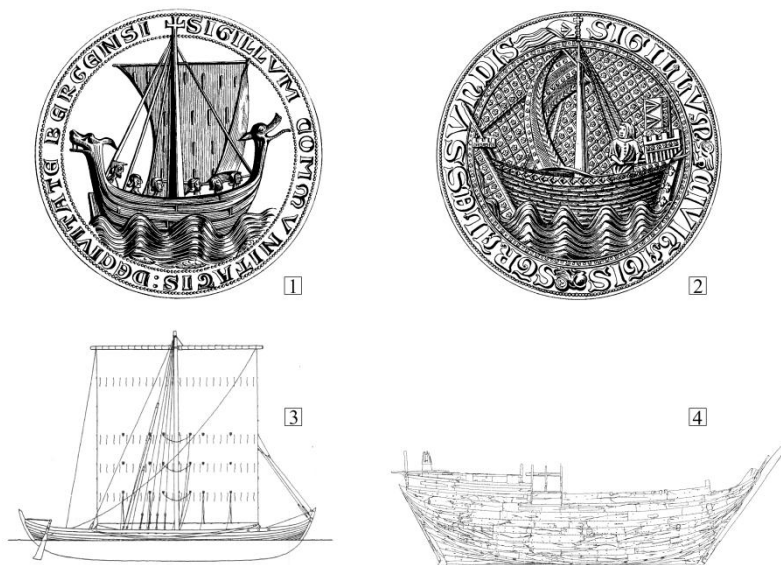


Figure 5. While the Scandinavian-built vessels like the mid twelfth-century Lynæs wreck (3) as typified by the thirteenth-century Bergen seal (1) have plied the waters of the Baltic for centuries, a distinctive group of high-sided vessels with straight stem- and sternposts and a stern-rudder is depicted on seals primarily from the southern Baltic Sea coast. One of them – the Stralsund seal of 1329 (2) – was referred to as a cog in a near contemporary document. The Bremen Cog (4) was the first vessel to be identified as a cog following the comparison of an excavated wreck to a seal. The striking similarity between the seal and the wreck from Bremen tempted several

scholars to define an exclusive list of constructional criteria based on this wreck. Not to scale. 1. After Herbert Ewe, *Schiffe auf Siegeln* (Rostock, 1972), p. 106, fig. 10. 2. After Ewe, *Schiffe...*, p. 198, fig. 194. 3. After Anton Englert *et al.*, “Ein nordisches Frachtschiff des 12. Jahrhunderts in Schleswig-Holstein,” *Archäologisches Korrespondenzblatt* 31 (2001), pp. 141-154. 4. Photogrammetric image after Werner Lahn, *Die Kogge von Bremen I. Bauteile und Bauablauf*, Schriften des Deutschen Schiffahrtsmuseums 30 (Hamburg, 1992), fol. 25.

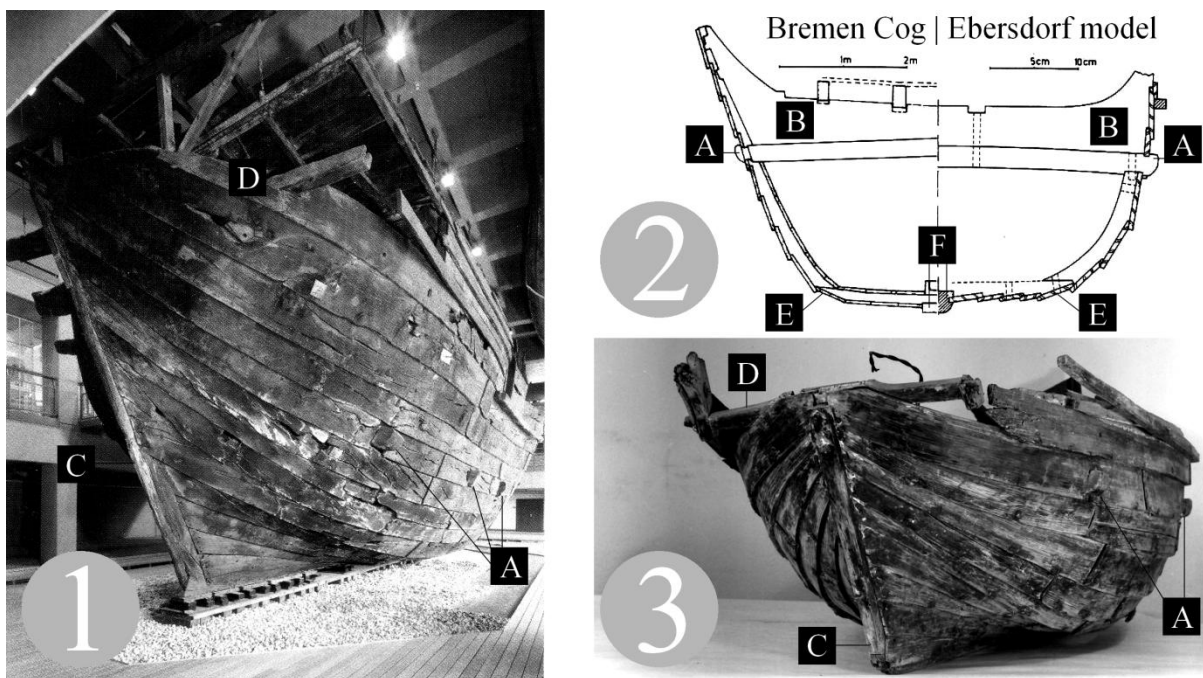


Figure 6. According to the typology for “cogs” and “bottom-based” vessels currently embraced, the Ebersdorf model (3) would represent a wholly distinctive shipbuilding tradition than the Bremen Cog (1), despite sharing an astonishing number of details. Most notably the Ebersdorf model differs in terms of its curved stem, beam-keel and clinker-planked bottom, but resembles the Bremen Cog with (A) protruding cross-beams, (B) massive standing knees with (C) a notch for longitudinal deck-beams, (D) a straight stern-post with fittings for a stern-rudder, (E) transom beam(s) to support the aftercastle, as well as the bulky hull shape in general and the double-bent nails in particular. 1. After Per Hoffmann, “Ein Schiff mit vielen Gesichtern,” in *Die Kogge – Sternstunde der deutschen Schiffarchäologie*, ed. Gabriele Hoffmann and Uwe Schnell, Schriften des Deutschen Schiffahrtsmuseums 60 (Hamburg, 2003), p. 14. 2. After Wolfgang Steusloff, “Das Ebersdorfer Koggenmodell von 1400,” *Deutsches Schiffahrtsarchiv* 6 (1983), p. 201. 3. Photo: Holger Strauß.

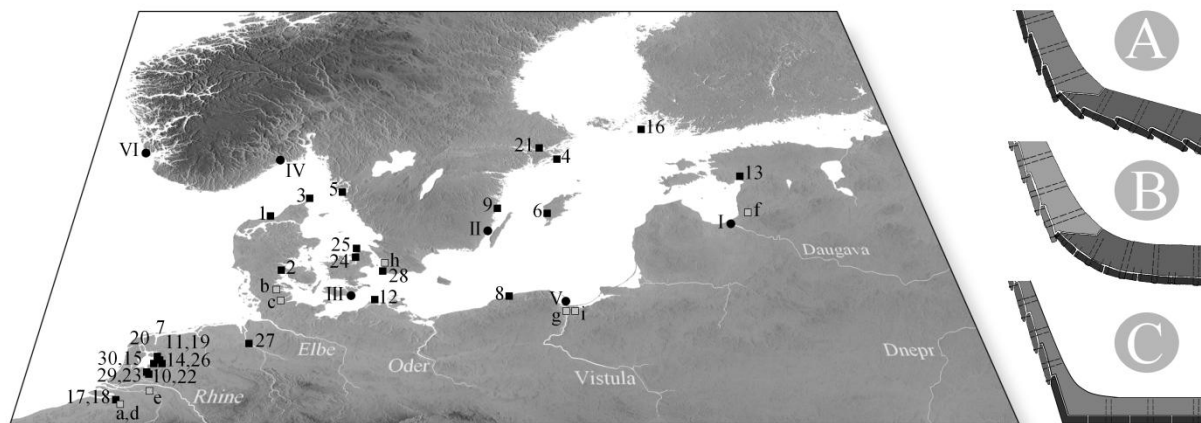


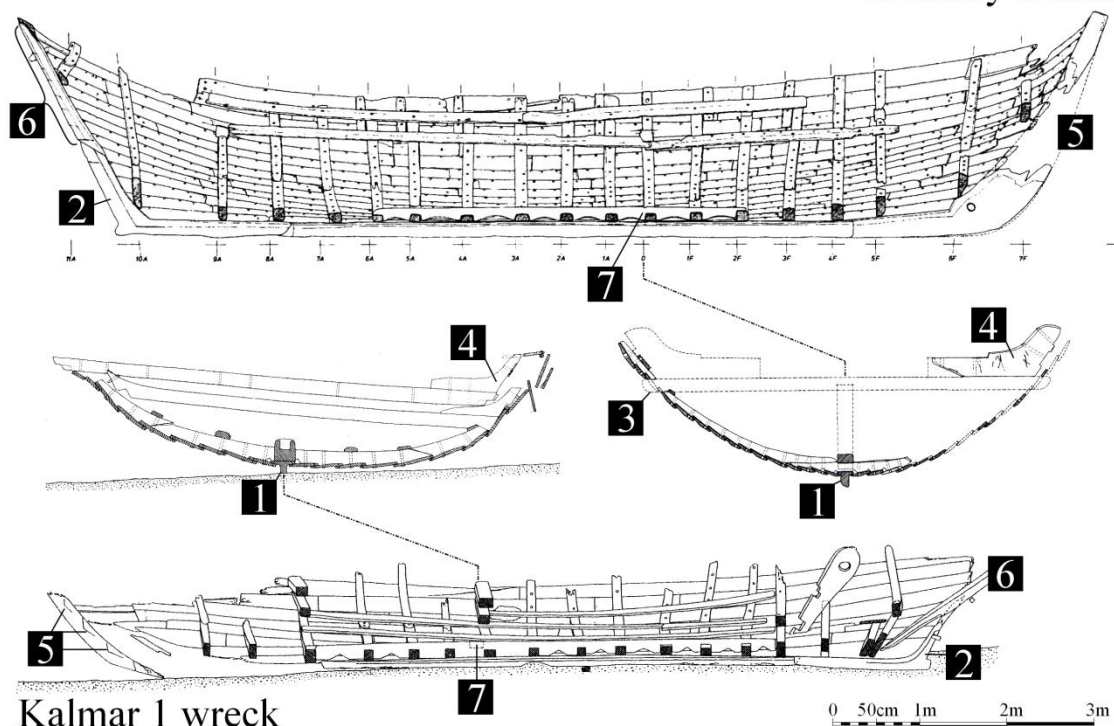
Figure 7. Twelfth- to fourteenth-century shipwrecks built in the bottom-based tradition (B) are shown in Arabic numerals and those built entirely in clinker (A) - yet have otherwise similar features - in Latin numerals. Inland craft built in the bottom-based tradition (C) are shown in lowercase letters: (1) Kollerup - *c.* 1150, (2) Kolding - 1188/89, (3) Skagen - *c.* 1195, (4) Kuggmaren - 1215, (5) Mollo - thought to be 13th century, but recently redated to *c.* 1345, (6) Kronsholmen - first half 13th century, (7) A57 - *c.* 1270, (8) Rowy - 1270, (9) Oskarshamn - after *c.* 1270, (10) OZ43 - after 1275, (11) M61 - after *c.* 1296, (12) Darss - after 1298, (13) Parnu - *c.* 1300, (14) Q75 - after 1300, (15) OG77 - *c.* 1305, (16) Egelskar - *ca.* 1320, (17) Doel 1 - *ca.* 1325, (18) Doel 2 - *c.* 1325, (19) N5 - *c.* 1325, (20) CZ46 - after 1327, (21) Helgeandsholm 2 - 1330, (22) OZ36 - 1336, (23) NZ42 - *c.* 1350, (24) Lille Kregme - *c.* 1358, (25) Vejby - 1372, (26) M107 - after 1375, (27) Bremen Cog - 1378, (28) Skanor - after 1382, (29) NZ43 - after 1402 (30) Almere - 1410. (I) Riga 2 - *c.*1250, (II) Kalmar 1 - second half of 13th century, (III) Gedesby - *c.* 1320, (IV) Bole - *c.* 1386, (V) Gdańsk W5 - *c.* 1390, (VI) Avaldsness - *c.* 1395. (a) Antwerp Lefebvre 1 - 12th century, (b) Egersund - 12th century, (c) Haithabu 4 - *c.* 1184, (d) Antwerp Lefebvre 2 - 13th century, (e) Meinerswijk 3 - 13th century, (f) Treiden - 13th century, (g) Kobyla Kępa - after 1291, (h) Falsterbo - *c.* 1311-1318, (i) Elbląg - *c.* 1400. Please note that the high concentration of wrecks in the Zuiderzee (the Netherlands) is owed primarily to archaeological work carried out in the wake of extensive land reclamation. Also note, that the cross-sections on the right side are schematic and the infill indicates the building sequence, i.e. the darker the earlier. Graph: Daniel Zwick.





Figure 8. The Gedesby reconstruction “Agnete” with lowered mast in Nykoping, Denmark. By courtesy of Middelaldercentret Nykobing Falster.

### Gedesby wreck



### Kalmar I wreck

Figure 9. A comparison between the Kalmar I wreck and the Gedesby wreck, represented in different orientations: 1.) T-shaped keel, 2.) stem- and sternhook, 3.) protruding beam (not visible on this cross-section of Kalmar I but detected by the excavator), 4.) massive beam knee, 5.) hood-ends notched into stempost, 6.) hood-ends overlapping stern-post, 7.) mast-stem integrated in keelson. After Jan Bill, *Small Scale Seafaring in Danish Waters AD 1000–1600*, doctoral dissertation (University of Copenhagen, 1997), fig. 36.1; Harald Åkerlund, *Fartygsfynden i den Forna Hamnen i Kalmar* (Uppsala, 1951), pl. 5c, 6e.



Figure 10. The first Lubeck seal of c. 1223. After Carsten Jahnke, “Zur Interpretation der ersten Lubecker Schiffssiegel,” *Zeitschrift des Vereins für Lubeckische Geschichte und Altertumskunde* 88 (2008), p. 16, fig. 1.

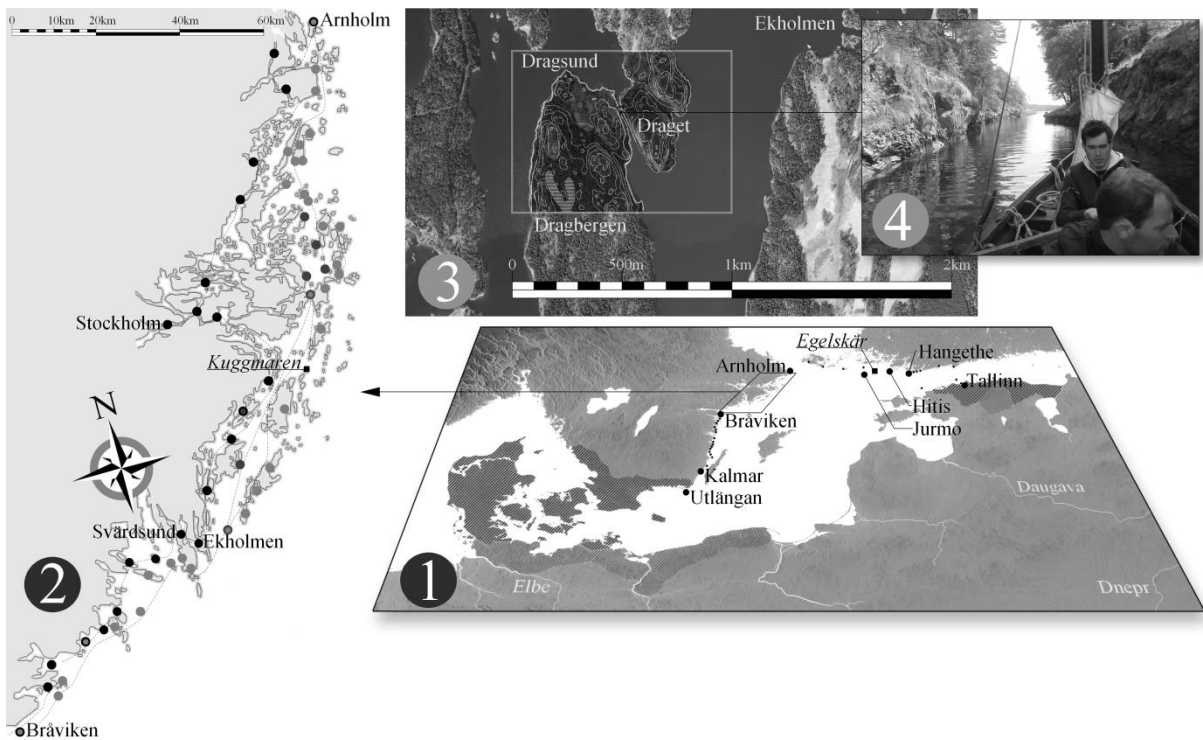


Figure 11 (opposite). (1) The points mentioned in the 13th-century Danish Itinerary (colloquially: King Valdemar’s Itinerary) from Utlangan to Tallinn along the Swedish and Finnish coast, with the Danish lands shaded and temporary possessions lightly shaded. (2) In the Stockholm Archipelago the itinerary splits up into an inner (black spots), a median (grey spots) and an outer route (light grey spots). (*Kung Valdemars*, ed. F link, p. 18, map 2. – modified by author.) (3) The Draget between Ekholmen and Svärdsund would have been crossed by mariners following the itinerary. The contour lines (5 m interval) indicate that this site might have formed an isthmus even 800 years ago despite the significant post-glacial land rise. The toponym ‘draget’ (drag = portage, et = isthmus) indicates that ships were pulled overland here, while other ‘drag’-attributes indicate the central importance of this place. (Map: Riksantikvarieämbetet: <http://www.fmis.raa.se/> – modified by author.) (4) Today Draget can be crossed through a modern canal, as on a sailing expedition in 2010 with the author’s traditionally built *smakke*. Photo: Daniel Zwick.

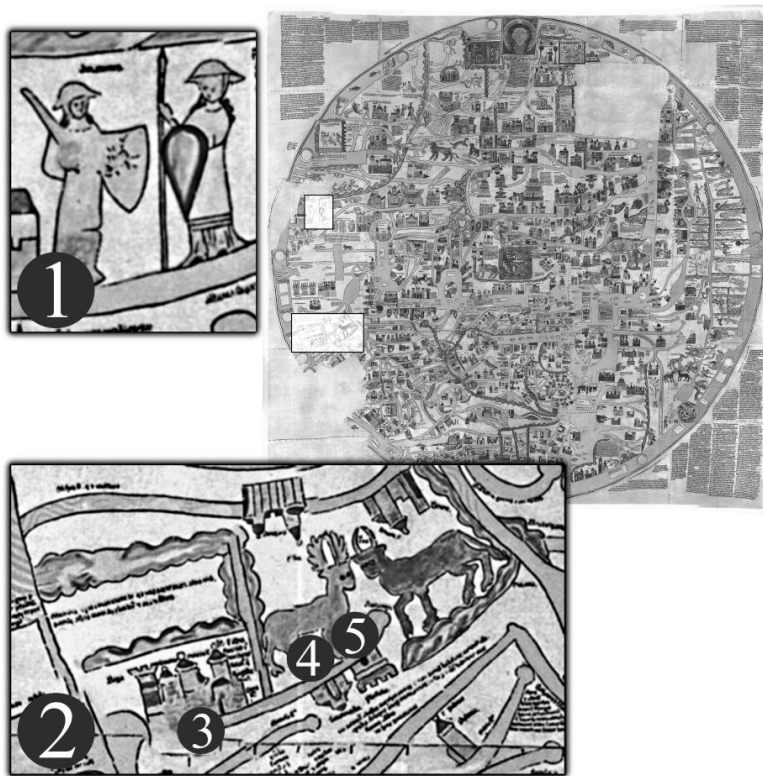


Figure 12. The Ebstorf world map from the early 13th century with indicated excerpts: (1) A mazon, (2) Livonia, (3) Riga, (4) Polotsk, (5) Smolensk. After the reproduced and annotated map on the website of the Leuphana University of Luneburg: <http://www2.leuphana.de/ebskart/>.

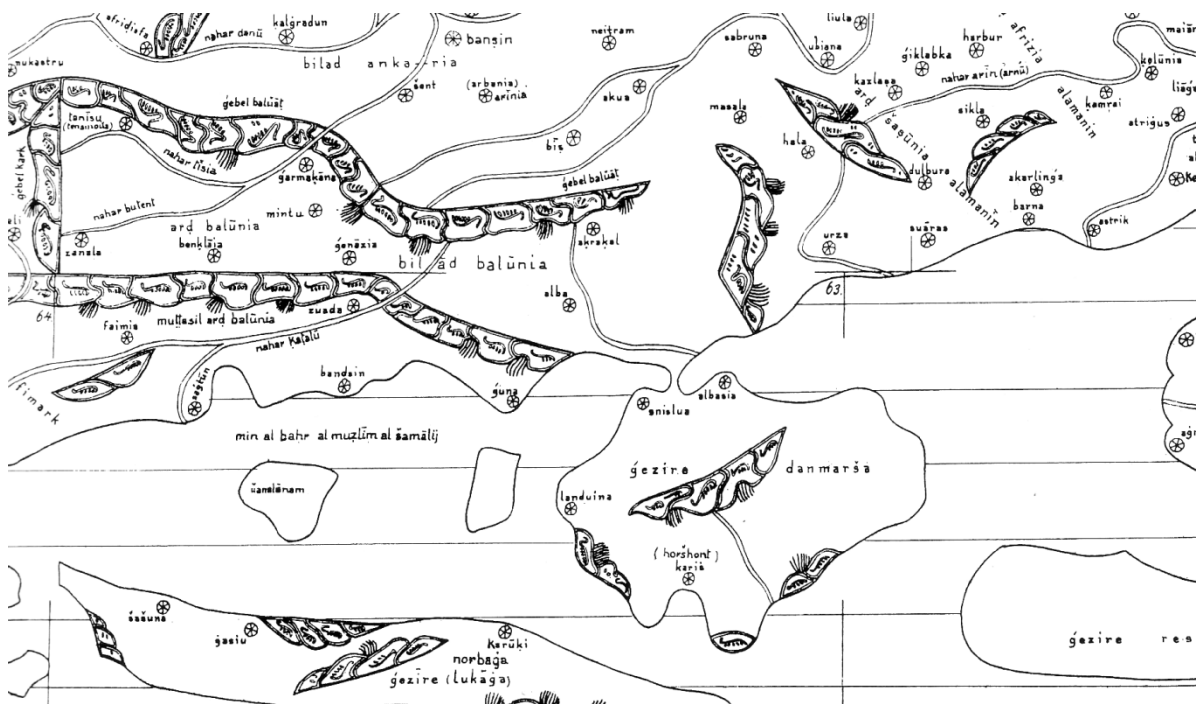


Figure 13. This detail from a twelfth-century map by the geographer Al-Idrisi shows a part of the Baltic Sea upside down. Places are arranged in reference to coastlines, rivers and ridges, while the isthmus near the site of Hedeby and the later town of Schleswig, from where goods were transhipped between the Baltic Sea and the North Sea, is arguably represented by the “bottleneck” at the juncture between mainland Denmark (centre bottom) and the continent. After Carsten Jahnke, “The Influence of the Hanseatic League on the Cities in the North-Sea and Baltic-Sea Area – Some Reflections on the Triad “Trade – Cities – Hanseatic League,”” in *Archaeology of Medieval Towns in the Baltic and North Sea Area*, ed. Nils Engberg, Anne Norgaard, Jakob Kieffer-Olsen, Per Kristian Madsen and Christian Radtke, Publications of the National Museum Studies in Archaeology & History 17 (Copenhagen, 2009), p. 54, fig. 2.

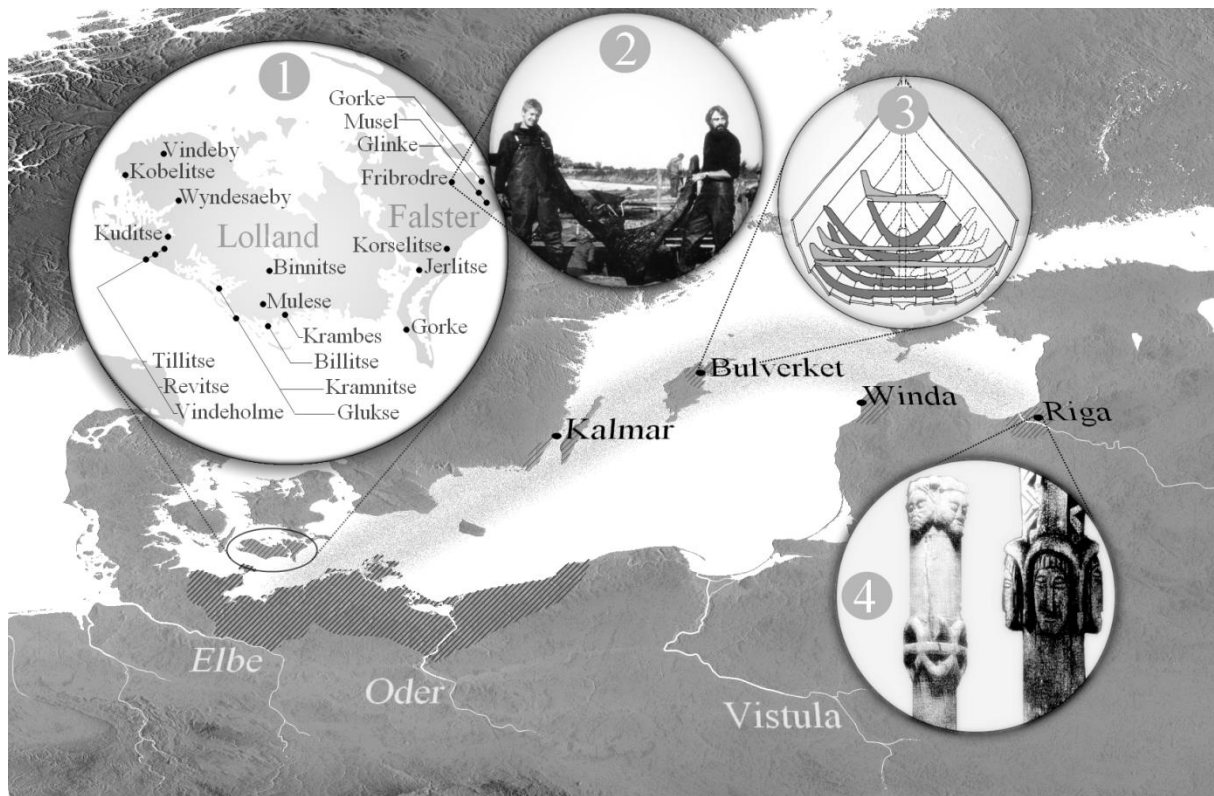


Figure 14. The Wendish Arc as hypothesized on the basis of – as yet – scanty archaeological evidence, written sources and toponyms, with the Wendish heartlands thickly hachured and the Wendish areas of influence lightly shaded. (1) Slavic toponyms in the Danish islands of Lolland and Falster. (2) Rudder frame from Fribrodre where numerous ship-timbers with diagnostic Slavic features were unearthed. After Jan Skamby-Madsen, “Fribrodre. A Shipyard Site from the Late 11th Century,” in *Aspects of Maritime Scandinavia, AD 200–1200. Proceedings of the Nordic Seminar on Maritime Aspects of Archaeology, Roskilde, 13th-15th March 1989*, ed. Ole Crumlin Pedersen (Roskilde, 1991), p. 197, fig. 10. (3) In the vicinity of the timber construction Bulverket in Lake Tingstade – connected to the Baltic Sea – a shipwreck with diagnostic Slavic features was discovered. After Bjorn Varenius, *Bulverket baten – ett gammalt fynd i ny behysning*, Statens Sjøhistoriska Museum Rapport 11 (Stockholm, 1979), cover. (4) Fourheaded Sventevit idols in Riga’s vicinity. After Andris Caune, “Einige Merkmale der Kulturbeziehungen zwischen den Einwohnern des Dunamundungs- und des sudwestlichen Ostseekustengebiets im fruhen Mittelalter,” *Archaeologia Baltica* 2 (1997), pp. 60–61, figs. 1–2.

## Paper B

Zwick 2014: D. Zwick, Conceptual Evolution in Ancient Shipbuilding: An Attempt to Reinvigorate a Shunned Theoretical Framework. In: J. Adams, J. Rönby (eds.), *Interpreting Shipwrecks: Maritime Archaeology Approaches / Southampton Monographs in Archaeology - New Series 4*. Southampton: Highfield Press.



# CONCEPTUAL EVOLUTION IN ANCIENT SHIPBUILDING: AN ATTEMPT TO REINVIGORATE A SHUNNED THEORETICAL FRAMEWORK

It has often been noted that archaeologists are adept at borrowing theory but not very good at building it. This applies particularly to evolutionary theory for conceptual lineages; the appropriated use thereof within archaeology is highly contested – particularly in its nautical branch – despite its metaphorical popularity and widespread use. Rejecting evolutionary allusions to the development of water-craft altogether, Thijs Maarleveld conceded that even those who *do* use such terminology “*will promptly deny the suggestion that ships are liable to produce offspring*”, while emphasizing instead “*human decisions regarding continuity or adaptations*” (Maarleveld 1995:4). At first glance, positions in favour of evolutionary analogies are ridiculed by this *reductio ad absurdum*. Upon closer consideration however, one will have to appreciate the extent to which human behaviour is restricted to tradition – i.e. inheritable practice. While things cannot reproduce, ideas can, and the latter become fossilized in the former. Archaeological typologies are intricately interwoven with the taxonomic method from the natural sciences and thus charged with the underlying evolutionary principle of descent with modification. Some critics have conflated the generalised use of evolutionary theory with biological reductionism by primarily associating it with environmental determinism and adaptationist models. These are considered to adopt a *passive view of human behaviour* in which “*societies react to external stimuli and do not initiate change for any reasons of their own*” (Preucel & Hodder 1996:207). In many cases, such vaunted criticism appears more like a pledge of fealty to modern post-processual currents, rather than a sincere reflection of what evolutionary principles actually encompass. Irrespective of the underlying profound epistemological question of the extent to which human intentionality is a proximate or an ultimate cause for change (cf. Mayr 1961), evolutionary lineages – whether biological or conceptual – are first and foremost a tool for structuring complex, spatiotemporally diverse yet recurring, phenomena, detached from any claim of full knowledge of the underlying mechanisms. The theory has a biological taint because it was first used purely in a biological rather than a conceptual context, for which reason advocates of the theory’s general application have suggested “*to stop using 19th century evolutionary concepts and terms as a basis for the archaeology of the 21st century*” (Clark & Barton 1997:316). In this paper however, the use of this – epistemologically more or less inadequate – terminology is a necessary trade-off, to emphasise the analogies between conceptual and biological evolution in a thought-provoking manner. Given the

complexity of watercraft, there is arguably no better framework through which interpretation and inference could be reconciled with the temporality of the archaeological record. This becomes all the more significant as shipwrecks continue to be encased into “*lignified typologies*”, which – although proven inadequate or outdated – are still being used for convenience or by force of habit. This problem is particularly well manifested in the elusive “*cog-type*”, whose problematic definition shall be evaluated as a case study. This discussion stresses the requirement for a theoretical framework which remains flexible enough to offer interpretative leeway on alternating strands of development, and thereby facilitates a fresh and more objective view on the growing body of differential data from shipwrecks. Or as Charles Darwin noted himself, “*I look at it as absolutely certain that very much in the Origin will be proved rubbish; but I expect and hope that the framework will stand*” (Gould 2002:2). It did stand. Will it also stand in its appropriated conceptual use within nautical archaeology?

## Conceptual evolution: more than a metaphor?

Ironically, Charles Darwin’s hypothesis of natural selection was anticipated by several decades in Patrick Matthew’s treatise ‘*On Naval Timber and Arboriculture*’ (cf. Matthew 1831:364f.), in which the lack of arboricultural practices with regard to timber supply suitable for shipbuilding was primarily stressed (Matthew 1831:106f.). The natural analogy is striking, because shipbuilding was deeply dependent on the availability of suitable compass timber, whose growth was adequately curved and strong. This natural resource dependency affects the selection criteria – quite generally – as “*a cohesive whole with its environment in such a way that this interaction causes replication to be differential*” (Hull 1988:408). Inevitably, this strong dependency will have shaped the concept of universal guiding principles and has therefore quite naturally entered biological metaphors: inspired by the swiftness of fish, the English shipwright Mathew Baker likened the hull shape of the ‘*race-built galleon*’ to the slender shape of a cod’s head and mackerel’s tail (Fig. 5.1). It conveyed not only the concept of a novel ship design, but also the underlying idea of hydrodynamics (Adams 2003:106). Although no treatise on shipbuilding before William Froude could be regarded as incorporating naval architecture in the

scientific sense, the importance of hydrodynamics must have been intuitively perceived and employed; as it turned out, to a noticeable effect: The commander of the Portuguese galleons of the 1588 Spanish Armada reportedly noted that the English racebuilt galleons could tack 4-5 times in the same time as it took his ships to tack just once (Parker 1996:281). While critics of evolutionary allusions reject the notion of an undirected development process, the “invention” of the race-built galleon appears to be more by “differential replication” rather than by intent. It originated from an experimental naval programme initially developing galleasses, which had to have distinctly long slender hulls in order to be capable of manoeuvring under oars (cf. Phillips 1994:102). While the success of the galleass programme was limited, the actual novelty consisted of the crossing of the slender galleass hull with the

full-rig and other characteristics of carracks, thereby forming a sharp contrast to the ‘medieval’ naval tactics of floating fortresses involving grappling and fighting at close quarters, – still prevalent in other parts of Europe –and replacing it with an emphasis on manoeuvrability and long-range artillery. Although Mathew Baker was preeminent among shipwrights in England who began to explore hull design on a conceptual level in the 16<sup>th</sup> century, the correlation between waterline length and hull speed – as later captured by the formula  $V_{\text{hull}} \approx 1.34 \times \sqrt{L_{\text{wl}}}$  (metres) was not known at that time. Thus the advantageous qualities of hull design resulting from a blend of constructional principles occurred more by coincidence than intent – by trial and error – emphasising the undirected nature of differential replication in this particular instance. But can this be also formulated as a more general principle?

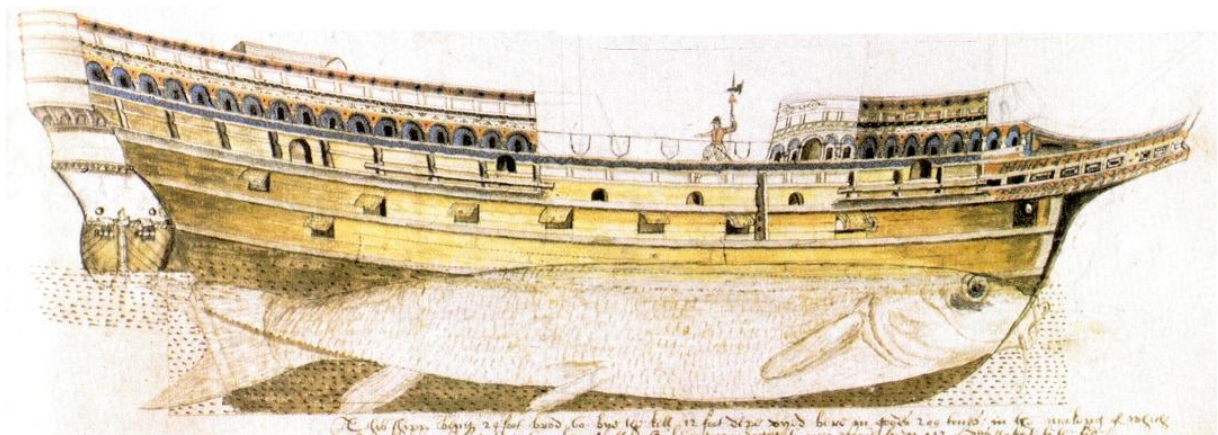


Fig. 5.1. The long and narrow “race-built” hull of an Elizabethan galleon, inspired by the shape of a cod’s head and a mackerel’s tail. From the *Fragments of Ancient English Shipwrightry*, by Mathew Baker and others (1586) (Pepysian Library, Magdalene College, Cambridge).

While this example was laid out as bait for the reader’s imagination to demonstrate that the genuine nature of “inventions” is far from being an uncontested matter, there is another analogous aspect that deserves attention – the linguistics. Naturally familiar with the taxonomical principle, the marine biologist James Hornell coined the way ethnographically studied watercraft were classified and – unsurprisingly – made blatant use of biological terminology by attesting a “genetic relationship” between the bark canoes, dugouts and plank-built boats, for instance (Hornell 1946:181). Similar allusions to striking genetic connotations also became popular whenever hereditary patterns in the development of shipbuilding traditions were implied, using terms like “extended family” (Eldjarn & Godal 1988:68), “archetype” (Crumlin-Pedersen 1965:82; Fliedner 1969), “cross-fertilization” (Hocker 1999:22) or “hybrid type” (Crumlin-Pedersen 2000:240, 2003:266), to name a few. They stress lineages as though they constitute phyletic relationships. This underlying evolutionary principle also marked the debate on whether planked craft originated from an expanded and extended

dugout or a skin-boat with overlapping seams (cf. Crumlin-Pedersen 1970a; Hasslöf 1972:28; Johnstone 1980:115; McGrail 1981:22) (Fig. 5.2). It is taken for granted that such changes are not inventions from scratch, but that new features were gradually incorporated, developed further in small steps from pre-existing designs that were conceptually not vastly distinctive from their predecessors. The late Ole Crumlin-Pedersen (1997:11) aptly observed that “...within a particular “school of boat-building”, a traditionally conditioned regularity is to be found in all vessels, which makes it possible for the ship-archaeologist to sort parts of ships and boats in much the same way as that in which the zoologist sorts a mixed bag of bones so that the “species” and the “family” as well as individual variations in size can be identified”. In fact, the most insightful method of “dissecting” a shipwreck is by cutting it into cross-sections like an odd animal, in order to reveal constructional elements that could be indicative or even diagnostic of a spatiotemporally determinable tradition, like *meginhufns* and *bitis* are for Scandinavian Viking Age vessels. The biological analogy is enforced by the use of organic terms for



certain constructional elements, such as ribs, skeleton and skin. In the widest sense the linguistic atavism is a constructional one: the aforementioned components were the actual building materials of hunter-gatherer craft, like skins in Inuit *umiaks* for instance (Petersen 1986:29ff.). This is not necessarily just an accidental linguistic correlation, but may relate to a principle dubbed ‘heritage constraint’, in which original concepts coin long-lasting ways an element or its function is perceived, even when the original use has been rendered obsolete. Such atavisms indicate the possible origin with regards to a shared ancestral character (cf. O’Brien & Lyman 2009:234); they could also be highlighted by the differential use of technical terms in different regions and dialects, which are indicative of origin (Eldjarn & Godal 1988:24f.). Undoubtedly, hereditary relationships in organisms can be traced in biological lineages. This paper argues that in the case of the ‘evolution of boat- and shipbuilding’ there is also more substance behind the metaphorical veil, in that conceptual lineages are as meaningfully constituted as biological lineages. Obviously, the inheritability of cultural phenomena differs from biological mechanisms, but selection processes within the field of biology itself are also vastly different and only conceivable by drawing analogies (Aldrich et al. 2008:579). Therefore, there is no reason to believe that traditions – as a consequence of social learning and replication – are exempt from this holistic principle. In the following, the three main principles of a Darwinian framework (variation, selection and retention) are translated into nautical archaeological case studies and supported in several cases with new insights from the cognitive sciences.

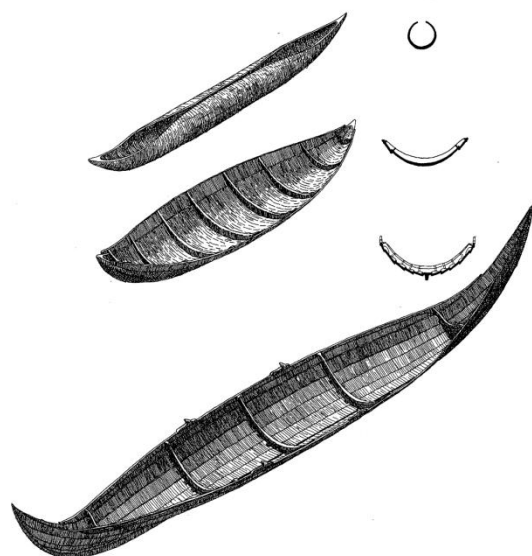


Fig. 5.2. Descent with modification? A smooth conceptual transition from the expanded and extended dugout to the plank-boat: Haapio/esping before and after expansion (above) and the smaller of the Kvalsund boats from ca. 700 (below) (after Crumlin-Pedersen 1970b).

## Variation

The source value of shipwrecks is unparalleled due to the great variation in constructional properties. It was fittingly observed that “in any preindustrial society ... a boat or a ship was the largest and most complex machine produced” (Muckelroy 1978:3). In spite of the unique potential for modular complexity, it often seems that the scientific value of shipwrecks cannot be fully unleashed, as the study of shipwrecks is regarded as too disparate and too technical to be meaningfully integrated into the general field of archaeology; a problem of which maritime archaeologists are well aware (cf. Cederlund 1995:103ff.; Gibbins & Adams 2001:283ff.; Maarleveld 1995:3). Nonetheless, there is a general sentiment that the only way to get intrinsic insights into shipbuilding traditions – and thus indirectly into societal developments – is by recording and comparing mundane constructional details. Apart from the cultural and social background of the shipbuilder, it can reveal something about the availability of timber and other materials, the prestige of the vessel and owner in terms of the quality of the material, workmanship and decorations, its purpose and destined maritime or fluvial environment, the cultural zones the vessel frequented as potentially indicated by repairs carried out in a ‘foreign’ technique or built of imported timber. So the study of the ship-structure could be rewarding in itself, let alone the information gained from contextual information such as accompanying archaeological finds. One potential of the study of shipwrecks clearly lies in the differential constructional features, captured in this section in terms of variation. Due to varied access to resources, skills, rights and – above all – the lack of blueprints, shipwrights could not implement a similar degree of standardisation as is possible in modern times. Even ships built in essentially the same tradition will have different features. Nevertheless, the analytical process of inferring these differences has often been cut short by the malpractice of simply dubbing shipwrecks as ‘types’ known from historical sources, as though such “identification” constitutes the ultimate purpose of a study, as Thijs Maarleveld (1995:5) points out. Apart from the problem that a historical ‘type’ is unlikely to correlate specifically to a type in the constructional sense – as archaeologists would prefer it – there is a temptation to think in terms of a ‘standard type’, representing a state of equilibrium in the development process before it became obsolete with the next innovation. Therefore, shipwrecks featuring a greater modular variety are often seen as imperfect approximations of a standard set of characteristics, particularly those labelled as ‘hybrid types’ in the belief that they are just intermediate or transient forms undergoing a temporary transformational phase. This underlying conceptual problem is deeply embedded within the rationale of evolutionary theory; but without being caused by it, as has been often

unjustly implied. This raises the question of how variation manifests in the maritime archaeological record and what significance the scale of variety has with regard to continuity and change in shipbuilding and contemporary societal circumstances. While the following sub-sections will deal with some observable phenomena of variation in shipwrecks, the anthropogenic and environmental mechanisms causing or limiting variation are expanded upon further in the section on selection and retention.

### **Confluence of influences: greater variation in estuarine regions?**

A recent ethnographic study from India attested an overwhelming variety of boat-types in the estuarine region of the Ganges Delta, which were “*not technically adapted to the polymorphic fluvial environments*” (Palmer & Blue 2009:483). At first glance, this appears counterintuitive to evolutionary theory, but only if taken in its most reductionist sense in applying a latent environmental determinism. However, the selective pressures are different from region to region. Particularly with regard to freshwater environments, it has been observed that archaic details “*stem from a milieu where boats are not absolutely necessary for survival*” (Christensen 2000:167). Therefore, boatbuilding traditions tend to survive much longer further inland, due to the lack of stimuli for change, as Christer Westerdahl similarly observed (1995:213f.). Noting the prevalence of certain types of water-craft in certain riverine regions, and their sometimes surprisingly great distinctions to types from neighbouring river valleys in southeast Norway, Arne Emil Christensen proclaimed “*as a general rule that each valley or lake/river system has, or had its own boat type*” (Christensen 2000:165). Similar observations were made elsewhere, where very pronounced differences between respective river-systems also became manifest in the material culture (cf. Filgueiras 1979:45; 1988:382; Westerdahl 1995:214). Correspondingly, river-systems were regarded as a self-contained zone of transport geography (Westerdahl 1995:214ff.). While river-systems as self-contained transport zones condition a surprising regional regularity in inland water-craft, variations become observable wherever these zones overlap. This is not only the case in delta regions, but also at pivotal points of transshipment. A case study from Denmark has highlighted that mercantile towns tend not to be located directly at an anchorage at the river mouth, but a bit further upstream where the water is just broad enough to be reached by seagoing vessels, and at a point that articulates with road transport (Crumlin-Pedersen 1990:95). Thus, great variation in watercraft could be also anticipated in urban centres of transshipment where seagoing and inland vessel meet, even some 50 km upstream, as in the case of Bremen (cf. Zwick 2012a). In contrast to their seagoing counterparts, inland and other regional vessels would have been exposed to totally different

and generally lower selection pressures, which tend to abet the retention of some ancient modular features. As such the L-shaped chine girder at the turn of the bilge could be described, which is a continuous feature with only modest changes in riverine watercraft spanning over a millennium in the Rhine area (cf. Vlierman 1996:104f.) and at least 650 years in the Weser (Zwick 2012a:287). One might ask whether – as a rule of thumb – less well adapted solutions in boatbuilding would have been considered negligible, possibly weighted in terms of a distinctive expression of identity at the expense of solely functional aspects.

### **‘Hybrid’ types: intermediate forms or variants in their own right?**

As stressed above, the term ‘hybrid’ is used somewhat generically to indicate that a mixture of modular features is believed to stem from different traditions. Such deviations are primarily – somewhat one-sidedly – associated with differential influences on a cultural level. Other aspects which affect variation, such as the social role and purpose of a vessel, have only recently been more explicitly addressed with regard to small vernacular watercraft (cf. Bill 1997). Still, the ‘cultural lens’ seems often to be the guiding principle in evaluating a shipwreck. In the case of the Kronholm wreck from the first half of the 13th century, a gradual amalgamation of shipbuilding between Scandinavians and northern Germans has been asserted with regard to a set of mixed features: the carvel-laid bottom, straight stem and fastening method was attributed to a German influence, while the slenderness of the frames and the use of pine instead of oak for the floor timbers was thought reminiscent of Scandinavian influence (Rönby 1996:70). If seen through a ‘cultural lens’ the interpretation does not seem too far-fetched given that the wreck-site is located in a silted-up former anchorage site in Paviken on Gotland near the provincial capital Visby, with its strong local presence of an influential German mercantile community. However, there are other possible explanations for modular variation in this case. If the find location is taken as indicator for the building location – for which no provenance has yet been ascertained – then one could also argue that the availability of oak in this region was limited or more costly, given that the timberline for oak is further south than for pine. The slender frames might be explained by the fact that pine woods would not have provided as strong and ample compass timber as oak woods. Thus the shortage of a key resource might have affected the appropriation with a more slender framesystem; the tradition was not essentially changed but just adapted to the local circumstances, which would have conditioned some analogous features in two dissimilar conceptual lineages. Through the limitation of a key resource, here oak, this would have effected – if translated into Darwinian terms – an ‘evolutionary convergence’ between two traditions in

a particular environmental ‘niche’. Aside from the importance of distinguishing between homologous and analogous features in similar phenomena, it is worth noting that the underlying mechanisms of such convergence are not caused by environmental factors alone, but also by anthropogenic factors, as will be demonstrated further below with regard to the *Grâce Dieu* case study. Not unlike the Kronholm wreck, the Gedesby wreck is also considered an unusual find which has been dubbed as ‘hybrid construction’ (Crumlin-Pedersen 2003:266). At first glance, it appears to be a vernacular vessel, perhaps a ferry, wide and spaciouly built, to carry cattle as indicated by a layer of dung (Bill 1997:83). It was found in a rural harbour near Gedesby, on the Danish Island of Falster, and was dated by dendrochronology to ca. 1320 (Bill 2003:14). In considering its vernacular purpose, one would not expect to find any innovative constructional details, especially in regard to the present connotation of the word ‘innovation’; implying a technological cutting edge. Thus the excavators were surprised to find novel construction, such as “*stem- and sternbook,.... protruding beams and massive beam knees, the occasional use of moss as luting and the use of sawn planks in the construction, with a broad margin the oldest example of this technique in a clinkerbuilt vessel in Scandinavia*” (Bill 1997:78). The only remaining details considered to be Scandinavian are the T-shaped keel and the entirely clinker-planked hull, yet even the long plank scarfs are still quite distinct from the short Scandinavian ones (Bill 1997:14f.). Also absent were the mouldings which normally decorated the visible edges of planks in Scandinavian watercraft at that time (Bill 1997:66). Were these later changes affected by an external influence, or was this a development within the local tradition, merely inspired by external influences? In fact, are there any unmistakably Scandinavian features left in the Gedesby wreck at all? If not, can it be viewed through a ‘cultural lens’? Again, with no ascertained provenance of the timber, one may only speculate how this vessel ended up in a small rural Danish harbour. Incidentally, a few years before the Gedesby ship was built, the Danish King Eric Menved ordered in 1304 that only cogs should be included in the *leding* - the Danish naval defence system (Lund 1996:282f.). Amongst other things, this was arguably owing to the advantage of raised fighting platforms on these high-sided and large ships. This decision must have marked a great turning point, as Denmark’s *leding* still relied on 1100 longships in the 13th-century (Crumlin-Pedersen 1972:190). Whether these new cogs were of foreign design or adapted Danish versions is not clear. The Gedesby wreck is neither high-sided nor large and certainly not a cog, but its very presence in a Danish harbour could be seen – through the ‘cultural lens’ – as a harbinger of a process through which Denmark gradually opened up to a foreign shipbuilding tradition. Alternatively, the possibility of similar vessels plying Danish waters long before the basic components of this tradition were appropriated for royal service cannot be

excluded. The fact that the earliest wrecks of the elusive “cog-tradition” are to be found in Denmark shows that such “un-Scandinavian” vessels were not an uncommon sight and perhaps even preferred by some Danes. After all, these types were less elaborately built than Scandinavian vessels and would have been cheaper to construct (Dokkedal 1996:62). When even a king could dispense with longships built in the local prestigious tradition, a peasant or ferryman would have probably cared little about sailing a less prestigious ship than his forefathers, especially one that smelled of dung. While it is not entirely clear if – or to what degree – the alleged ‘modular hybridism’ of the Gedesby wreck reflects a transformational phase in shipbuilding, the Kalmar I wreck from the second half of the 13th century is built in an astonishingly similar way (Fig. 5.3). It has a comparable length-to-beam ratio of roughly 2:1, a T-shaped keel, and was fully clinker-planked, in which the planks were connected with iron rivets, the hood-ends of the planks overlapped the sternpost, but were notched into the stempost, and the hull was strengthened by protruding cross-beams (Akerlund, 1951:27ff.). One may even question whether the strong curvature of Kalmar I’s stem – as originally reconstructed by Akerlund – is actually correct or guided by his contemporary bias on how stems of historical vessels should look (cf. Akerlund 1951:62f.). Only the lowermost portion was preserved, from which a more moderately raking stem – similar to the one from the Gedesby wreck – is very feasible. Given the number of shared features, one may wonder whether both wrecks really represent some kind of transient hybrid type, or whether they constitute a class in their own right; a class of vernacular watercraft that is obviously not as prominent a ship-type as a ‘cog’ or ‘longship’ in written sources due to its mundane purpose. One might also question whether innovation was imposed from above and could be only found in state-of-the-art vessels intended for warfare and royal service, or if actually the greatest impetus for innovation and change evolved at a local scale by trial and error. Although it is not possible yet to answer all these questions on the basis of the number of shipwrecks from this period known today, one thing is clear: an explanation aligned to the conventional “lignified typology” in which mixed features are merely interpreted in light of an “*interchange of constructional features between Nordic ships and cogs*” (Crumlin-Pedersen 2000:241) would do no justice to the breadth of variation and would be only employable in the most holistic sense, which would discourage further debate.

### A telling ‘freak’ feature

An interesting case study on variation in a shipbuilding tradition is showcased by the wreck of the *Grâce Dieu* in the Hamble River. Its *raison d’être* was an attempt by King Henry V to build a ship as large as Genoese mercenary carracks in French

service, which were admired by the English during the siege of Harfleur of 1415; in 1436 retrospectively described as “*orrible, grete and stoute*” (Warner 1926:51). They had a deadweight capacity of between 400 and 600 tons, whilst few contemporary English ships exceeded 300 tons (Friel 1994:85). These carracks were fitted with a mizzen mast, which must have been a striking feature at a time when only single-masted vessels plied the waters of northern Europe. The term *mesan maste* (mizzen mast) was not in use before 1420 (Friel 1994:80; Hutchinson 1994:44). With the capture of two of those carracks in 1410 and Henry’s plans to build up a navy of such ‘great ships’ one would have imagined that a technology transfer would have been straightforward, in that the carracks’ construction just needed to be replicated. Interestingly, this was not the case. Built in 1418, *Grâce Dieu* had great dimensions and was multi-masted, thus having an analogous outer appearance to the Genoese carracks, but the English appropriations happened within the boundaries of

their own shipbuilding tradition, i.e. of the shell-first clinker technique. What Seán McGrail (2001:244) has termed the “*final phase of the Nordic tradition*” is the visual manifestation of the clinker-technique reaching its limitation; an evolutionary *cul-de-sac*, so to speak. This is reflected by the triple-planking (Fig. 5.4-2), a unique ‘freak’ feature which was the English adaptation necessary to build such large ships within the limitation of shell first construction. In evolutionary terms, this could be described as ‘evolutionary convergence’, in which two unrelated conceptual lineages (two distinctive shipbuilding traditions) started to display analogous features (in terms of size and rigging of the vessel) due to extra-somatic pressures (competition amongst conspecifics). Thus, the inspiration from another type caused new variation in the form of analogous appropriation, but within the boundaries of their own tradition, rather than by a true adaptation of an aspect of a “foreign” homological conceptual lineage.

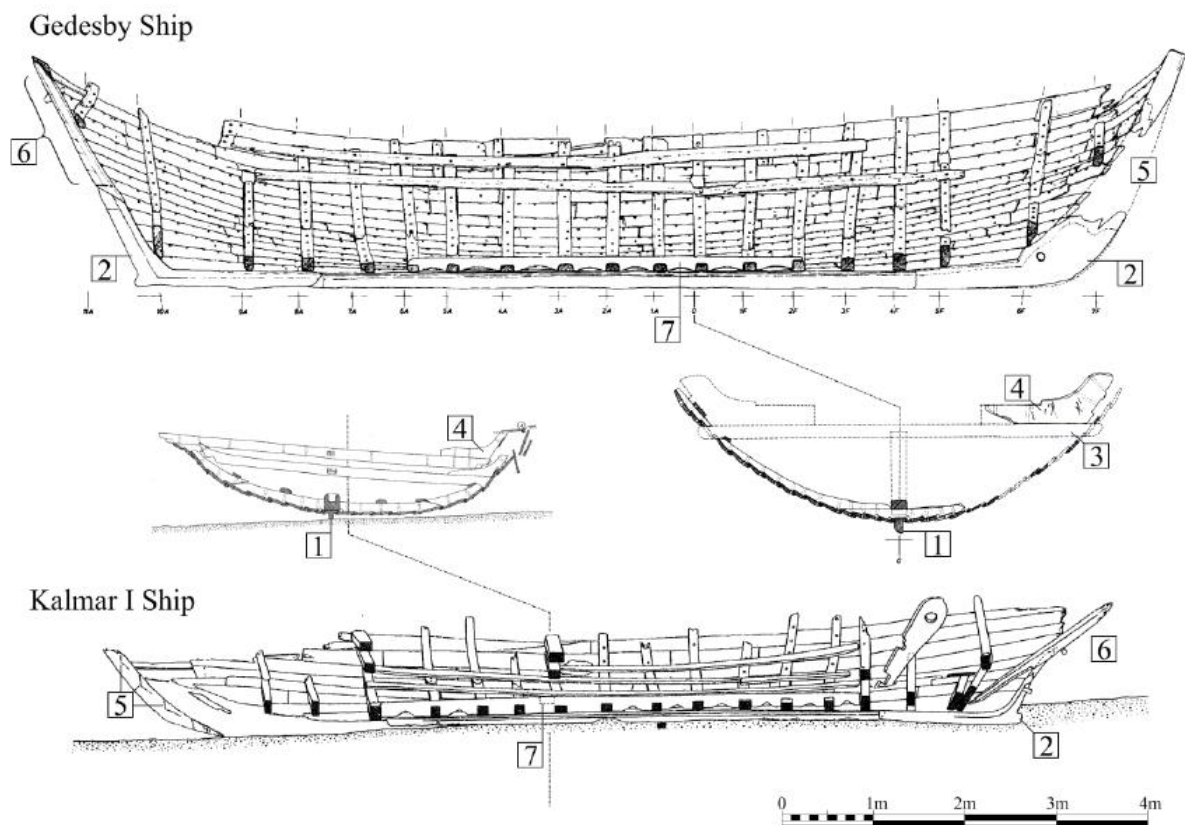


Fig. 5.3. Hybrid-type or a class of vernacular craft in its own right? Comparative constructional analysis of the Kalmar I wreck and the Gedesby wreck, displayed here in opposite orientations: 1) T-shaped keel, 2) stem- and sternbook, 3) protruding beam (not visible on this cross-section of Kalmar I but detected by the excavator), 4) massive beam knee, 5) hood-ends notched into stempost, 6) hood-ends overlapping stern-post, 7) mast-stem integrated in keelson (after Bill 1997, fig. 36.1 and Åkerlund 1951, pl. 5c, 6e, modified by the author).

## Selection

It is remarkable that *Grâce Dieu* retained entirely the “DNA” of the Nordic clinker shipbuilding tradition, since no apparent effort was undertaken to copy the carracks’ construction on a conceptual level. This notion is very important in light of the central critique that evolutionary theory would act upon the presumption that variation is a random rather than a deliberate selection process of the shipbuilder (cf. Hocker 2004a:8; Maarleveld 1995:4). Admittedly, the choice of using triple-clinker is a conscious act, but the necessity of adopting this particular solution for building larger vessels in the shell-first technique was accidental, as ‘selection’ would have had no direct influence on the formation of new traits and the successfulness of its outcome. Selection in the Darwinian sense implies an undirected rather than deterministic process (cf. Cullen 2000:102; Rindos 1985:65). Therefore evolutionists would readily agree that variation is by no means random, but undirected, which is particularly well manifested in the outcome of the triple-clinker solution.

### **‘Maladaptive traits’ as indicators of a biased transmission?**

Whether *Grâce Dieu* was considered a successful ship by contemporaries will probably never be known. The fact that she made only one voyage on which a near mutiny occurred and was then permanently moored near Bursledon in River Hamble for subsequent use as representational ship could be possibly ascribed to her unseaworthiness, but also to the ending of the war with France which removed the need to keep large warships in active service (cf. Carpenter Turner 1954:68; Friel 1993:10; Rose 1977:5). In any case, the great waste of resources – in particular of iron needed for the massive bolts to hold five layers of planking together and the fact that the triple-planking method was not applied in later constructions, indicates that this method did not stand the test of time. In the meantime problems also emerged with attempts to maintain the captured Genoese carracks when the keeper of the king’s carracks begged in a petition for permission to hire “*carpenters and caulkers of foreign country[s]...for in this country we shall find few people who know how to renew and amend the same carracks*” (Friel 1995:173f.). In fact, the conceptual gap between craft built in the shell-first and skeleton-first methods can be perceived to be as large as the gap between vertebrates and crustaceans, as it incorporates an entirely distinctive concept of how shape and stability is given to the vessel, which affects the work processes and sequences accordingly.

As such, the maladaptive appropriation leading to the triple-clinker solution is a prime example for what cognitive scientists have termed *transmission bias*. In inaccurate replications such as this, “*We assume that*

*cognitive processes generate strong attractors, but that inferences, based on the available public representations, are highly inaccurate. We use discrete-representations to show that, even when transmission fidelity is very low, cultural transmission can still create cultural inertia and adaptive cultural evolution*” (Henrich & Boyd 2002:97). Translated into plain English, the ‘attractors’ would be the size and general appearance of the Genoese carracks, which were deemed worth replicating, but no inference could be made due to the lack of ‘public representations’, i.e. the lack of instances in which Genoese shipbuilders practised their craft in front of the eyes of English shipbuilders that would have provided a chance to emulate their techniques and methods through social learning. Consequently, the transmission fidelity is very low due to the lack of visual examples, while at the same time there is no doubt of an inertia which spawned some analogous features. This phenomenon has been described as *prestige-biased transmission* or *cues of success*; an indirectly influenced transmission of observable phenomena deemed to be advantageous but difficult to replicate (Henrich & McElrath 2007:559). This kind of cultural transmission is a very noisy process which leads to high inaccuracy, primarily because representations are not really replicated but rather reconstructed. The evidence suggests that the process of adoption of the carvel-technique in northern Europe was long-winded. In the case of another English ship built 1419 in Bayonne, documentary evidence suggests that although the hull was clinker-built, the skeleton-first concept of how tailframes were used permeated the building sequence, arguably breaking the strict shell-first into an alternating building sequence (cf. Loewen 1997:328ff.). This raises the question of whether high fidelity replication of certain modular features occurred on the basis of a successful inference or whether they were actually mediated by persons acquainted with the ‘foreign’ method. In any case, the free choice of construction technique would have been very much constrained by the *conformist bias* of the local shipbuilding tradition, the *transmission bias* of details inferred from other traditions and, last but not least, the dependence on individuals well-versed in ‘foreign’ concepts. As we shall see in the next section, even with the influx of foreign shipwrights and the due appreciation of their knowledge and skill, transmission remained a tenacious process, although it undoubtedly led to fresh and sustainable impulses in shipbuilding. Given the fact that shipwrights were at that time illiterate practitioners and that the free flow of ideas was consequently restricted to the aforementioned parameters, it can be concluded that Thijs Maarleveld’s (1995:4) emphasis on “*human decisions regarding continuity or adaptations*” implies an unrealistic level of consciousness and choice than can be advocated in this paper.

**Analogous change: ‘evolutionary convergence’ during the carvel revolution**

A century after the *Grâce Dieu*, carvel planking had become a more common feature in northern European waters, but even then it often remained an analogous rather than a homologous feature.

In the Noorderkwartier – the northern Netherlands – an aspect of the bottom-based method prevalent in the Hanseatic sphere was retained, i.e. bottom planks were laid out first, held together temporarily by cleats until floor-timbers were inserted later (cf. Maarleveld 1994:155ff). Dutch shipwrights were more prone to implement the carvel technique quicker than elsewhere, because they would have been partially familiar with flush-laid planks due to the predominant locally employed bottom-based tradition, in which the

bottom planking was flush-laid too (cf. Bill & Hocker 2004; Bill 2009: 259; Hocker 2004b, Maarleveld 1992:169, Maarleveld 1994:155ff). Nevertheless, it was not a complete transition to the skeleton-first technique, as it mainly encompassed an entirely carvel-planked hull, leading to the aforementioned “cross-fertilization” known as *Dutch flush* (Fig. 5.4-6). With the increase of ship sizes, Dutch shipbuilders circumspectly doubled the carvel-planking, thus going to great lengths to retain the inherent shell-first character in a carvel planked hull. This way of construction became known as *double-Dutch* (cf. Lemée 2006:233ff.; Maanders 2003:320; Maarleveld 1994) but did not last long however, as it was proven to be redundant for its imagined purpose (Thijs Maarleveld, pers. comm.). Thus the innovative *double-Dutch* solution was a maladaptive feature, but in a fairly neutral sense in that it was simply superfluous rather than fatal.

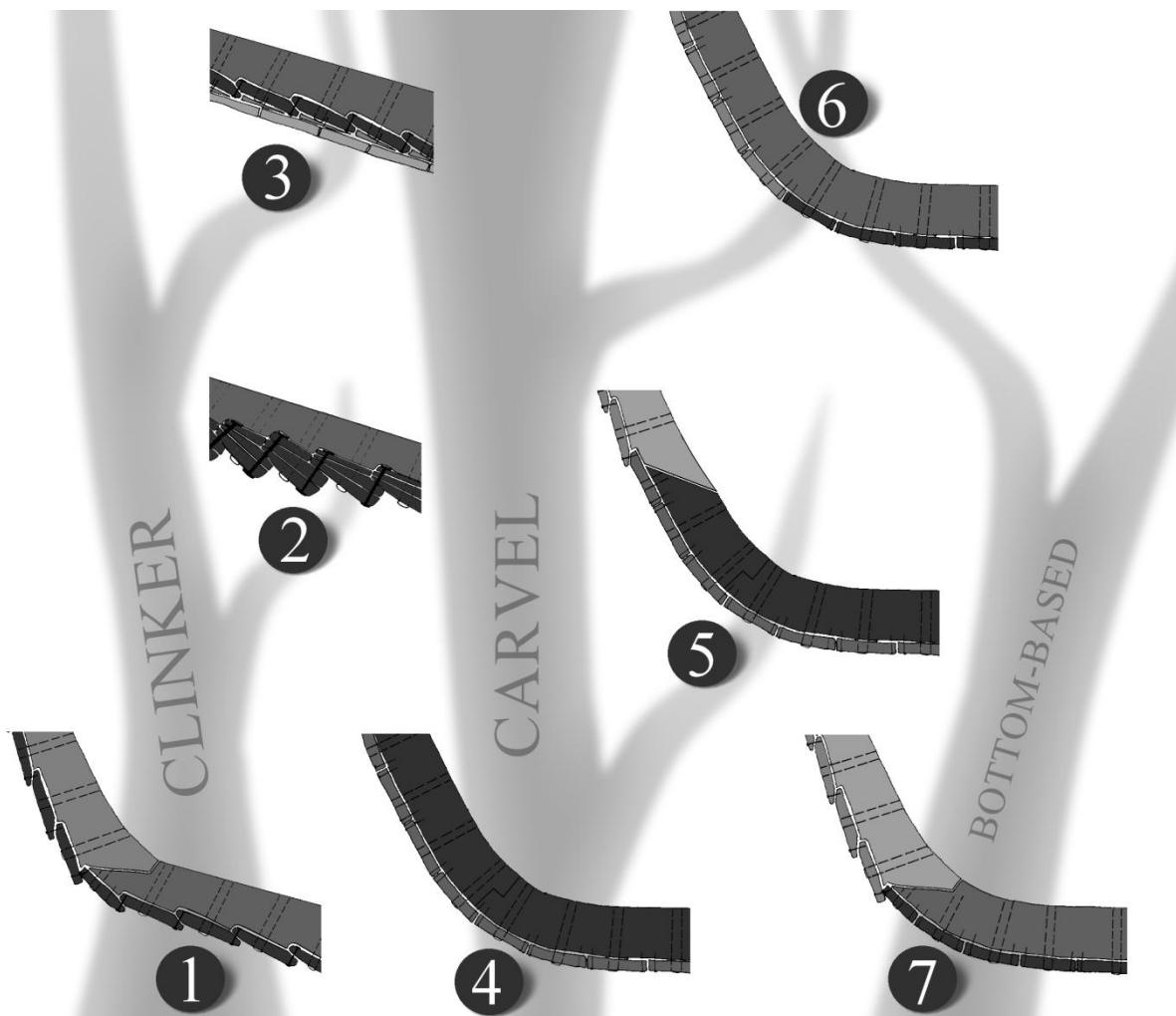


Fig. 5.4. Simplified model in which conceptual lineages of shipbuilding traditions are represented as a phyletic tree. The tripleclinker method (2) as hitherto unique in the *Grâce Dieu* stems from a clinker tradition (1), but prompted by the aspiration to reach a ship-size analogous to carvel-built carracks (4). Later analogies also include converted clinker constructions amended with a second layer of flush-laid planking (3), carvel-clinker hybrids (5) or a “cross-fertilization” between carvel (4) and bottom-based technology (7), leading to the (6) Dutch-flush method. The building sequence is indicated by the darkness of a shaded area, i.e. the darker the earlier (the author).

Cognitive psychologists who study creativity in evolutionary terms would probably refer to the *double-Dutch* solution as a ‘perceptual set’, which describes a phenomenon in which a subject with a history of solving problems in a particular way or tradition “*will continue to apply this strategy even when a simpler method would succeed*” (Morgan et al. 1992:130). The fact that in the southern region of Maaskant, which had belonged to the Spanish Netherlands since the mid 16th century, a moulding system existed that adhered exactly to the Iberian method (Probst 1994:143), suggests that the political circumstances were a decisive factor in which techniques would amalgamate at a local level, abetted by the mobility of foreign shipwrights. While in these cases the clinker planking was replaced by carvel, there is an increasing number of finds in which an additional layer of carvel planking was fastened on top of the clinker-built shell (Fig. 5.4- 3). The frequency and chronological range of such finds suggests that it was not merely a transient ‘freak feature’ within a gradual development process towards carvel, but probably a more established standard. These ships belonged only by outer appearance – i.e. by analogy – to the new generation of carvel-built ships, whilst inherently still embedded in the old Nordic tradition of shell-first clinker construction. There is not enough data yet to identify a clear pattern whether the second flushlaid planking shell was added during later rebuilding (cf. Auer 2009; Gotheche 1991; Hasslöff 1972; Ossowski 2006; Probst 1994), but it was claimed at least in one case that this two-layer system was incorporated from the very start before launching (cf. Mäss 1994). Apart from protecting a worn out hull or strengthening it against ice pressures, which might explain why this type of construction occurs only in the Baltic Sea, the analogous carvel planking could be also explained in terms of a *prestige-biased transmission* (cf. Henrich & Gil-White 2001). This is highlighted by so-called ‘half-carvels’ from the 16th century onwards, which are clinker-built below the water-line, but carvel-planked above the water-line – i.e. at the visible portion of the hull, where fashionable analogous features mattered. These vessels are essentially still built in the old clinker method, which was then associated with vernacular craft of peasants, so it is essentially a make-believe construction to increase the owner’s prestige (Eriksson 2010:78f.).

### **Environmental determinism: a reductionist implication?**

As demonstrated above, the genesis of watercraft is by no means determined by environmental factors alone. In fact, it is determined to a great extent by cultural contact in general and *prestige-biased transmission* in particular. However, it would be short-sighted to take practical necessity out of the equation of adapting watercraft to the respective environment. Although some like to stress that it is – in theory – possible to cross an ocean with a raft, such aberrant

behaviour would have had – as a common practice – wider implications for the successfulness of the parent society. Universally-shared constructional solutions in discrete shipbuilding traditions can be observed in comparable environmental conditions, particularly with regard to differential requirements in sea-going and inland craft (cf. Hornell 1920:69; Greenhill & Mannering 1997; Steffy 1994). Although great diversity is to be found in beaching craft in all parts of the world, fishermen independently adopted similar solutions in order to cross the surf, i.e. flat bottoms and high-ended prows (Palmer, forthcoming). Apart from the maritime environment itself, terrestrial parameters come into play with regard to the availability of resources, which affect analogies in discrete conceptual lineages. It has been observed, for instance, that the large paddled craft of the Maori in New Zealand, the Haida on the northwest coast of America and – as an anachronistic analogy – the depictions of Aegean Cycladic ships all looked very similar. While there was undoubtedly no cultural contact whatsoever between the three, the occurrence of giant trees was seen as the determining factor for the peculiar construction and appearance (Guttandin, forthcoming). Adaptability to environmental conditions should not be perceived as a gradual subconscious process of ‘natural selection’ through trial and error. On the contrary, the suitability of different classes of watercraft in their respective environments was even formally recognized. This is reflected in a 13th century Danish itinerary, describing a route along the Swedish and Finnish coast to Estonia. The route was split into an inner and outer route in the Stockholm archipelago, in which only the inner route continued to be measured in *ukeasio* units. The etymological origin of this unit strongly suggests that it was not a distance measure *per se*, but related to the shifting of rowers, thus only relevant to vessels propelled under oars. Apart from this indication, the winding inner archipelago and the likely presence of portages on the inner route (cf. Zwick 2012b:109f.) all indicate that those recording the itinerary were well aware of the necessity of using a distinctive class of water-craft for the inner route; moderately sized vessels, small enough for traversing portages and suited to navigating in these narrow waters under oars and sails, perhaps similar to the Helgeandsholmen V wreck from around 1300 (cf. Varenius 1989, 38ff.). Half a millennium later, in the ‘Age of Sail’, the galley appears somewhat outdated, but the implied anachronism is unjust. When the Russo-Swedish struggle for maritime supremacy reached its peak, Fredrik Henrik Chapman was ordered to develop hull designs for a new archipelago fleet – *skärgårdsflottan* – where a class of hybrids propelled under oars and sails was “re-invented” in order to safeguard the waters of the Swedish and Finnish archipelago. Significantly, this fleet was most of the time under the command of the army rather than the navy, as an amphibious arm of a primarily terrestrial strategy to exert rule on the dispersed islands (cf. Norman 2000).

Thus, the environmental factor is mirrored in the differential participation of sections of the parent society, which determines a distinctive premise under which a particular shipbuilding practise can flourish. This diachronic perspective demonstrates that environmentally conditioned regularity, manifested in analogous technical solutions, can be found irrespective of the conceptual basis of a shipbuilding tradition or the period. Similar types of environments and resources encourage similar solutions to meet natural requirements, comparable perhaps to an ecological niche which affects evolutionary convergence amongst different species.

### Shipwreck as the ultimate selection process?

Although a majority of watercraft that survive in the archaeological record were scrapped, reused or intentionally deposited, the popular image of shipwrecks is associated with the foundering of a vessel. This is a recurrent allegory for the struggle for survival, touching on the primal evolutionary impulse most famously captured in Lucretius' words: "*Pleasant it is, when over a great sea the winds trouble the waters, to gaze from shore upon another's tribulation: not because any man's troubles are a delectable joy, but because to perceive from what ills you are free yourself is pleasant*" (Lucretius, *De Rerum Natura*, Book II, line 1, transl. Leonard 1943). This excerpt describes the dark fascination of a spectator witnessing a distress at sea, who gains his relative fortune in the knowledge to be eluded from the maelstrom of atoms of the treacherous and hostile maritime element (cf. Blumenberg 1997:31ff.). This recurrent maritime allegory must have captured the minds of many generations and might be seen as the ultimate selection process and, indeed, punishment for failing to live up to the challenge of conquering the sea. How does the failure to meet this challenge reflect on the parent society? And is the database of shipwrecks consequentially biased towards failures, "in that it inevitably accounts for bad designs, for poorly maintained, old and rotten vessels, or for aberrant behaviour"? This question, posed as 'Devil's advocate' by Adams (2003:19) is twofold, in that – firstly – the possibility is addressed that failures could be overrepresented in the archaeological record. Its implication would be that constructional properties observed in shipwrecks should not be seen as typical examples of a shipbuilding tradition. And secondly, it raises the question whether the wrecks of communities and cultures which encourage aberrant behaviour in maintaining and crewing their ships are overrepresented too. The latter issue touches upon the cultural transmission of maladaptive social norms, which has been addressed by proponents of the Dual Inheritance Theory, which stresses culture-gene, coevolutionary tendencies. This theory emphasises that the success of a population (and thus their genetic legacy) depends on whether their culture abets adaptive or maladaptive behaviour (cf. Henrich

& McElreath 2007:567ff.). Admittedly, this framework sounds very academic and its real life impact is questionable, but with respect to the example of the Spanish Armada it is very thought-provoking: aside from the constructional favourability of the English 'race-built' galleons, the chances of success of the Spaniards were also decreased considerably by a societal malpractice of rating social rank higher than nautical experience: the 'landlubber' Duke of Medina Sidonia was appointed admiral of the Spanish Armada, which indeed appears to have been – amongst other aspects – a determining ingredient for its defeat and the gradual decline of Habsburg supremacy. While conceding that some shipwrecks may have occurred because of an erroneous construction, the vast majority occurred due to a combination of forces, which included human error. (Adams 2001:294). This is illustrated vividly in Adam Olearius's travelogue from 1635, describing a dreadful tempest, which "*...continu'd all night, during which, we discover'd, that our Mariners were as raw as the Ship was new ...*" and a master's mate with a false sense of security, who exclaimed "*there was no danger, since we had Sea-room enough*", until the ship eventually hit a rock, causing the crew to panic and pray, the master to weep, and the eventual loss of the vessel off the island of Öland (Olearius *et al.* 1662:34). A scenario in which societal norms had an aberrant effect is often drawn in the case of the Swedish warship *Vasa*, which capsized on her maiden voyage in 1628. According to a popular myth this is a direct consequence of subsequent alterations of specifications at the highhanded behest of the king, which deviated from the shipwright's original design. While this particular point has been refuted (Cederlund & Hocker 2006:44f.) the Admiral Klas Fleming was apparently not granted enough authority to object to the commissioning of an unseaworthy ship. One month before the ship sailed he conducted stability tests but when heeled over the ship showed such a weak righting moment he had to abort, so he must have been well aware of the imminent danger. Nonetheless he was pressurized by the king's express request to send the ship to sea in support of his war with Poland (Cederlund & Hocker 2006:53). Although this could be merely attributed to a lack of character on the admiral's part, it could nevertheless be argued that insubordination to an absolutist ruler – even if well-founded – might have brought about dire consequences for the admiral and thus prompted aberrant behaviour out of fear to fail the king, with disastrous effect. A similar case has been made with regard to the *Mary Rose*, which was deemed not worthwhile studying because of her technological failures (cf. Mudie 1996). Admittedly, the latter remark was made by a naval architect commissioned with the reconstruction of John Cabot's ship *Matthew*, who searched for a "default blueprint" of a contemporary successful ship. For the study of the dynamics of change and innovation in past human societies, however, *Mary Rose* is a prime case study; not in spite of, but *because* of her constructional error



– just like *Vasa*. While the hull itself was not badly designed and had completed numerous successful voyages since her launch in 1511, the rebuilding measures of 1536 to accommodate heavier artillery decreased stability considerably, which was the main reason why she capsized. A dendrological study confirmed that it was specifically the structure to support a gun-deck – i.e. riders, diagonal and vertical braces, heavy transom knees and deck beams – that was added around that date (Dobbs & Bridge 2000:258). So the transmission mechanism was, firstly, of modular nature from the evolutionary perspective in analytically discrete variants (cf. O'Brien & Lyman 2009:229), and secondly of undirected – hence indeterminate – nature, because the rebuilding measures were not designed by the original builders, as Adams (2001:294) points out. Here the error was fossilized in the wreck, exposing the lack of knowledge about how the centre of gravity would be affected by additional heavy guns placed along a flush deck, itself of considerable mass. It was therefore not a determinist process – which would have effected an adequate adaptation – but in fact a selective process of undirected nature. The catalyst that affected a precipitous adoption of a novel ballistic strategy was a societal one; the competition with France for maritime supremacy. Although modular change was of course affected by a number of intentional acts, it was effectively an undirected transformation process in its outcome. Thus trial and error are indicative of change, as it reflects experimentation with innovative forms. As a natural consequence, errors in particular tend to survive archaeologically in shipwrecks that sank as whole assemblages – a time capsule – whose fate it was to escape scrapping or intentional grounding. In retrospect, the assumption that the database is somewhat biased towards failure does not undermine the archaeological potential of those wrecks, but rather increases it, since they are likely to contain innovations that have not been excessively tested and thus might indicate a transformational phase in ship construction.

### **'Intelligent design' or not: 'memes' as units for cognitive selection?**

It would be beyond the scope of this paper to make an in-depth assessment of the findings of the neurological, psychological or social sciences on the exact nature of human decision-making. Although one is naturally inclined to regard one's own actions to be wholly conscious and one's own thoughts to be genuinely original, human cognitive behaviour is to a large extent conditioned by subliminal factors resulting from imitative social learning, which shape dialects, gestures, skills, behaviour, ethics and even opinions. Nonetheless, the question of the finer-grained processes for the transmission of knowledge and skills is central for understanding the significance of continuity and change within shipbuilding

traditions. Therefore, some basic issues of this intricate question shall be briefly explored. A pattern of inheritability in anthropogenic products has long been recognized. The Swedish antiquarian Oscar Montelius rhetorically asked whether human latitude is really so constricted that no discrete form could be created and concluded: *"Before examining the circumstances one feels inveigled to answer suchlike questions with "no". Since the strange history of human manufacture has been studied closer, one will find that the answer has to be "yes". Development can occur slow or fast, while new forms are always bound to the same laws of development, which also apply for nature"* (Montelius 1903:20). Indeed, in view of the overwhelming evidence for material culture in which some cultural 'phenotypes' lasted throughout the centuries, it has been hypothesised that there must be a unit through which cultural inheritance is replicated. As recently stressed by certain social scientists, *"the existence of social replicators cannot be denied simply because DNAlike mechanisms are absent"* (Aldrich et al. 2008:586). Despite such a replicating unit being neither visible nor measurable, Richard Dawkins famously promoted the 'meme' as the replicator of units of cultural inheritance, in equivalence to the gene as archetypal replicator (Dawkins 1976). The extra-somatic consequence of a meme, which becomes manifest in behavioural patterns among others, has been duly addressed with the notion that a *"meme is the least unit of sociocultural information relative to a selection process that has favourable or unfavourable selection bias that exceeds its endogenous tendency to change"* (Wilkins 1998:8). This is a very important point, because it highlights that the size of the unit is not fixed but can vary, depending on the context, while the fidelity – i.e. the degree to which an object is replicated – is conditioned by the selection bias, which basically is the context. This striking ambivalence, which makes 'memes' even less tangible, has sparked some criticism and prompted some to abandon the meme-theory altogether. It was stressed that cultural transmission processes are – unlike genetic systems – usually incomplete and imperfect, in which high fidelity replication is the exception rather than the rule. Moreover *"cultural representations are rarely discrete units, suggesting that the idea of a 'replicator' (or meme) makes little sense for most types of cultural representations"*, giving rise to the idea of *mutation-like* processes being more relevant than *selection-like* processes (Henrich & Boyd 2002:88, see also Henrich & McElreath 2003:131). Although the essence appears to be correct, there does not necessarily appear to be a contradiction to meme-theory, for Dawkins principally agreed that cultural copying processes are less precise than genetic ones, and also conceded that they contain a mutational element (Dawkins 1999:112). Besides, genes are not discrete units either, because *"selection at any one locus is not independent of selection at other loci"* Dawkins (1999:111) continues, *"Once a lineage begins evolving in a particular direction, many loci will fall into step, and the resulting positive feedbacks will tend to propel the lineage in the same direction, in spite of pressures from the outside world. An important aspect of the environment which*

*selects between alleles*<sup>187</sup> at any one locus will be the genes that already dominate the gene-pool at other loci.” Also, in a cultural context, there seem to be alleles in terms of a predisposition to adopt certain new concepts if the locus is dominated by a set of similar memes. Dutch shipbuilders were therefore arguably more prone to adopt carvel technology than practitioners of the Nordic clinker tradition, because they were already familiar with a “meme” of carvel technology, i.e. flush-laid bottom planking, as a prevalent feature in the local bottom-based tradition (for definition see Hocker 2004b). Therefore, they had a common denominator with the carvel technology, although it also encompassed the “alien” meme of skeleton-first construction. Despite the Dutch being arguably more open to this technology due to similarities within their own conceptual inheritance in naval architecture, the transmission of carvel technology still remained biased, leading to a low fidelity replication in the initial stage of construction: The bottom planking was held together by temporary cleats and thus retained an aspect of shell-first technology, leading to the “Dutch-flush” method (Fig. 5.4-6), which has been so aptly framed as “crossfertilization” by Fred Hocker (1999:22). However, how could the causality of this conceptual deviation – which spawns new variation – be envisioned? With regards to the proposed ‘mutationlike’ process, the aforementioned ‘freak feature’ of the triple-clinker solution comes to mind. Would it really be apt to refer to it in analogy as ‘mutation-like’? This is highly questionable, even if one is willing to accept the Darwinian premise that mutations are – although seemingly random – always according to laws, without displaying any specific tendency towards adaptive qualities. The underlying idea that innovations are merely random would appear – very understandably – alienating to many at first glance, but maybe less so when the units are broken down to trial and error on a cognitive micro-scale, which could be perhaps quintessentially perceived as “Lamarckian causal arrows leading from phenotype to replicator” (Dawkins 1999:112; see also Cullen 2000:32ff.). Nevertheless, the main reason why the analogy to a mutation-like process appears to be controversial is because ‘freak features’ seem to occur predominantly during transitional phases; as side products of a noisy replication process, conditioned by the cognitive filter of the transmission bias. Although – in contrast to Darwinian gradualism – extrinsic factors are thought to have an influence on the frequency with which new variants are spawned by mutations, a notion promoted by the theory of punctuated equilibrium (cf. Gould 2002:870ff.), it remains questionable whether it would be apt to speak of mutation-like

<sup>187</sup> As defined by Dawkins: “Each gene is able to occupy only a particular region of chromosome, its locus. At any given locus there may exist, in the population, alternative forms of the gene. These alternatives are called alleles of one another” (Dawkins 1999:283).

processes in cultural analogies. Until this issue is solved, it is perhaps better to speak more neutrally in terms of an “undirected process”, in order to highlight the non-deterministic outcome of cultural transmission (cf. Cullen 2000:102; Rindos 1985:65). Ironically, in the same year that Richard Dawkins aimed to deconstruct the replicating mechanisms behind phenomena of cultural inheritance, Wendell Oswalt published a paper where he similarly made an attempt at deconstruction; however, not of the causality of replication mechanisms, but of their visible outcomes. He divided the modular structure of hunting gear into *techno-units* in order to make a cost-benefit assessment. Highly complex gear, for example, is not necessarily seen as the expression of a more advanced concept, but may just as well reflect the scarcity of a key resource; necessitating an alternative solution with a higher investment in *techno-units* to achieve the same goal (cf. Oswalt 1976). It has been suggested that we speak of a ‘cultural selection pressure’, in which the device which fulfils its purpose best with the lowest investment in materials continues to be used, whereas other devices “die out” (Kunst 1982:13). This may tend to be true, but has to be regarded nevertheless as gross simplification, rooted in the misapprehension of a ‘cultural selection’ being a genuinely conscious process; “selection” used in the vernacular sense of the word implying free choice. As has been previously pointed out, replication processes are distorted by a transmission bias and yield a differential outcome and rarely lead directly to the wholesale adoption of the favoured design with the lowest investment of material and work – quite the contrary, as has been exemplified by the cumbersome adaptation of the carvel technology in northern Europe.

## Retention

Evolutionary theory is often reduced to being merely a gradual and progressive framework, in that – allegedly – the struggle for survival imposes a permanent competitive situation, through which maladaptive traits are sieved out. This reductionist application of evolutionary theory for explaining technological change in shipbuilding has been rightly scrutinized; amongst others this critique is reflected in the sentiment that “in nautical archaeology the idea of an unfailling evolution from raft to ocean-liner has not stopped since Hornell” (Maarleveld 1995:4), or that attempts to rationalise the linear evolutionary development of watercraft “have created a series of problems that apparently defy explanation” in that the social, economic, political and religious preconditions comprising the context within which change was generated were ignored (Adams 2001:307). Even Ole Crumlin-Pedersen, who frequently used evolutionary concepts, noted that “today, the focus of interest has moved from evolutionbased typologies to the study of ancient boats in their societal context” (Crumlin-Pedersen 2004:42) as though evolutionary

development occurs detached from societal influences. These views reflect the notion that the “irrational” factor of culture and society is *not* seen as an inherent part of evolutionary processes. As demonstrated above however, evolutionary theory neither implies a permanent competitive situation, nor is it streamlined to the best possible designs. On the contrary, evolutionary theory provides explanations for some striking retention in modular features at the expense of adaptability.

### Social learning, apprenticeship and ‘conformist bias’

Gunnar Eldjarn and Jon Godal made it very clear in their famous ethnographic study on Norse vernacular watercraft, in which they opposed the ritualised way of doing things in historical times to our contemporary popular culture, which has cultivated individualism in spawning a mind-set of feeling free of norms and rules; a gap that is filled by the slavish following of fashion to attain identity by conformity. This present-day bias might have given rise to the strong emphasis on individual agency in the post-processualist agenda. In former times, however, boatbuilding was essentially a ritual, in which deviation from the norm was despised and boat-types were defined to such a degree that a local identity was evident through a common form and its associated work processes: “*Båt-typene var svært så veldefinerte. Identiteten var tydelig gjennom lokal, felles form. Dette galdt også sjølve arbeidsprosessen; måten ein gjorde ting på.*” (Eldjarn & Godal 1988:32). But what exactly causes this strong conservatism which discourages change or even downright suffocates deviation? The answer might lie in a new swathe of cognitive science, which has rediscovered evolutionary models and translated them into conceptual terms. In this context the notions of neo-Darwinian cultural evolutionists with regard to conservative traits in selection is noteworthy; referring to concepts like the *conformist bias* as a form of imitative social learning (Richerson & Boyd 2005:162), to *path dependency* in which antecedent conditions define and delimit agency (Spencer 1997), or *heritage constraint* as the habitual cultural phenotype (Cullen 2000:100ff.). All of these concepts describe more or less the same phenomena, which tend to preserve a tradition. These subliminal forces became manifest in ethnographic studies, in that “*boats are a central part of the identities of the peoples who use them and they are artefacts that are deeply embedded in the history and culture of the societies. Quite simply, the local shape constitutes a ‘proper boat’ in the eyes of the local people*” (Palmer & Blue 2009:484). When ethnographers asked Indian boatbuilders why they constructed their boats the way they did, the only answer they could give was “*tradition*” (Blue 1997:341), or more specifically, “*because that is what we do around here*”, “*because we always do it that way*” or “*because that is how my father taught me to do it*” (Palmer, forthcoming). This shows that the possibility of selection from a

range of alternatives is not even considered. Here, the notion of the underlying principle is important; that no selection in the evolutionary sense has taken place in merely reproducing a homologous feature and thus, continuing a conceptual lineage. While ethnographic studies already provide a hint for the rigidity of cultural transmission in preindustrial societies, a more immediate glimpse of the manifestation of a heritage constraint in an actual event is described in Snorri Sturlson’s *Heimskringla* written around 1230. *Early next morning the king returns again to the ship, and Thorberg with him. The carpenters were there before them, but all were standing idle with their arms across. The king asked “what was the matter?” They said the ship was destroyed; for somebody had gone from stem to stern, and cut one deep notch after the other down the one side of the planking. When the king came nearer he saw it was so, and said, with an oath, “The man shall die who has thus destroyed the vessel out of envy, if he can be discovered, and I shall bestow a great reward on whoever finds him out.” “I can tell you, king,” said Thorberg, “who has done this piece of work.” “I don’t think,” replies the king, “that any one is so likely to find it out as thou art.” Thorberg says, “I will tell you, king, who did it. I did it myself.” The king says, “Thou must restore it all to the same condition as before, or thy life shall pay for it.” Then Thorberg went and chipped the planks until the deep notches were all smoothed and made even with the rest; and the king and all present declared that the ship was much handsomer on the side of the hull which Thorberg had chipped, and bade him shape the other side in the same way, and gave him great thanks for the improvement (Laing 1844:457). Although, in this case, an inventive individual has liberated himself from his ‘conformist bias’ by thinking outside the box – actually a great example of individual agency – this nevertheless shows how deeply ingrained the idea about the shape of a *proper ship* must have been in the collective mind-set. This societal pressure would have made it hard for any individual to deviate from the norm, the way it was taught by the forefathers. Moreover, this particular ship was apparently seen within a lineage of royal ships and thus obtained a certain identity not unlike that of a creature’s, with which we touch once more upon the “absurd” idea of ships with offspring, which is maybe not *that* absurd after all. King Ólafr Tryggvason’s new ship was called “*Orm hinn langa*” (the long serpent), while its predecessor – also called *Orm* – was thence re-named “*Orm hinn skammi*” (the short serpent) (Falk 1912:32). Apart from the obvious faunal allusion, there appears an explicit hereditary line as the same “species”, in which the new *orm* replaces the old *orm* as royal flagship.*

### Homology as continuity: ‘atavisms’ in shipbuilding

Evolutionary development does not consist of continuous smooth change, but also periods of equilibrium. The absence of conceptual change is no less interesting, as it gives an idea of the depth of an ingrained practice for doing and manufacturing things

in the ritualized social landscape. It is particularly 'atavisms' – archaic constructional details with no function in the utilitarian sense – which indicate a stasis in a specific environmental, social or cultural context. Although atavisms – in the biological sense – are the functionally obsolete phenotypes within lineages, they remain identifiable characteristics of a species and thereby – translated into the cultural sense – may have acquired symbolic value, as a unique cultural expression of a certain shape or form. One good example is the late medieval version of the *Oberländer*-type; a planked river-craft of the Rhine area, based on a trapezoidal substructure. This peculiar shape had been initially determined by halved logs, used to their maximum width, i.e. the base of the log having a larger diameter than its upper part. Detlev Ellmers (2002:102) points out that the shortage of adequately thick logs in late medieval times led to a shift to wholly planked versions of the *Oberländer*-type, whilst the peculiar shape – despite having become obsolete – was retained. A similar scenario was suggested for the Utrecht-type in that the depletion of a large oak tree population would have prompted “boat builders to replace the logboats with fully planked bottoms while retaining the characteristically deep curvature typical of Utrecht-type hulls” (Van de Moortel 2009:333). Surely, in the first case, and probably also in the latter, change occurred due to the paucity of a resource. However, instead of reassessing the construction as a whole, a makeshift strategy was adopted to overcome the most imminent problem – a short term solution. This is a good example for homology, both in its static and transient sense. While the use of logs corresponds to what has been called an ‘ancestral trait’, the log-shaped planked version would consequently be a ‘derived trait’ (cf. O’Brien & Lyman 2009:234). Particularly in the first case, the disproportionately cumbersome implementation of a conventional solution may be yet again identified as a ‘perceptual set’, which generates anachronistic modular features that make little functional sense. There are scholars, however, ascribing little diagnostic value to homologous features. Timm Weski (1999a: 97) criticised the tracing of shipbuilding traditions through hereditary constructional features, such as clamps for lashed plank-to-frame fastenings, as shared by the Hjortspring, Oseberg and Gokstad ships. He argued that this cannot be seen as a diagnostic feature through which a tradition could be identified, because the same building method could be also found on the Solomon Islands. Here Timm Weski categorically rules out the potential of homologous features for reconstructing a hereditary relationship, by merely opposing the possibility of an independent development of similar solutions elsewhere. The error of this thought lies in the conflation of the concepts of homology and analogy, irrespective of the spatiotemporal context.

## The type-fallacy: illusive conceptual lineages

While retention is well-reflected in certain characteristics in the form of atavisms, homologous features, and other traces indicating continuity, it becomes a contested issue when the attempt is made to cast it into a typology and to bundle lineages with historically-derived type tags. The problem of classifying shipwrecks was summarized by Seán McGrail (1995:139f) as follows: “If classification schemes are too complex, they run the risk of obscuring patterns; if too simple, the classifier may be tempted to drive them too far and draw unwarranted conclusion”. The underlying problem has also been discussed as a dichotomy between essentialist and materialist perspectives (cf. O’Brien & Lyman 2009:229), which shall be demonstrated as a case study in the following section. Obviously, the perception of the tradition will be distorted by various shortcomings, such as an unbalanced representation of certain types of wrecks in the database or the mix up between analogous and homologous features, blurring the understanding of conceptual lineages within shipbuilding traditions. Therefore, archaeologists will always have to keep in mind that they are essentially dealing with a fictitious typology (cf. Kunst 1982:3), which – of course – should ideally match up with the real typology. Fictitious typologies ought therefore to be seen as transient approximations and remain flexible enough to maintain an objective view as the database grows, or in McGrail’s words, “The aim of establishing such a classification scheme is not to fossilise types, for any scheme must be capable of responding to newly acquired data; nor is the aim to demonstrate any ‘evolution’ or ‘development’ of one type from another in a hierarchy of classes (cladogram)” (McGrail 1998:4). While there cannot be any doubt of the validity of his first point, McGrail’s later advice ought to be viewed with caution, because a detachment from hereditary lineages would undermine the study of traditions. Restrictively, one has to see McGrail’s criticism of evolutionary concepts in light of how James Hornell employed them, i.e. as direct biological analogies, somewhat awkwardly superimposed on watercraft and not conditioned to conceptual lineages. The actual problem is constituted by the challenge to align the fictitious typology as close to the real one as possible. In the case of watercraft from the recent past and the late post-medieval period the type-concept can be used with little bias, due to the wealth of written records. It is often possible to link a wreck not only to a type, but to even reveal the vessel’s identity. The decisive hint is seldom found in the construction itself, but in the artefact assemblage, such as a ship’s bell bearing the vessel’s name (Ossowski 2008:50), gauge marks (Auer & Belasus 2008:136), and stone ballast with a petrologically-determined provenance (Adams 1985) as indication for the origin of the ship, or the emblem of the guns, revealing the maker, owner, date, and place of origin (Martin 2001:384). These hints are

traced through contemporary records, so that light may be shed on concomitants and individuals, as in the case of the *Amsterdam*, where astonishingly many details emerged through a historical-archaeological approach (cf. Gawronski 1987:31ff.). It becomes clear that the main emphases in post-medieval shipwreck studies lie more on the artefact assemblage on the one side and archival studies on the other, while the construction itself is of relatively minor importance; in spite of the fact that theoretical treatises on shipbuilding accounted little for how the work had been actually conducted, as Colin Martin (2001:394) points out. Whenever no contemporary records or meaningful find assemblages could be found, it is not only impossible to identify the vessel by its name, but often even by its type, since the type in early modern times referred to the way the vessel was rigged rather than how it was constructed. Moreover, nautical terminology has never been static, so the same type name might also have been employed for a totally differently constructed vessel (cf. Baker 1998:18; McGrail 1998:3). The study of medieval shipwrecks is even more problematic, especially when it often follows a similar approach. The strong reliance on historical sources has prevailed, despite that specific written evidence is almost totally lacking for the medieval case, such as registers of ship-losses, payrolls, construction drawings and ship models which would allow detailed structural insights; with the only exceptions being the renowned models of Ebersdorf (Steusloff 1983) and Mataró (Culver & Nance 1929; van Nouhuys 1931; Winter 1956). The use of methods to classify medieval wrecks in a similar way as modern wrecks, has encouraged the malpractice of taking vague sources at face value, in order to link a shipwreck's construction to a historical type. This has led to the erroneous impression that the identification of a defined "type" should constitute the ultimate purpose of a study, as has been rightly critiqued by Thijs Maarleveld (1995:5). The way typologies are built reveals that the large conceptual gap between the study of post-medieval and medieval shipwrecks is often hugely underestimated. Application of the same standards is attempted, due to a preoccupation with the ethnic or cultural affiliation of the wreck and its historical type; as though this would present a shortcut in the classification process, through which the painstaking examination of homologous and analogous modular features could be circumvented. Both concepts rise and fall with the predominant historical theory of the day and hence form no independent analytical tool (cf. Indruszewski 2004: 20ff).

## The cog delusion

There is arguably no better case to demonstrate the type-fallacy than the example of the alleged 'cog-type'; particularly because the constructional properties, as currently defined, are widely taken for

granted today and have ossified the narrative. This section highlights how the failure to formulate a consistent theoretical framework for mechanisms of cultural inheritance and technological transmission in shipbuilding technology has resulted in an arbitrary "cog-typology", which was strongly biased by the sequence of wreck discoveries. Although Thijs Maarleveld's strict antagonism towards Darwinian processes in cultural development is opposed here, his critique that archaeological interpretation tends to be too dependent on historical typeconcepts (cf. Maarleveld 1995:5f.) can be endorsed, as archaeologists have effectively stolen the thunder of their own discipline's interpretative potential. This unwholesome dependency can be observed with regard to the 'Bremen Cog' of 1380, which became a paradigm for the "cog-type". Discovered in 1962 during dredging works in the River Weser, approximately 4 km downstream of the City of Bremen, Germany, the hitherto unfamiliar construction and visually distinctive appearance of the wreck was noted and led to the identification as a "cog" (Flidner 1964). This identification was based on Paul Heinsius' (1956:55ff.) inference of the term cog, mainly from historical sources, in a study that suggested that regional variation of ship design is reflected in iconographic representations. The decisive hint is often seen in a documentary reference from 1483 to the Stralsund seal of 1329 "*vnser Stad Sigel ghenomed den koggben*" (our seal reproduced from the cog) (Flidner & Pohl-Weber 1968:24); in spite of the fact that the cog had been superseded in the late 15th century written sources by the hulk. So the 'cog' reference could have been a generic reference for an 'old ship'. Moreover, the two ship depictions on the seals of Lübeck and La Rochelle were also referred to as cogs by contemporary sources and look different from the Stralsund seal, which casts further doubt upon the reliability of the respective references (cf. Crumlin-Pedersen 2000:233; Weski 1999b:366ff). Admittedly, it cannot be denied that there is a striking similarity between the Stralsund seal and the great majority of ship-depicting seals from the Hanseatic sphere, which coincided spatiotemporally with the heyday of the cog. So let us accept the premise – for the sake of brevity – that from these three seals most contemporaries would have chosen the Stralsund seal as the most truthful representation of a 'cog' and that cogs could be – consequently – identified by a flat bottom, a sharp transition to the stem- and sternposts, the straightness of the same, a stern-rudder and the exceptionally high hull sides. So far so good, but what followed next was an exactly inversed process of inference. Subsequently further criteria were inferred archaeologically from the 'Bremen Cog' and fed back to the defining criteria of the "cog-type", i.e. all criteria that could be neither deduced from written sources nor pictorial representations. These encompassed a 'keel-plank' replacing a proper keel, hooks that connected the plank-keel and the stem and sternposts, flush-laid ('carvel') bottom planking gradually becoming lapstrake towards the

hood-ends, clinkered side-planking, the use of double-bent nails in plank-to-plank fastening and, last but not least, the use of moss as caulking material, held in the groove by laths stapled with *sintel* cramps (cf. Crumlin-Pedersen 2000:232f.; Hocker 2004b:75). While there can be no doubt that the criteria were distinctive enough to form an independent shipbuilding tradition, the additional criteria were simply added to the type definition as though the Bremen Cog was a blueprint – a perfect representation of its own tradition. “*Considering that the Bremen ship was beyond doubt called a cog by those who built and sailed her, why should this term not be used for that ship and for other seagoing Late-Medieval vessels with the same basic characteristics? We have described precisely the complex of features which we take as a definition of a cog in archaeological terms*” (Crumlin-Pedersen 2000:239) (Fig. 5.5). The complex features of a singular specimen – a paradigm – were apparently thought adequate for a universally applicable set of defining criteria, through which – perhaps inadvertently – a high degree of standardization was implied. The underlying problem presented here is typical for studies that entail evolutionary concepts, touching on the central issue of the dichotomy between a materialistic or essentialistic bias, prompting an inclusive or exclusive rationale in deducing a typology. For the essentialist, the type is real and variation an illusion, while for the materialist the average type is an abstraction and variation is real (O’Brien & Lyman 2009:229). Ole Crumlin-Pedersen thus follows a very essentialist approach in that sense, since he is concerned with tying a type down to a precise set of construction details inferred from the archaeology, yet unwarranted by historical sources. He evidently did not fail to notice himself the fragile basis of his claim and continued – somewhat apologetically – that if a vessel fulfils “*our criteria, it is a cog in our archaeological terminology*” (Crumlin-Pedersen 2000:239). The emphasis on *our* suggests that he foresaw the conflict of ‘cog-type definition’ between historians and archaeologists. His belief in the continuity in this set of deduced features was indeed so strong that he expected the same characteristics also in the ancestral character of wrecks of the same tradition, making the revealing remark of hoping to find more “*proto-cogs*” in order to “*guide further discussions on the pre-12th-century history of vessels with this particular set of constructional characteristics*” (Crumlin-Pedersen 2000:239f.). The belief in such proto-cogs probably stems from over-interpretation of the 9th century reference to *cogscult* – often translated as cog tax – which “*confirms the existence before 1150 of ships called by a term equivalent to the present term cog*” (Crumlin-Pedersen 2000:238). ‘Confirm’ is a strong word, given that this is an equation with two unknowns. Firstly, there is no positive evidence to suggest that people used the term “cog” to describe a similar type of ship in 900 and 1150, let alone employed the same guiding principles in its construction. Secondly, the term *cog* in this particular case seems to relate rather to a *Koke* in a regional Frisian dialect, i.e. a legal person (Fliedner

1969:44; Heinsius 1956:70). Also *Koggenland* in West Frisia has nothing to do with cogs, since a *kogge* was also a term to denote a judicial district consisting of four to five villages, which has not, however, stopped the authorities adopting a historicised image of a “cog” on the province’s new coat-of-arms. The assumption that cogs plied the water in early medieval times has also induced the assumption that half of the Hedeby and Birka coins depict cogs. Despite Crumlin-Pedersen (1965:122ff.) convincingly arguing that the angular appearance can be in some cases ascribed to a *barð*, a piece of deadwood added to the stem and sternpost to enhance lateral stability, he over-interprets those depictions where the sheer of the planks is less pronounced and therefore lacks the deadwood at the keel transition thought to represent these “stem beards”. Is the proto-cog a phantom? In a nutshell, medieval sources are mute on constructional peculiarities, only rendering the general impression that cogs were large transport ships suited for long voyages (cf. Jahnke & Englert, forthcoming; Paulsen 2010). There is, for instance, no way of knowing whether the four Danish cogs that approached Tallinn in 1220 (cf. *Heinrici Chronicon Livoniae* XXIV:7, see Bauer 1975:266) were constructed similarly to the “*duas magnas naves, que koggen appellantur*” (UHDL 91, acc. to Jahnke & Englert, forthcoming), which were granted to Wismar in 1209 by the emperor. The four Danish ships that Henry of Livonia – a German missionary – perceived as cogs were maybe even called something different by the Danes. Admittedly, the general appearance and operational capabilities of cogs could be inferred indirectly, so there is at least a slight contextual intersection between historical and archaeological sources: Henry of Livonia’s description of kedge anchors being brought out by smaller boats in order to kedge nine German cogs out of a narrow inlet (*Heinrici Chronicon Livoniae* XIX:5, Bauer 1975:189ff.), suggests that cogs could not be propelled under oars of their own accord; an impression that is congruent with the impressions gained from seal depictions on which alleged cogs are represented as high sided and bulky vessels. In spite of some hints that seem to support the conventional way in which cogs are defined today, it seems nevertheless questionable whether the cog-type constituted a type in the strict constructional sense as currently endorsed by a majority of scholars. Essentialist properties define an idea, or archetype, to which objects are only imperfect approximations (cf. O’Brien & Lyman 2009:229). Several smaller wrecks from the IJsselmeer are perceived in this way. Despite them sharing many constructional features with the ‘Bremen Cog’ and evidently being descended from the same shipbuilding tradition, they could not, by definition, be cogs due to their modest sizes. For this reason they were called – somewhat awkwardly – “cog-like” vessels (van de Moortel 1991; Reinders 1985a:400ff., 1985b:7ff.). Another imperfect approximation would be the atypical deep keel in the ‘Bossholmen Cog’, which Fred Hocker called an exception (2004b:75).

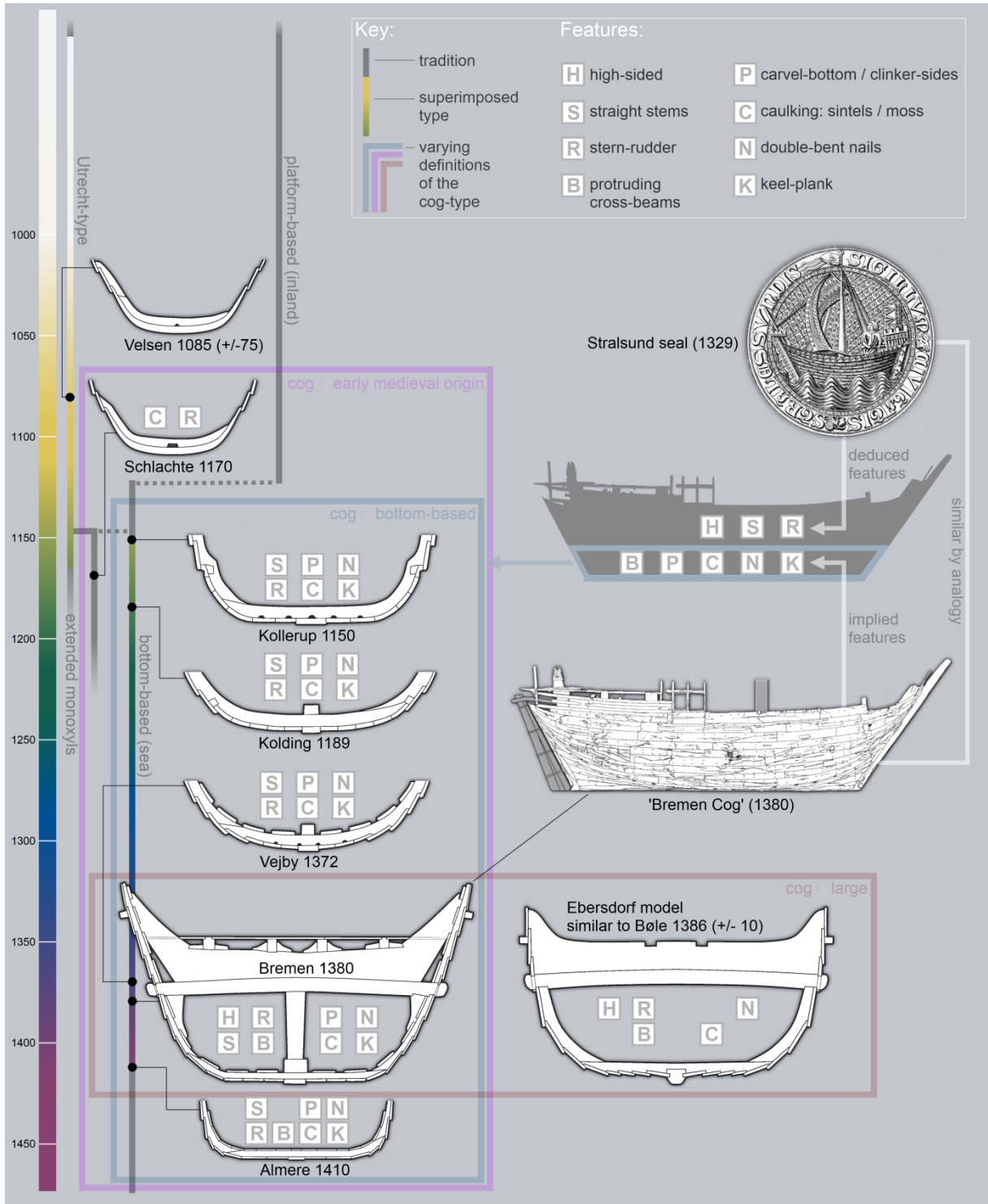


Figure 5.5. This graph highlights the conflicting deduction and definition of the cog-type. The graph schematically demonstrates the problem of superimposing the concept of a cog-type on traditions, as the boundaries between traditions are floating and thus any attempt to establish a standard-type would exclude forms that clearly belonged to the same tradition, or shared at least ancestral links. With the exception of rare cases like the 'Bremen Cog', most shipwrecks tend to be only preserved at the bottom construction and thus there is virtually no overlap with pictorial representations. Thus the cog-type definition rises and falls with the frail analogy between the ship depicted on the Stralsund seal and the Bremen Cog. While having some analogous features in common, most features that are currently associated with cogs are actually derived from the 'Bremen Cog' itself and fed back into the general cog type-concept, thus artificially elevating it to a paradigm (Graph: Daniel Zwick).

The latter restrictively admits that the “*identification of the diagnostic characteristics largely depends on whether the author has an inclusive or exclusive orientation*”. Now the question arises, of how the number of possible exceptions to the rule could be objectively fixed in order to determine whether the wreck is still part of a certain tradition or not. Merely by the number of deviating components, or through a modular hierarchy, in which some constructional features are thought to be more integral to the conceptual lineage than other more subsidiary criteria? The exclusive orientation of the essentialist approach artificially divides a congruent tradition by means of a superimposed idealised type-concept. Inversely, a type in the historical sense may encompass various strands of archaeologically verifiable traditions. This type-travesty was noted by several authors who were concerned with establishing a more objective typology; in the case of the “cog” most notably spearheaded by Timm Weski’s proposition to call it the *IJsselmeer type* instead, with regard to its assumed origin (Weski 1999b). Weski’s critique in itself is absolutely justified, but his alternative proposition would have spawned another bias regarding the type’s assumed origin, as Crumlin-Pedersen convincingly pointed out (2000:26ff.). Anton Englert suggested referring to the tradition in the archaeologically correct sense as the *Kollerup-Bremen type* (Englert 2000:44). Although this would foreclose the historical type bias, it would suffer the drawback of implying a preconceived linearity in the development from the Kollerup wreck of 1150 to the Bremen wreck of 1380. The *bottombased shipbuilding tradition* (Hocker 2004b) appears to be the most objective typological concept, but it has weaknesses too, as it is arguably too exclusive. Bottombased ships have, strictly speaking, structurally a lot in common with a group of entirely clinker-built ships that are commonly associated with the Nordic tradition. Both have in common shell-first construction and the bottom strakes of bottom-based ships – albeit carvellaid – gradually overlap at their hood-ends too (cf. Lahn 1992:34). It could be therefore argued that these are conceptually not as distinctive from fully clinkerbuilt ships as has often been implied. The claim that the bottom-based tradition has in effect a ‘monopoly’ – paraphrasing here – on cogs (cf. Hocker 2004b:72ff.) has to be seen critically, since there is no evidence to suggest that entirely clinker-built vessels, such as the kind of ship after which the Ebersdorf Ship was modelled in all possible detail (cf. Steusloff 1983:189), or the Bole wreck (Daly & Nymoen 2008), were not referred to as cogs by contemporaries, despite also featuring a great visual similarity to the “cog-depicting seals”. Although a certain similarity in appearance can be taken for granted, it seems highly questionable whether the term cog denominated a type of ship in a strict constructional sense. As argued above, analogous criteria can be treacherous, as they suggest a conceptual coherency, but may entail totally different conceptual solutions in the construction. The type of medieval source that makes most

frequent mention of ship types are customs and tax registers, in which types would have been classified in relative terms since capacities fluctuated over time (Wolf 1986:28). What mattered primarily to the customs officer was an estimate of the loadbearing capacity, according to which the toll could be fixed. He would have neither crept into the hold to ascertain whether the bottom planking was carvel or clinker, nor would he have measured the curvature of the stem in order to determine whether the ship was a cog or not. In opposition to the essentialist approach stands the materialist approach, in which the ideal type becomes an abstraction of reality and variation regarded as the regular case. Although Detlev Ellmers has a similar take on the justification of identifying shipwrecks by their historical type (Ellmers 1972:14, 1979:493f.), he contrasts the essentialist approach by conceding great constructional variety within a type. This manifests particularly well in the case of what he called the ‘Schlachte Cog’; a late 12th century wreck from Bremen with a unique construction, consisting of an extended log-based stern section, which finishes in a carved out skeg with fittings for a stern-rudder (cf. Wesemann & von Fick 1993; Zwick 2012a:287ff.). The reason for calling it a cog was based on Ellmers’ conviction that the cog evolved gradually from an extended log-boat to a planked sea-going ship (Ellmers 2005:69). There are two problems with this. Firstly, a log-based “cog” would have been anachronistic when planked versions of allegedly the same type had emerged some decades earlier. Secondly, the underlying evolutionary concept is stripped of its analytical potential and reduced to a hypothesis, which was simply superimposed upon the wreck. Not for a moment was the possibility of a different ancestry considered, such as the local tradition of river-craft which employed to some degree concepts from extended log-boats, tentatively associated with the *eke* or “oaks”. The conceptual gap to extended logboats would have been much smaller, yet the unusual ‘freak feature’ of a stern-rudder was apparently seen as the decisive factor for drawing a link to cogs, rather than addressing it as an analogous feature, which the builder apparently took great lengths to include, given that the whole stern had to be carved out from the trunk to obtain an analogous shape to planked vessels. Notwithstanding, the wreck entered the literature as the ‘Schlachte Cog’ (or ‘Schlachte Kogge’ in German), so as not to leave any interpretative leeway or – heaven forbid – allow a re-evaluation of its type (cf. Rech 1991, 1993, 2004: 243ff.; Wesemann & von Fick 1993). In general, the establishment of a presupposed type as an epithet has to be condemned as unscientific practice, since it precludes a serious inquiry into the phenomenon itself. This should even extend to the ‘Bremen Cog’, as Timm Weski (2006) more recently stressed. Neither Crumlin-Pedersen’s nor Ellmers’ approach is fundamentally wrong; the first simply believed that a type is characterised more by continuity and the latter favours more variation within a type over time. Contradictions are mainly due to the urge to



harmonise the essentialist historical perspective with the materialistic archaeological perspective. The overinterpretation of details at this contested interface has arguably multiplied the error in interpretation.

## Conclusion

It could be concluded that the arbitrary use of type concepts distorts typologies which ought to be based on traditions. Therefore, to speak of cog-like vessels whenever wrecks with flush-laid bottom planks and clinkered sides held together with double-bent nails are excavated would make as much sense as for future archaeologists to refer to a 19th century river barge as an ocean-liner-like vessel, because its hull is – similar to the *Titanic's* – clad by riveted steel plates. Type and tradition are entirely different concepts, therefore the use of the term “cog-tradition” reflects a redundant concept. Historical type-concepts seldom relate to a typology in the archaeological sense, i.e. tradition, and should therefore be treated as discrete entities. This puts more emphasis on a discrete tool for developing typologies more independent from the prevalent historical narrative. As advocated in this paper, such a tool could be gained by following an evolutionary approach, or at least, by becoming more aware of the mechanisms behind inheritable cultural phenomena that form a tradition. As was stated a decade ago, however, there “*can be little doubt that a serious engagement with the problems raised by a scientific evolutionary archaeology will require practitioners to work outside the norms of contemporary social theory*” (Murray 2002:56). While the body of work on scientific evolutionary archaeology and other relevant work that examines hereditary patterns in culture and behaviour has grown, not much has changed in terms of wider acceptance. The implementation of this new perspective with concrete nautical archaeological case studies – as done in this paper – should not be regarded as an effort to install a universally applicable framework for interpretation, but should be seen as an attempt to understand the finer-grained causes and mechanisms through which continuity is preserved, or innovation and change effected. It is hoped that this contribution will rekindle the debate on the significance and scope of hereditary patterns within shipbuilding traditions and, thereby, lead to the development of more sensible, truly archaeological typologies, through which genuine traditions could be reconstructed. Whether this goal can be achieved by an evolutionary approach has yet to be shown – the gauntlet has been thrown. Who will pick it up?

**Acknowledgements** I am particularly indebted to Jon Adams for reviewing this paper, challenging me on several points in a thought-provoking manner and for providing numerous amendments. I also thank Nicole Taylor for cross-reading and Anton Englert, Thomas Guttandin, Thijs Maarleveld, Oliver Nelle, Colin Palmer, Johan Rönby, Timm Weski and

Christer Westerdahl for kind comments on the first draft of this paper, access to unpublished manuscripts or further literature recommendations. The views presented in this article do not necessarily reflect those of the aforementioned.

## References

- Akerlund, H. 1951. *Fartygsfynden i den Forne Hamnen i Kalmar*, Stockholm: Sjöhistoriska Samfundet.
- Adams, J. 1985. Sea Venture: A second interim report, part 1. *International Journal of Nautical Archaeology* 14.4: 275–99.
- Adams, J. 2001. Ships and boats as archaeological source material. *World Archaeology* 32.3: 292–310.
- Adams, J. 2003. *Ships, Innovation and Social Change. Aspects of Carvel Shipbuilding in Northern Europe 1450–1850*, Stockholm: Stockholm University.
- Aldrich, H. E., Hodgson, G.M., Hull, D.L., Knudsen, T., Mokyry, J. & Vanberg, V.J. 2008. In Defence of Generalized Darwinism. *Journal of Evolutionary Economics* 18.5: 577–96.
- Auer, J. 2009. Fieldwork report. Ostsee Bereich IV, Fischland, FPL 7. *Esbjerg Maritime Archaeology Reports* 2. Esbjerg: University of Southern Denmark.
- Auer, J. & Belasus, M. 2008. The British Brig Water Nymph or ... even an Englishman cannot take the liberty to deride a civil servant on German soil. *International Journal of Nautical Archaeology* 37.1: 130–141.
- Baker, W.A. 1998. The technical importance of shipwreck archaeology. In: L. E. Babits & H. van Tilburg (eds) *Maritime Archaeology. A Reader of Substantive and Theoretical Contributions*: 17–21. New York & London: Plenum Press.
- Bauer, A. 1959 (repr. 1975). *Heinrich von Lettland – Livländische Chronik*. Ausgewählte Quellen zur deutschen Geschichte des Mittelalters - Freiherr vom Stein-Gedächtnisausgabe 24, Darmstadt.
- Bill, J. 1997. *Small Scale Seafaring in Danish Waters AD 1000–1600*. Ph.D. thesis. University of Copenhagen.
- Bill, J. 2003. Schiffe als Transportmittel im nordeuropäischen Raum. In: *Warentransport im Mittelalter und in der Frühen Neuzeit. Transportwege – Transportmittel – Infrastruktur* (= Mitteilungsblatt der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit 14), 2003.
- Bill, J. 2009. Zwischen Kogge und Kraweel. Traditioneller Kleinschiffbau in Südkandinavien in einer Zeit der Wende. In: B. Scholkmann, S.

- Frommer, C. Vossler (eds) *Zwischen Tradition und Wandel- Archäologie des 15. und 16. Jahrhunderts*. Tübinger Forschungen zur historischen Archäologie 3: 251-260. Büchenbach: Faustus.
- Bill, J. & Hocker, F. 2004. Haithabu 4 seen in the context of contemporary shipbuilding in Southern Scandinavia. In K. Brandt and H.J. Kühn (eds) *Der Prähistorische Hafen von Haithabu. Beiträge zu antiken und mittelalterlichen Flachbodenschiffen*. Schriften des Archäologischen Landesmuseums – Ergänzungsreihe 2: 43-53. Neumünster: Wachholz.
- Blue, L. 1997. Boats of South Asia. *International Journal of Nautical Archaeology* 26.4: 339-343. Blumenberg, H. 1997. *Schiffbruch mit Zuschauer. Paradigma einer Daseinsmetapher*, Frankfurt am Main: Suhrkamp.
- Carpenter Turner, W.J. 1954. The building of the Gracedieu, Valentine and Falconer at Southampton, 1416-1420. *Mariner's Mirror* 40.1: 55-75.
- Cederlund, C.O. 1995. Ship archaeology - "communications archaeology", In: C. O. Cederlund (ed.) *Medieval ship archaeology*. Stockholm Marine Archaeology Reports 1:103-106. Stockholm: University of Stockholm.
- Cederlund, C.O. & Hocker, F. 2006. *Vasa I: The Archaeology of a Swedish Warship of 1628*. Stockholm: Statens Maritima Museer.
- Christensen, A.E. 2000. Some archaic details of Norwegian fresh-water boats. In: J. Litwin (ed.) *Down the River to the Sea*. Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997: 163-168. Gdańsk: Polish Maritime Museum.
- Clark, G.A. & Barton, C. M. 1997. Rediscovering Darwin. In: C.M. Barton and G.A. Clark (eds) *Rediscovering Darwin: Evolutionary Theory and Archaeological Explanation*. Archaeological Papers 7: 309-319. Arlington, VA: American Anthropological Association.
- Crumlin-Pedersen, O. 1965. Cog – Kogge - Kaag. Trak af en frisisk skibstypes historie. In: *Handels- og Søfartsmuseet på Kronborg Årbog* 1965: 81-144.
- Crumlin-Pedersen, O. 1970a Skin or wood? A Study of the Scandinavian Plank Boat. In: O. Hasslöf, H. Henningsen & A.E. Christensen (eds) *Ships and Shipyards, Sailors and Fishermen*: 213-239. Copenhagen: Rosenkilde & Bagger.
- Crumlin-Pedersen, O. 1970b. The Viking Ships of Roskilde. In: B. Greenhill (ed.) *Aspects of the History of Wooden Shipbuilding*. Maritime Monographs and Reports 1: 7-23. Greenwich: National Maritime Museum.
- Crumlin-Pedersen, O. 1972. Die Wikinger und die hansischen Kaufleute: 900-1400. In G.F. Bass (ed.) *Taucher in der Vergangenheit. Unterwasser-Archäologen schreiben die Geschichte der Seefahrt*, Luzern: Bucher.
- Crumlin-Pedersen, O. 1990. Sejle op ad aen. Skibsfund og sejlsparringer i danske indvande. In: *Vandløb og kulturhistorie*. Skrifter fra Historisk Institut 39: 93-104. Odense: Odense University.
- Crumlin-Pedersen, O. 1997. *Viking Age Ships and Shipbuilding in Hedeby/Haithabu and Schleswig*. Ships and Boats of the North 2. Schleswig & Roskilde: Archaeology State Museum of the Christian-Albrecht University, Viking Museum Haithabu, National Museum of Denmark, Viking Ship Museum Roskilde.
- Crumlin-Pedersen, O. 2000. To be or not to be a cog: the Bremen cog in perspective. *International Journal of Nautical Archaeology* 29.1: 230-246.
- Crumlin-Pedersen, O. 2003. Die Bremer Kogge – ein Schlüssel zur Geschichte des Schiffbaus im Mittelalter. In: G. Hoffmann & U. Schnall (eds) *Die Kogge - Sternstunde der deutschen Schiffsarchäologie*. Schriften des Deutschen Schiffahrtsmuseum 60: 256-271. Hamburg: Convent.
- Crumlin-Pedersen, O. 2004. Nordic clinker construction. In: F. M. Hocker & C. A. Ward (eds) *The Philosophy of Shipbuilding. Conceptual approaches to the study of wooden ships*: 37-63. College Station: Texas A&M University.
- Cullen, B. S. 2000. *Contagious ideas: On evolution, culture, archaeology and cultural virus theory*. Oxford: Oxbow Books.
- Culver, H. B. & Nance, M. 1929. A contemporary Fifteenth Century Ship. *The Mariner's Mirror* 15.3: 213-221.
- Dawkins, R. 1976. *The Selfish Gene*. Oxford: Oxford University Press.
- Dawkins, R. 1999. *The Extended Phenotype: The Long Reach of the Gene*, Oxford: Oxford University Press.
- Dobbs, C.T.C. & Bridge. M. 2000. Preliminary Results from Dendrochronological studies on the Mary Rose. In: J. Litwin (ed.) *Down the River to the Sea*. Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk 1997: 257-262. Gdańsk: Polish Maritime Museum.
- Dokkedal, L. 1996. *Koggen i Nordeuropa fra 1150-1450 e. Kr. – Definition af skibstypen og diskussion af en mulig årsag til dens anvendelse i nordeuropaisk skibsfart*, (University of Copenhagen Ph.D. dissertation).
- Eldjarn, G. & Godal, J. 1988. *Nordlandsbåten og Afjordsbåten I: Båten i bruk*. Lesja: A. Kjellands.

- Ellmers, D. 1972. *Frühmittelalterliche Handelsschiffahrt in Mittel- und Nordeuropa*, Neumünster: Wachholtz.
- Ellmers, D. 1979. Schiffsarchäologie. In: H. Jankuhn & R. Wenskus (eds) *Geschichtswissenschaft und Archäologie. Untersuchungen zur Siedlungs-, Wirtschafts- und Kirchengeschicht*: 485-518. Siegmaringen: Thorbecke.
- Ellmers, D. 2002. Baumschiff und Oberländer. Archäologie, Ikonografie und Typenbezeichnungen einer mittelalterlichen Binnenschiffsfamilie. In: K. Elmshäuser (ed.) *Häfen, Schiffe, Wasserwege: zur Schiffahrt des Mittelalters*. Schriften des Deutschen Schiffahrtsmuseums 58: 97-106. Hamburg: Convent.
- Ellmers, D. 2005. The Hanseatic Cog of Bremen AD 1380. *Drassana* 13: 58-72.
- Englert, A. 2000. *Large cargo vessels in Danish water AD 1000 - 1250*. Ph.D. thesis. University of Kiel.
- Eriksson, N. 2010. Between clinker and carvel: aspects of hulls built with mixed planking in Scandinavia between 1550 and 1900. In: A. Girininkas (ed.) *Underwater Archaeology in the Baltic Region*. Archaeologia Baltica 14: 77-84. Klaipėda: Klaipėda University Press.
- Falk, H. 1912. Altnordisches Seewesen. In: *Wörter und Sachen* 4, Heidelberg: C. Winther.
- Filgueiras, O. L. 1979. A presumptive Germanic heritage for a Portuguese boat-building tradition. In: S. McGrail (ed.) *The Archaeology of Medieval Ships and Harbours in Northern Europe*. Second International Symposium on Boat and Ship Archaeology, Bremerhaven 1979. British Archaeological Reports – International Series 66: 17-34. Oxford: British Archaeology Reports.
- Filgueiras, O.L. (ed.) 1988. *Local Boats* 2. Fourth International Symposium on Boat and Ship Archaeology, Porto 1985. British Archaeological Reports – International Series 438.2: 275-528. Oxford: British Archaeology Reports.
- Fliedner, S. 1964. Der Fund einer Kogge bei Bremen im Oktober 1962. In: *Bremer Jahrbuch* 49: 7-10.
- Fliedner, S. 1969. 'Kogge' und 'Hulk'. Ein Beitrag zur Schiffstypengeschichte. In: *Die Bremer Hanse-Kogge*. 39-121. Bremen: Focke Museum.
- Fliedner, S. & Pohl-Weber, R. 1968. *Die Bremer Kogge*. Hefte des Focke-Museums 19. Bremen: Focke Museum.
- Friel, I. 1993. Henry V's Grace Dieu and the wreck in the R. Hamble near Bursledon, Hampshire. *International Journal of Nautical Archaeology* 22.1: 3-19.
- Friel, I. 1994. The Carrack: The Advent of the Full Rigged Ship. In: R. W. Unger (ed.) *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*: 77-90, London: Conway Maritime Press.
- Friel, I. 1995. *The Good Ship. Ships, Shipbuilding and Technology in England 1200-1520*. London: British Museum Press.
- Gawronski, J. H. G. (ed.) 1987. *V.O.C. Schip Amsterdam*. Annual Report of the VOC-Ship "Amsterdam" Foundation. Amsterdam: VOC Schip Amsterdam.
- Gibbins, D. & Adams, J. 2001. Shipwrecks and maritime archaeology. In: *World Archaeology* 32.3: 279-291.
- Gould, S.J. 2002. *The Structure of Evolutionary Theory*. Cambridge MA: Belknap Press of Harvard University Press.
- Gothche, M. 1991. Three Danish 17th - 19th century wrecks as examples of clinker building techniques versus carvel building techniques in local shipwrightry. In: R. Reinders and K. Paul (eds) *Carvel Construction Technique*. 85-88. Oxford: Oxbow Books.
- Greenhill, B. & Mannering, J. (eds) 1997. *The Chatham directory of Inshore Craft: Traditional working vessels of the British Isles*. London: Chatham.
- Guttandin, T. Seagoing Paddled Ships. In: H. Tzalas (ed.) *Tropis IX. 9th International Symposium on Ship Construction in Antiquity, Agia Napa 2005*. Athens. (forthcoming)
- Hasslöf, O. 1972. Main principles in the technology of shipbuilding. In: O. Hasslöf, H. Henningsen, & A.E. Christensen (eds) *Ships and Shipyards, Sailors and Fishermen*. 27-72. Copenhagen: Copenhagen University Press, Rosenkilde & Bagger.
- Heinsius, P. 1956 (reprinted 1986). *Das Schiff der hansischen Frühzeit*. Weimar: Böhlau.
- Heinsius, P. 1986. Mecklenburger Schiffsformen des 13./14. Jahrhunderts. In H. Wieden (ed.) *Schiffe und Seefahrt in der südlichen Ostsee*. Mitteldeutsche Forschungen 91: 89-104. Cologne: Böhlau.
- Henrich, J. & Boyd, R. 2002. On Modeling Cognition and Culture. Why cultural evolution does not require replication of representations. *Journal of Cognition and Culture* 2.2: 87-112.
- Henrich, J. & Gil-White, F. 2001. The Evolution of Prestige: freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. In: *Evolution and Human Behavior* 22.3: 165-196.
- Henrich, J. & McElreath, R. 2003. The Evolution of Cultural Evolution. In: *Evolutionary Anthropology* 12: 123-135.

- Henrich, J. & McElreath, R. 2007. Dual inheritance theory: the evolution of human cultural capacities and cultural evolution. In: R. Dunbar and L. Barrett, (eds) *Oxford Handbook of Evolutionary Psychology* Oxford: 555-570. Oxford: Oxford University Press.
- Hocker, F. M. 1999. Technical and organizational development in European shipyards 1400 – 1600. In: J. Bill & B.L. Clausen (eds) *Maritime Topography and the Medieval Town*. Papers from the 5th International Conference on Waterfront Archaeology in Copenhagen, 14-16 May, 1998: 95-108. Copenhagen: National Museum of Denmark.
- Hocker, F. M. 2004a. Shipbuilding: Philosophy, Practice, and Research. In: F. M. Hocker & C. A. Ward (eds) *The Philosophy of Shipbuilding. Conceptual approaches to the study of wooden ships*: 1-11. College Station: Texas A&M University.
- Hocker, F. M. 2004b. Bottom-based shipbuilding in northwestern Europe. In: F. M. Hocker & C. A. Ward (eds) *The Philosophy of Shipbuilding. Conceptual approaches to the study of wooden ships*: 65-93. College Station: Texas A&M University.
- Hornell, J. 1920. Origins and ethnographical significance of Indian boat design. *Memoirs of the Asiatic Society of Bengal* 7: 139-256.
- Hornell, J. 1946. *Water transport. Origins and Early Evolution*. Cambridge: Cambridge University Press.
- Hull, D.L. 1988. Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science. Chicago: University of Chicago Press.
- Hutchinson, G. 1994. *Medieval ships and shipping*, London: Leicester University Press.
- Indruszewski, G. 2004. *Man, Ship, Landscape. Ships and seafaring in the Oder Mouth Area AD 400-1400. A case study of an ideological context*. Copenhagen: National Museum of Denmark.
- Jahnke, C. & Englert, A. The state of historical research on merchant seafaring in Danish waters and in the western Baltic Sea 1000-1250. In: A. Englert (ed.) *Large Cargo Ships in Danish Waters 1000-1250*. Ships & Boats of the North. Roskilde: Viking Ship Museum. (Forthcoming)
- Johnstone, P. 1980. *The Sea-Craft of Prehistory*, London & New York: Routledge.
- Kunst, M. 1982. Intellektuelle Information – Genetische Information. In: *Acta praehistorica et archaeologica* 13/14: 1-26.
- Lahn, W. 1992. *Die Kogge von Bremen =the Hanse Cog of Bremen. Bd. 1: Bauteile und Bauablauf = Structural members and construction process*. Schriften des Deutschen Schiffahrtsmuseums 30. Hamburg: Convent.
- Lemée, C.P. 2006. *The Renaissance Shipwrecks from Christianshavn*. Ships and Boats of the North. 6. Roskilde: Viking Ship Museum.
- Leonard, W. E. 1943. *On the Nature of Things*. London: Dent.
- Laing, S. 1844. *Heimskringla: A History of the Norse Kings*. London: Longman, Brown, Green, and Longmans.
- Loewen, B. 1997. Bayonne 1419. Lapstraking and moulded frames in the same hull? *The Mariner's Mirror* 83.3: 328-330.
- Lund, N. 1996. *Lid, leding og landeværn*. Roskilde: Vikingskibshallen.
- Maanders, M.R. 2003. The Mysteries of a Baltic Trader, in: C. Beltrame (ed.) *Boats, Ships and Shipyards*. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000: 320-328. Oxford: Oxbow.
- Maarleveld, T. J. 1992. Archaeology and early modern merchant ships. Building sequence and consequences. An introductory review. In: A. Carmiggelt (ed.) *Rotterdam Papers VII: a contribution to medieval archaeology*: 155-174. Rotterdam: A. Carmiggelt.
- Maarleveld, T.J. 1994. Double Dutch Solutions in Flush-Planked Shipbuilding: Continuity and Adaptations at the Start of Modern History. In: C. Westerdahl (ed.) *Crossroads in Ancient Shipbuilding*. Proceedings of the International Symposium on Boat and Ship Archaeology 6, 1991 Roskilde: 153-163. Oxford: Oxbow.
- Maarleveld, T. 1995. Type or technique. Some thoughts on boat and ship finds as indicative of cultural traditions. *International Journal of Nautical Archaeology* 24.1: 3-7.
- Mäss, V. 1994. A unique 16th-century Estonian ship find. In: C. Westerdahl (ed.) *Crossroads in Ancient Shipbuilding*. Proceedings of the International Symposium on Boat and Ship Archaeology 6, 1991 Roskilde: 189-194. Oxford: Oxbow.
- Martin, C. 2001. De-particularizing the particular: approaches to the investigation of well-documented post-medieval shipwrecks. *World Archaeology* 32.3: 383-399.
- Matthew, P. 1831. *On Naval Timber and Arboriculture*. London: Longman, Rees, Orme, Brown, and Green.

- Mayr, E. 1961. Cause and Effect in Biology. *Science* 134: 1501-1506.
- McGrail, S. 1981. *The Ship: Rafts, Boats, and Ships*. Greenwich: National Maritime Museum.
- McGrail, S. 1995. Romano-Celtic boats and ships: characteristic features. *International Journal of Nautical Archaeology* 24.2: 139-145.
- McGrail, S. 1998. *Ancient Boats in North-West Europe. The Archaeology of Water Transport to AD 1500*. London & New York: Longman.
- McGrail, S. 2001. *Boats of the World*. Oxford: Oxford University Press.
- van de Moortel, A. 1991. *A Cog-like Vessel from the Netherlands*. Flevovericht 331. Lelystad: Rijkswaterstaat Directie Flevoland.
- van de Moortel, A. 2009. The Utrecht Ship Type: an Expanded Logboat Tradition in its Historical Context. In: R. Bockius (ed.) *Between the Seas. Transfer and Exchange in Nautical Technology*. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology, Mainz, 2006: 329-336. Mainz: Römisch-Germanisches Zentralmuseum.
- Montelius, O. 1903. *Die älteren Kulturperioden im Orient und in Europa I. Die Methode*. Stockholm: Asher.
- Morgan, D.L., Morgan, R.K. & Toth, J.M. 1992. Variation and Selection: The Evolutionary Analogy and the Convergence of Cognitive and Behavioral Psychology. *The Behavior Analyst* 15: 129-138.
- Muckelroy, K. 1978. *Maritime Archaeology*. Cambridge: Cambridge University Press.
- Mudie, C. 1996. Matthew and Naval Architecture. In: *Historic Ships: Design, Restoration & Maintenance*. London: The Royal Institution of Naval Architects.
- Murray, T. 2002. Evaluating evolutionary archaeology. *World Archaeology* 34.1: 47-59.
- Norman, H. 2000. *Skärgårdsflottan: Uppbyggnad, militär användning och förankring i det svenska samhället 1700-1824*. Lund: Historiska Media.
- van Nouhuys, J.W. 1931. The model of a Spanish caravel of the beginning of the 15th century. *Mariner's Mirror* 17: 327-346.
- O'Brien, M.J. & Lyman, R.L. 2009. Darwinism and Historical Archaeology. In: T. Majewski & D. Gaimster (eds) *International Handbook of Historical Archaeology*: 227-252. New York: Springer.
- Olearius, A., Davies, J. & von Mandelslo, J.A. 1662. *The Voyages & Travels of the Ambassadors from the Duke of Holstein, to the Great Duke of Muscovy, and the King of Persia*. London: Dring & Starkey.
- Ossowski, W. 2006. Two double-planked wrecks from Poland. In: L. Blue, F. Hocker & A. Englert (eds) *Connected by the Sea*. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology, Roskilde 2003: 257-265. Oxford: Oxbow.
- Ossowski, W. 2008. *The General Carleton shipwreck, 1785*. Gdańsk: Polish Maritime Museum.
- Oswalt, W.H. 1976. *An Anthropological Analysis of Food-Getting Technology*. New York: John Wiley & Sons.
- Palmer, C. The Diversity of Traditional Boats: What causes it and why does it persist? In: Proceedings of the 10th TAG conference, Exeter 2006. (Forthcoming)
- Palmer, C. & Blue, L. 2009. The country boats of the Ganges delta. An ethnographic study of inland navigation. In: R. Bockius (ed.) *Between the Seas. Transfer and Exchange in Nautical Technology*. Proceedings of the 11th International Symposium on Boat and Ship Archaeology, Mainz 2006: 479-488. Mainz: Römisch-Germanisches Zentralmuseum.
- Parker, G. 1996. The Dreadnought Revolution in Tudor England. *Mariner's Mirror* 82.3: 269-300.
- Paulsen, R. 2010. Die Koggendiskussion in der Forschung. Methodische Probleme und ideologische Verzerrungen. *Hansische Geschichtsblätter* 128: 19-112.
- Petersen, H.C. 1986. *Skinboats of Greenland*. Ships and Boats of the North 1. Roskilde: Viking Ship Museum.
- Phillips, C. R. 1994. The Caravel and the Galleon. In: R. W. Unger (ed.) *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*: 91-114. London: Conway Maritime Press.
- Preucel, R.W. & Hodder, I. 1996. *Contemporary archaeology in theory: a reader*. Oxford: Wiley-Blackwell.
- Probst, N.M. 1994. The Introduction of Flush-Planked Skin in Northern Europe and the Elsinore Wrecks. In: C. Westerdahl (ed.) *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde 1991: 143-152. Oxford: Oxbow.
- Rech, M. 1991. Übersicht der Schiffsfunde auf Bremer Gebiet. In: *Bremer Archäologische Blätter - Neue Folge* 1: 25-32.
- Rech, M. 1993. Neufund einer Kogge: Fundgeschichte und Datierung. *Bremer Archäologische Blätter - Neue Folge* 2: 31-35.

- Rech, M. 2004. *Gefundene Vergangenheit – Archäologie des Mittelalters in Bremen*. Bremer Archäologische Blätter, Beiheft 3. Bonn: Habelt.
- Reinders, R. 1985a. Recent developments in ship and boat archaeology in the Netherlands. In: C. O. Cederlund (ed.) *Postmedieval Boat and Ship Archaeology*. British Archaeological Reports - International Series 256: 399-412. Oxford: British Archaeology Reports.
- Reinders, R. 1985b. *Cog finds from the IJsselmeerpolders*. Flevovericht 248. Lelystad: Rijkswaterstaat Directie Flevoland.
- Richerson, P.J. & Boyd, R. 2005. *Not by genes alone: how culture transformed human evolution*. Chicago: University of Chicago Press.
- Rindos, D. 1985. Darwinian selection, symbolic variation, and the evolution of culture. *Current Anthropology* 26: 65-88.
- Salisbury, W. 1961. The Woolwich Ship. *The Mariner's Mirror* 47.2: 81-90.
- Spencer, C. 1997. Evolutionary approaches in archaeology. *Journal of Archaeological Research* 5.3: 209-264.
- Rönby, J. 1996. Kronholmskoggen – Om ett skeppsfynd och tolkningsmöjligheter. In: H. Ranheden, E. Hyenstrand, M. Jacobsson, J. Rönby & A Nilsson (eds) *Metodstudier & tolkningsmöjligheter*. Arkeologiska Undersökningar 20: 65-75. Stockholm: Riksantikvarieämbetet.
- Rose, S. 1977. Henry V's Grace Dieu and Mutiny at Sea: Some new evidence. In: *The Mariner's Mirror* 63.1: 3-6.
- Steffy, J.R. 1994. *Wooden ship building and the interpretation of shipwrecks*. College Station: Texas A&M University.
- Steusloff, W. 1983. Das Ebersdorfer Koggenmodell von 1400. *Deutsches Schifffahrtsarchiv* 6: 189-207.
- Varenius, B. 1989. *Båtarna från Helgeandsbolmen*. Stockholm: Riksantikvarieämbetet.
- Vlierman, K. 1996. *Kleine bootjes en middeleeuws scheepsbout met constructedetails*. Scheepsarcheologie II. Flevovericht 404. Lelystad: Rijkswaterstaat Directie Flevoland.
- Warner, G.F. 1926. *The libelle of Engghyshe polyeeye: a poem on the use of sea-power 1436*. Oxford: Clarendon.
- Wesemann, S. & von Fick, C. C. 1993. Die neue Kogge - Ausgrabung und Bautyp (Vorbericht). *Bremer Archäologische Blätter – Neue Folge* 2: 36-45.
- Weski, T. 1999a. Fiktion oder Realität? Anmerkungen zum archäologischen Nachweis spätmittelalterlicher Schiffsbezeichnungen. *Skyllis* 2.2: 96-106.
- Weski, T. 1999b. The IJsselmeer type: some thoughts on Hanseatic cogs. *International Journal of Nautical Archaeology* 28: 360-379.
- Weski, T. 2006. Wurde wirklich eine Kogge gefunden? Spätmittelalterliche Funde der Schiffsarchäologie in Nord- und Ostsee. *Antike Welt. Zeitschrift für Archäologie und Kulturgeschichte* 1: 91-96.
- Westerdahl, C. 1995. Traditional zones of transport geography in relation to ship types. In: O. Olsen, J.S. Madsen and F. Rieck (eds) *Shipshape: Essays for Ole Crumlin-Pedersen*. Roskilde: Viking Ship Museum.
- Wilkins, J.S. 1998. What's in a meme? Reflections from the perspective of the history and philosophy of evolutionary biology. *Journal of Memetics - Evolutionary Models of Information Transmission* 2.1: 2-33.
- Winter, H. 1956. *Die Katalanische Nao von 1450*. Magdeburg: Loef.
- Wolf, T. 1986. *Tragfähigkeiten, Ladungen und Maße im Schiffsverkehr der Hanse vornehmlich im Spiegel Revaler Quellen*. Cologne & Vienna: Böhlau.
- Zwick, D. 2012a. Variationen in der mittelalterlichen Schiffbautechnik anhand von Wrackfunden in Bremen. In: *Holzbau in Mittelalter und Neuzeit*. Mitteilungen der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit 24: 283-298.
- Zwick, D. 2012b. Lineare nautische Netzwerke im Ostseeraum des Mittelalters? In: S. Kleingärtner & G. Zeilinger (eds) *Raubbildung durch Netzwerke? Der Ostseeraum zwischen Wikingerzeit und Spätmittelalter aus archäologischer und geschichtswissenschaftlicher Perspektive*. Zeitschrift für Archäologie des Mittelalters. Beiheft 23: 95-115. Bonn: R. Habelt.

## Paper C

Zwick forthcoming: D. Zwick, A 15th-century shipwreck with Scandinavian features from Bremen, Germany. In: B. van Tilburg (ed.) *Ships and Maritime Landscapes* / 13th International Symposium on Boat and Ship Archaeology. Amsterdam. Groningen: Barkhuis.





# A 15<sup>TH</sup>-CENTURY SHIPWRECK WITH SCANDINAVIAN FEATURES FROM BREMEN, GERMANY

## Introduction

In the course of a rescue excavation carried out in spring 2007 on the Beluga Shipping construction site in Bremen, Germany, a shipwreck was unearthed within the excavation's sheet pile wall. It was dubbed 'Beluga Ship' in reference to the developer, who kindly funded the PEG conservation. With its radially cleft planks, wool luting and rivet fastenings, the wreck displays a number of features that point typologically to a vernacular Scandinavian origin and thus complements the great variety of shipwrecks

discovered in Bremen so far (Fig. 1). Interestingly however, the plank provenances fall into two groups outside of Scandinavia: high quality wainscot planks cut in the Baltic region in the course of the 14<sup>th</sup> century, and a group of locally cut timber — arguably for repairs — dating from the second quarter of the 15<sup>th</sup> century. The wreck was excavated under difficult circumstances and the tight schedule of a rescue excavation, allowing only 2 days for an *in situ* documentation carried out by this author single-handedly, employing the offset survey method.



Fig. 1: Overview of medieval and post-medieval wreck finds in the City of Bremen: [1] Bremen Cog (ca. 1380) – discovered in 1962, [2] Parts of a pram (1070–1240) and a log-boat – discovered in 1972/78, [3] Teerhof-Ship I (ca. 15<sup>th</sup> century) – discovered in 1978, [4] Pram “Karl” (ca. 808) – discovered in 1989, [5] Becks-Ship (ca.1444) – discovered in 1989, [6] Schlachte-Ship (ca.1170) – discovered in 1992, [7] Beluga-Ship (early 15<sup>th</sup> century) – discovered in 2007, [8 and 9]: two river barges (late 17<sup>th</sup> century) – discovered in 2007. The Balge tributary — which still served as harbour for inland vessels up to the 15<sup>th</sup> century — and a former side arm of the Weser River are indicated by the area hachured in blue (Photo and graph: Daniel Zwick, basis data from TopSoKa 1:10 000 ©Geoinformation Bremen, licensed on 22.07.2011).

## Site context

The site of discovery — *Teerhof* — is situated on a Weser peninsular and literally translates as ‘tar yard’. Its name dates back to at least the 17<sup>th</sup> century and initially referred to a tar storage near a sawmill at the peninsular’s northwestern extent, which is predated by a ‘tar house’ first mentioned in 1547 (Bischof, 2008a: pp. 95-97). These buildings served the taring of ships during building and maintenance works. Such tar yards are regularly found outside city precincts due to fire hazard of heating tar, so the peninsular offered optimal conditions. Already in the 13<sup>th</sup> century half a dozen buildings on the peninsular supplied ships and *Teerhof* was Bremen’s most important — if not only — shipbuilding site (Helm, 1955: p. 182). Corresponding archaeological finds testify shipbuilding activities, like the remains of a slipway and materials used for shipbuilding just ca. 20 m further downstream from where the Beluga Ship was discovered (Bischof, 2008a: pp. 95-97). Interestingly, this correlates to the location of a slipway shown on a woodcut from 1640/41 by Matthäus Merian the Elder (Fig. 2 - bottom). Very close to the Beluga Ship, but deeper, another late medieval clinker-built shipwreck was discovered in winter 1979 during an extreme low tide, with a keel preserved up to 11m in length and a mast-step in the stern-section (Brandt, 1979: p. 331).<sup>188</sup> The wreck extends to a depth of between 1.6 m to 0.65 m above mean sea level. In comparison, the late medieval groundwater table is reconstructed with +1.5 m above the present sea level in this area (Ortlam, 1996: p. 30). Thus the wreck would have been almost completely inundated at mean spring tide and exposed at low tide. Land erosion caused by the intensified deforestation as well as the continuous rise of the sea level from the 17<sup>th</sup> century onwards (cf. Behre, 2003: fig. 13) led to an aggradation of the Weser, covering the wreck by fluvial deposits of silty sands (Fig. 2 - top right). These and the lowermost planks were later truncated by erosive action of a high energy current, as indicated by coarse gravelly sands. Aided by the currents, fishing became a major activity at this site, as evidenced by numerous clay net sinkers found in the layers above (Bischof, 2008b: p. 208) and the wooden piles driven through the planking, which probably served for fastening weirs.<sup>189</sup>

<sup>188</sup> Regrettably, this wreck was neither published nor preserved, despite having been salvaged with great efforts in winter 1978/79. Judging from the photographic documentation, the vessel had a sharp turn-of-the-bilge reinforced by a stringer, comparable to the construction of the Blackfriars 3 wreck in London — a river barge from ca. 1400 (cf. Marsden 1996, 79ff).

<sup>189</sup> The fishermen were probably unaware of the wreck, as this had been covered already in fluvial sediments. It is fascinating to see the long-lasting presence of fishing activity at this river-bank: At

It is not surprising that the Beluga Ship was discovered at this site, since it was a common practise to scrap old worn-out vessels where new vessels were built, as many of the constructional elements could be reused. The frames had been removed with little damage, leaving only some planks with angular cuts where the frames would have been fastened. The careful removal indicates that the slab of planking was possibly intentionally left intact for reuse as a whole. Articulated slabs of planking are often found as roof and wall covering, road surface or as revetment shuttering (cf. Bleile, 1998: 13-16; Goodburn, 1997: p. 32; Larsen *et al*, 2011; Sorokin, 2003: p. 159). Whether the slab of planking was left there to prevent erosion or as working platform is not clear, but it seems notable that it is situated at a level that would have corresponded to the tidal range in the late medieval period. Similar findings of reuse could be also observed in the 14<sup>th</sup>-century Sandwich wreck, where most of the 22 frames had been chopped, sawn or broken off (Milne, 2004), and in the case of the Sørenga 1 wreck from the mid 14<sup>th</sup> century the keel was removed for re-use (Nævestad, 1998: p. 171). In Århus 15<sup>th</sup> century slabs of planking were reused as revetment, indicating a life span of roughly 30 before the vessels were broken up (Larsen *et al*, 2011: p. 23), and Sørenga 10 from the late 15<sup>th</sup> century was reused as articulated slab of planking, as indicated by two cuts on both ends of the keel (Fawsitt, 2012b: p. 9). Frames from clinker-vessels were even re-used in carvel-built vessels.<sup>190</sup> Re-use must of have been a widespread practise at that time, but understandably there is mostly only indirect evidence in the archaeological record of this, with the exception of a boatyard in Poole, England, where an open-air boatyard timber store from the late 14<sup>th</sup> or early 15<sup>th</sup> century was preserved *in situ* under estuarine deposits, in different groups of timbers such as knees, Y-shaped floor timbers, and planks from dismantled vessels neatly stacked in groups, like in a spare parts stock (cf. Watkins, 1994: pp. 10-11).

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Herrlichkeit — a bit further south of *Teerhof* where a bridge connected the peninsular with the city — fish-millers were granted the exclusive right of use in 1250 at the expense of shipbuilders (Weidinger; 2002: p. 119).

<sup>190</sup> The Woolwich wreck in London has been identified as the “Sovereign”, which frames feature beveled notches, as though it used to be a clinker-construction which was subsequently re-planked in carvel during the major maintenance works in 1509 (Salisbury, 1966). However, it appears that even a large royal ship like the “Sovereign” was built of reused frames, as indicated by a documentary source instructing the breaking up of the “Grâce Dieu” in 1449 and reusing the timber for the “Sovereign” (Adams, 2003: 66). So frames were even reused in totally distinctive constructions.

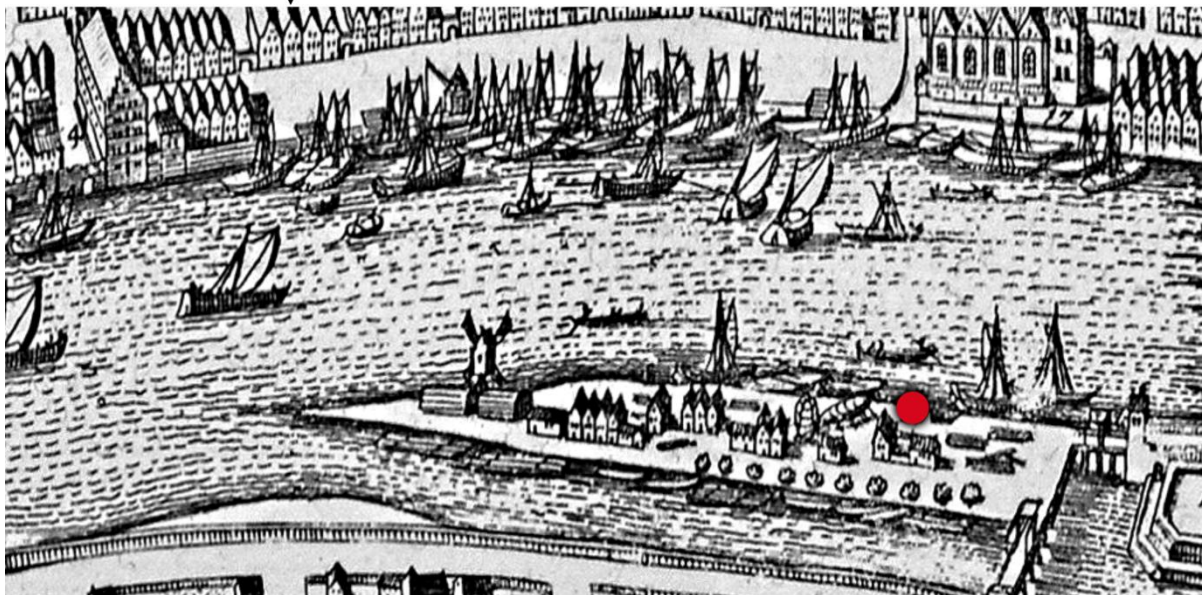
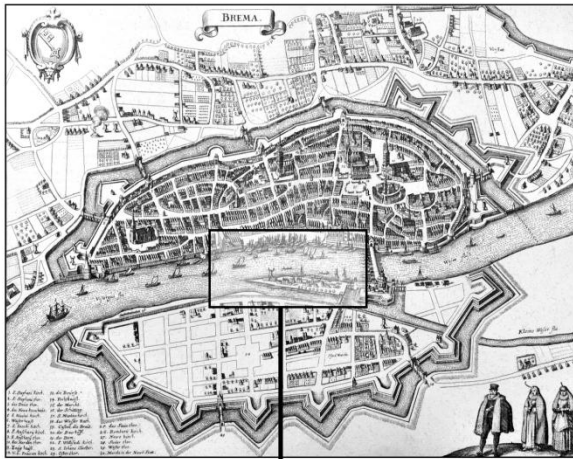


Fig. 2: Top right: After its deposition, the wreck was covered by clayey silty sands, some high in iron content [5], which were later partially eroded away [4], probably due to a change in river flow direction. So the first layers [5] are abutted by a new deposition of silty to coarse dark-brown organic sands [3] indicating two major changes in the macro-environment: The soil runoff in the course of deforestation led to the silting-up of rivers and thereby increased the flow velocity. This is also reflected in the deposition of coarser sediments. Tidal erosion undercut [2] the fluvial deposits [5], while building debris and muddled sands indicate that the uppermost deposit [1] was backfilled material, perhaps to solidify the river bank behind a revetment (Graph: Daniel Zwick). — Bottom: The 'Teerbof' as depicted by Matthäus Merian the Elder (1640/41), showing timber stacks and two slipways. The red dot indicates the approximate finding spot of the Beluga wreck. On the opposite river bank is the Schlachte quay where sprit-rigged lighters are unloaded.

## Ship timbers

Not much of the wreck has survived and would be more appropriately classified as articulated slab of planking, if not for the survival of a part of the stempost and keel. The latter was truncated by the excavator's bucket upon its discovery. On the port side eight strakes of planking have survived, becoming gradually more fragmented, and on the starboard side only a fragmented garboard plank. The absence of plank-to-plank fastenings in the upper planks is not indicative of the maximum height of the sides, but can be attributed to the deterioration of the plank edges and corrosion of the iron fastenings

which accelerated fragmentation (Fig. 3 — bottom). The analysed planks have a mean thickness of ca. 2.1 cm and a width of 20 to 26 cm and were clinker-fastened throughout. Unfortunately there are no indications to determine the original length and thus there is no way of knowing whether the amidships section formed part of the preserved slab of planking. The analysed planks were radially cleft, as indicated already by the narrow plank widths.

The width of the lands measure at least 2.5 cm and vary slightly. The plank scarfs roughly measure between 15 - 20 cm and finish with an even surface, with the forward facing edge inboard to prevent water entering through the joints. The upper strakes

— that is the lowermost planks in the *in situ* find — were increasingly deteriorated by erosion, owing to its position at the lower slope of the riverbank.

Keel and stem are diagonally notched together with a scarf of a length of ca. 25cm and a width of 6.2 cm (Fig. 3 — top). The tapering side of the stem exceeds the length of the notch and was wedged in between

the keel and the garboard. The width of the keel directly behind the scarf is 6.2 cm but widens continuously to 11.3 cm shortly before the keel damage, i.e. 180 cm behind the scarf. The keel features a trapezoidal shape in cross-section, a near V-shaped profile which elides into a U-shaped profile at the stem, owing to the sharper angle at which the hood-ends are rabbeted into the stem.

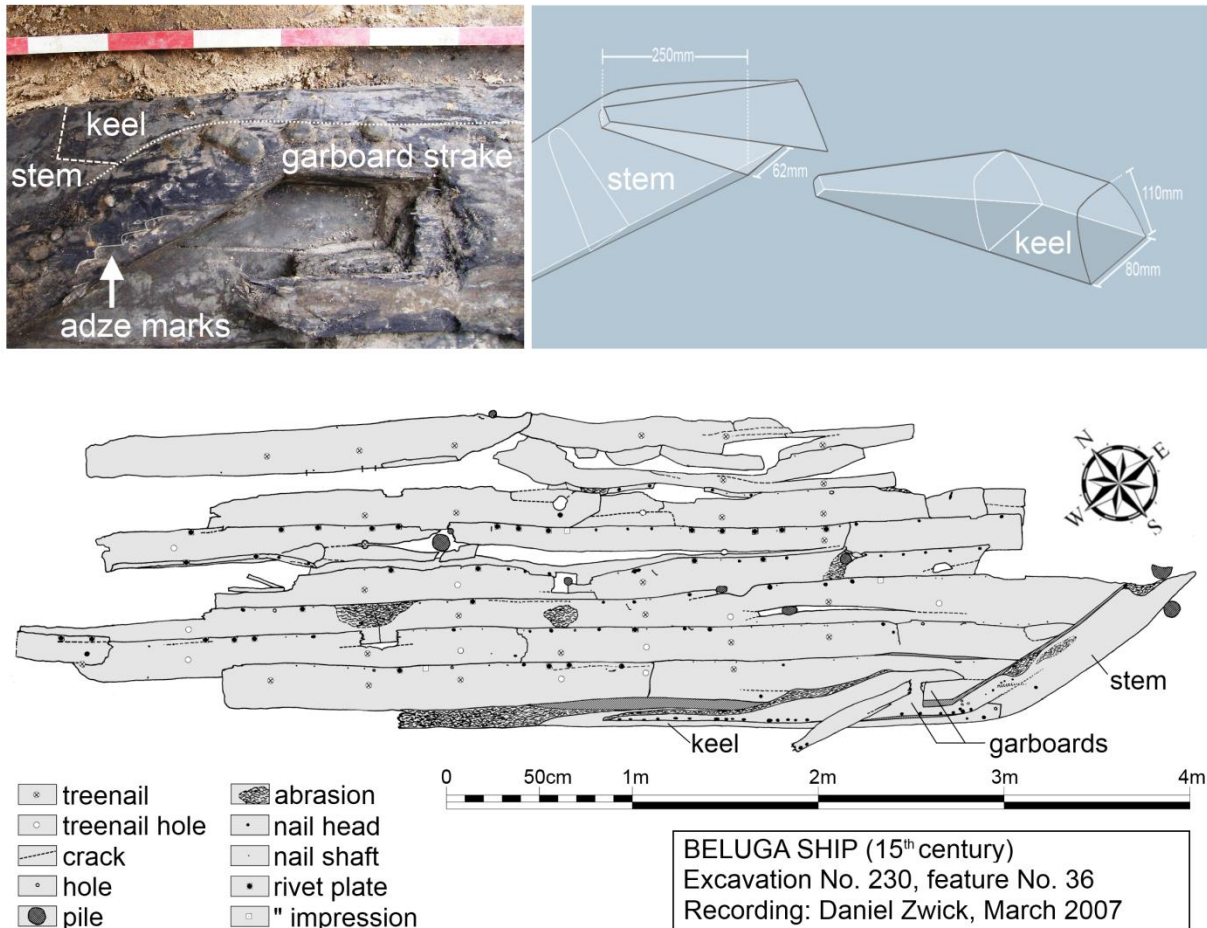


Fig. 3. Bottom: The *in situ* plan of the Beluga Ship shows the inner side of the starboard planking. On this drawing a loose plank from the second strake was not included and thus the wreck does not show in its maximum extent of 7m. The symbols for the connection elements are slightly magnified. — Top left: The planking was adzed off on the starboard side, leaving only a fragment of the garboard. The tool marks are highlighted. The hood-ends of the starboard planking were adzed off the stem (white). The angular cut might display an effort of removing a V-shaped frame located at the keel-stem transition (yellow). The planks (blue) were fastened to the keel and to the stem with nails (red) with great variances in spacings and head sizes, albeit the latter can be attributed to iron concretions. — Top right: A schematic drawing of the vertical stem-keel scarf seen from the underside. The scarf is also tapering in moulded height due to the curvature of the stem (Graph: Daniel Zwick).

It seems as though the hood-ends are flush, as the rabbet does not indicate stepped recesses. However, the keel does not seem to have rabbets for the garboard strakes; the latter were apparently just nailed onto the former with numerous spikes, leaving smaller gaps than between the rivet plank-to-plank fastenings. The keel is very similar to that of the Aber Wrac'h wreck, which also lacks a proper rabbet to receive the garboards and has only a slight lateral groove at the ends which disappears amidships, with the planks merely nailed onto the keel (L'Hour and

Veyrat, 1994: p. 169). The stem has a rabbet for receiving the hood-ends, which however is invisible on the starboard side and thus appears to have been abraded or adzed off. Apart from the fact that almost all planks from the starboard side were removed, with the exception of a garboard fragment, all frames were carefully removed too. Only the treenail rows at an interval of roughly 50 cm indicate their former position.

## Waterproofing

The lands of the overlapping planks were luted<sup>191</sup> with brownish wool strands. The microscopic analysis of a luting sample has shown that it was made of wool blend of an older sheep race, consisting of very fine to rough fibres without pucker, with a thickness of between 20-70  $\mu\text{m}$ , a length of only a few centimetres and of frail texture when washed (Van't Hull, 2007). The short length of the fibres may indicate that the wool may have been reused from a worn out fabric, while the dark brown colouring indicates a treatment with tar. The scarfs were also laminarily luted. The waterproofing technique in vessels built of radially cleft planks was more difficult due to the irregular edge thicknesses of hewn planks (Coates, 1977: p. 223). This explains the ample quantities of caulking material used. Evidence from Britain, Norway (Steen, 2012: p. 50) and Denmark (Bill, 1997: tab. 1) has shown that the overlapping lands in clinker constructions were almost exclusively luted with animal fibres up to the late medieval period, with the exception of scarfs (cf. Auer & Maarleveld, 2013: p. 15; Thowsen, 1965: p. 45).

## Fastenings

The treenail rows are regularly spaced at an interval of roughly 50 cm. Each frame had been connected with one treenail per strake. A couple of treenails were missing, probably rebored or driven out to facilitate the removal of the frames. The remaining treenails in place are all stubs.

The garboard strakes are connected to the keel and the lowermost post of the stem with an exceedingly high number of iron nails with larger than average heads. In the following, near-average measures are provided, as the circumstances did not allow a complete recording of all variances. The clinker planks were interconnected with iron nails in fairly irregular intervals. Their shafts are about 42 mm long and rectangular in cross-section, measuring ca. 65 x 45 mm. The head is oval with a diameter of 24 - 30 mm and a thickness of 5 mm (Fig. 4 — top). Some heads appear considerably larger. The iron fasteners which have not been corroded away on the inboard side were all rivetted over rectangular roves, measuring ca. 25 x 23 mm, with a thickness of 6mm. A single loose bend iron nail was also found nearby, which possibly served for fastenings in areas with no access for a clench-holder

Particularly at places not covered by silty fluvial deposits, several rivetted plates and nail heads have corroded away, leaving only the nail shafts in the

wood. The corrosion would have been accelerated by being exposed to the brackish Weser waters, and the gallic acid found in oak (cf. Wagner, 1984: p. 132). At several points only the imprint of roves has been preserved in the wood, while the roves and nails have corroded away entirely. The good visibility of the rove-impressions may be an indicator for the vessel's advanced age at the time it was scrapped, as this could be an indication that the roves have "eaten" their way into the wood, which usually leads to problems with water-tightness. This would be a good explanation for the scrapping of the vessel at the end of its working life. Modern boat-building experience has shown that it is particularly difficult to keep large clinker-built ships watertight, and that therefore rivets used to be much larger than they are today (Godal, 1995: p. 282), arguably with the intent to increase the thrust face to avoid deep rove-impressions and thus a loose fastening. Such tendency in rivet-sizes is also reflected in the ship-fragments discovered in London (Goodburn, 1991: p. 112), although reduction in size is linked to closer spacings (Damian Goodburn, pers. comm.).

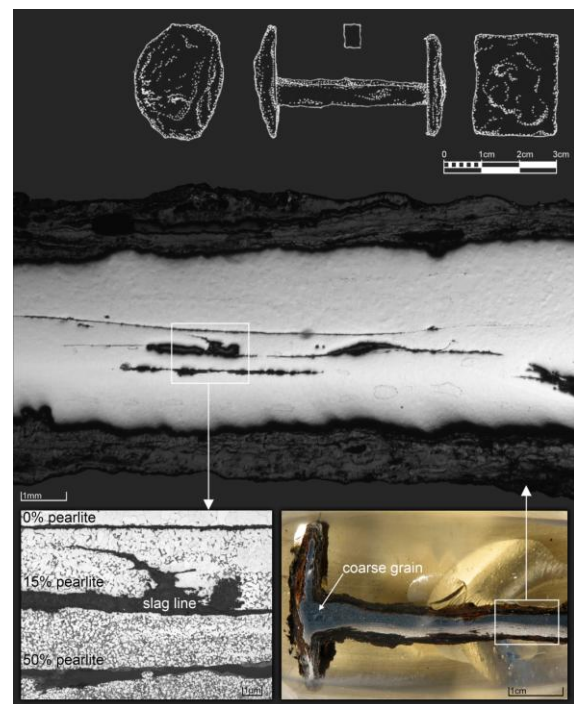


Fig. 4: Top: Rivetted square-shanked iron nails as the one depicted above served as plank fastenings (graph: Daniel Zwick). — Bottom: The metallurgical analysis showed the ferrite and pearlite lamination with slag lines as typical for iron production in bloomeries. The coarse grain in the transition from head to shaft indicates that there was little deformation and thus indicated that the nail was manufactured from one strip of iron. (Photos: Stefan Koch, modified by the author).

Albeit certainly not representative, a metallurgical analysis of one of the iron rivets was conducted, which confirmed that it was produced in a bloomery, the typical way of iron production in medieval times and before. The varied thickness of slag lines, the

<sup>191</sup> caulking material inserted before the fastenings of the planks, also referred to as 'inlaid caulking'

varied ferrite, perlite and carbon concentrations are typical indicators for this practice, in which blooms were formed in the melting process and iron strips folded to hammer out the slag (Koch, 2008: p. 4).<sup>192</sup> The slag lines can be explained by the folding and welding together of scrap iron. While irregular carbon concentrations in the banded structure do not necessarily indicate welding, slag lines certainly do (Piaskowski, 1982: p. 47). They form as a consequence of using a fluxing agent, like sand, in order to bind the oxide layer, which leads to the characteristic black slag lines (Fig. 4 — bottom). The transition from head to shaft features coarse grain and thus shows that the nail has been subject to less deformation at this point, indicating that the nail was manufactured from one strip of iron (Koch, 2008: 3-4). This also corresponds to the typical way of manufacturing in medieval times, in which an oblong metal strip was hammered into an angular shaft, cut off at a certain interval and the head welded over a form (cf. Bill, 1994: p. 56). This type featuring an angular shaft and a rectangular rove was once typical in Scandinavia and the British Isles, but has assumed a commonplace spread in northern Europe beyond the Scandinavian sphere since the end of the twelfth century (Bill, 1994: p. 60).<sup>193</sup>

## Dating and provenance

The first dendrological samples taken from the fragmentary upper planks yielded a result from the second quarter of the 15<sup>th</sup> century with a provenance

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<sup>192</sup> This method was described in Georg Agricola's posthumously published *de re metallica* from 1556 (Agricola, 1556: book IX; see also Hoover and Hoover; 1912: pp. 420-422).

<sup>193</sup> Although the metallurgical analysis of just one rivetted nail is certainly not representative, it seems nevertheless worth noting, that this nail alone is harder than a whole range of iron fittings from the 'Bremen Cog'. While the characteristic banded structure indicates an identical forging technique, which leads to the characteristic slag lines, along the varied carbon concentrations and the coarse grain in the head-shaft transition, the sample from the Beluga Ship had a hardness of 108 HV10 at the head and 127 HV10 (kp/mm<sup>2</sup>) at the shaft (Koch, 2008: p. 5) and thus excels the maximum value for one of the three nail samples from the 'Bremen Cog', which is 97 HV10 (kp/mm<sup>2</sup>) (Ladeburg, 1969: p. 159). Although this finding might be of little consequence, it adds to the impression that greater care was taken in the choice of materials and construction of the Beluga Ship, whereas the 'Bremen Cog' was more coarsely and heavily built with lower quality of materials. It is notable that the quality of timber used in the Beluga Ship likewise exceeds that of timber used for the 'Bremen Cog', so there might be a general pattern in the cost-benefit assessment regarding choice of material and workmanship.

from the Weser Lowland (Heußner, 2009a). Wood in riverine lowland regions is subject to unique conditions which lead to a distinctive regional annual ring growth by which their provenance could be closely determined.<sup>194</sup> The date is supported by a *terminus post quem*, a Siegburg stoneware fragment found beneath the wreck, pointing to the turn of the 15<sup>th</sup> century. The decision to take further samples from the lowermost and better preserved strakes — despite infringing the wreck's structural integrity — was rewarded with an unexpected result: The lowermost planks did not only antedate the latter by a few decades, but originated from the Baltic region (Heußner, 2009c). The findings and implications of the dendrological analysis are discussed in further detail in a forthcoming article of this author (Zwick, forthcoming).

## Timber supply and workmanship

The planks with the Baltic provenance are of the highest quality oak, virtually knotless and straight grained. While it is not possible to determine the exact provenance for Baltic oak timber (Ważny, 2002), not least due to the extensive hinterland where Baltic oak was cut and floated down the Daugava River to Riga (Zunde, 1998/99), the quality itself indicates that the timber was cut in a wildwood area. In such woods, the lower branches die off early and grown over due to the overarching shade provided by treetops, leaving small knots only in the first few growth rings (McGrail, 1998: p. 37). As opposed to the heavily branched trees in managed woodlands, these tall straight-grained trunks are easily cleft and planks can be of much greater lengths (Goodburn, 2003: p. 293).<sup>195</sup> Timber supply directly affects timber conversion and ultimately the shipbuilding technique.

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<sup>194</sup> No matches were found with the master chronologies, so the dendro laboratory Pfreffer was consulted, which specialised in local wood (Karl-Uwe Heußner, pers. comm. 1.4.2009).

<sup>195</sup> If compared to the 'Bremen Cog' from around 1380, the Beluga Ship is not only distinctive in terms of construction, but also in terms of wood supply. The tangentially sawn timber used as planks in the 'Bremen Cog' were of such bad quality, that even during the initial construction some cracks needed to be patched (Lahn, 1992: pp. 44-45). Its planks were made of logs floated down the Weser River from the Weser mountains and reflects little choice in oak supply. These logs could not have been cleft in a similar way as those in the Beluga Ship due to their knotty nature, which would have resulted in a contorted twisted plank with many weak spots. Thus, it would have been impossible to build the Beluga Ship with the kind of wood available to the builders of the 'Bremen Cog', so the reliance on high quality

Sawing is commonly regarded as the more modern method of timber conversion, whereas radial cleaving is often regarded as old-fashioned and vernacular. However, shipbuilding techniques perceived as innovative could have been primarily driven by scarcity of adequate timber, rather than a progression in technology in its own right. It should be kept in mind that radially cleft timber had technical advantages which explains its longevity even in late medieval times. It allowed the planks to be thinner, as medullary rays were left intact, adding strength while making planks more flexible and lighter. Moreover, radially cleft planks are watertight, thus regularly also used as barrel staves. And last not least, radially split edge-wood offers a better nail hold (Godal, 1995: p. 274).

## Reconstructing the vessel

Although the dimensions of the planks in the Beluga Ship appear very modest, this is not necessarily a good indicator for the vessel's original size. Seán McGrail addressed the issue of estimating ship-sizes on the basis of dimensions of individual ship-timbers, and by his estimate the Beluga wreck would make it into the group of 'large boats or small ships' (cf. McGrail, 1993: p. 11 and pp. 19-21).<sup>196</sup> Interestingly, and quite prudently, McGrail did not include plank width as criteria, which is often elsewhere instinctively taken as indicator. But even in late medieval times, sizeable vessels could be built with planks of minor widths and thicknesses. The Dokøen 3 wreck<sup>197</sup> discovered in Copenhagen dates to ca. 1423 and is about 13 m in length and likewise planked with imported wainscot boards with widths and thicknesses averaging 24 cm and 2.75 cm, respectively (Nielsen, forthcoming: p. 108). And even the Basque built clinker-wreck from Aber Wrac'k has very modest plank, keel and stem dimensions despite its great general length of approximately 25 m. On the one side its hull was preserved only to its 8<sup>th</sup> strake, with the turn-of-the-bilge forming the breaking point, but on the other as many as 24 strakes survived (L'Hour & Veyrat, 1994: p. 170).<sup>198</sup>

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import timber from the Baltic was very much the precondition for this construction.

<sup>196</sup> However, even this rough classification does not fit all sizes: The Norwegian Bårset wreck from ca. 800-895 AD, for instance, has plank thicknesses in the range of only 1.2 - 1.6 cm as would be expected in small boats, but an overall length of a 'small ship' of between 11 to 15 m. The exceptional quality of the material explains the thin planks (Godal, 1995: p. 277).

<sup>197</sup> elsewhere also named as Dock Islands 3

<sup>198</sup> Whether a sharp turn of the bilge offering a natural breaking point explains the increased fragmentation at the Beluga Ship's deteriorated seventh and eighth strake cannot be answered. But it

Due to the missing of the frames and the frailty of waterlogged wood, the Beluga Ship has undergone considerable deformation, with the port-side shell collapsed on the river bank's downside slope, making it difficult to infer the hull shape. But on the basis of the construction some characteristics can be deduced. The use of radially cleft wainscots for the planking and the wide frame intervals show that the vessel was lightly constructed, which would have been advantageous if it was meant to operate under oars. This is also indicated by the find location, as seagoing sailing vessels that were too sturdy to operate under oars usually anchored in the Weser estuary and their cargo was transshipped via lighter traffic to Bremen at that time. The keel-stem construction on the other hand suggests that the vessel was by no means bound exclusively to inland waters, but would have been a seaworthy vessel. Also the absence of garboard rabbets in the keel indicates a greater deadrise angle than would have been common with T-shaped or plank keels, with the garboards running almost vertically. This would have added lateral stability to decrease side drift when sailing close-hauled.

## Conclusion and outlook

The Beluga Ship is a distinctive find given the combination of its German find location, its Scandinavian way of construction and Baltic provenance, highlighting the interconnectedness of the northern European maritime network. It is one of the very few medieval wrecks known to date that has been built of timber actually cut in the Baltic region. This is very significant, as the bulk of timber was imported from the Vistula region, which is often generically — but quite misleadingly — also referred to as "Baltic timber". Since structural timber was usually cut locally, further indications on the wreck's origin could be deduced from the remaining keel and stem, which are unfortunately inaccessible for sampling at the present.

While this paper discusses the specifics of construction and site context, a second paper by this author compares the Beluga Ship to over 50 other late medieval clinker-built shipwrecks in NW-Europe, while exploring the significance of Baltic timber imports for western European shipbuilders (Zwick, forthcoming).

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can be confidently stated that there might have been many more strakes in the original construction, as plank dimensions alone are no precise parameters for estimating the vessel's original size.

## Acknowledgments

I am indebted to Dieter Bishop for entrusting me with the recording, study and publication of this shipwreck. Thanks are also due to Per Hoffmann for his on-site first aid conservation advice, Stefan Koch for conducting the metallurgical analysis for free of charge, and Karl-Uwe Heußner for providing valuable background information on the dendrological analysis. Last not least, I am very much indebted to Anton Englert and Damian Goodburn for their highly appreciated critical feedback on the draft.

## Bibliography

- Adams, J. 2003. *Ships, Innovation and Social Change. Aspects of Carvel Shipbuilding in Northern Europe 1450-1850* (Stockholm: Stockholms Universitet).
- Auer, J. and Maarleveld, T. 2013. *Skjernøysund Wreck 3: Fieldwork Report 2011*. Esbjerg Maritime Archaeology Reports 5 (Esbjerg: Syddansk Universitet).
- Behre, K.-E. 2003. Eine neue Meeresspiegelkurve für die südliche Nordsee, *Probleme der Küstistenforschung in südlichen Nordseegebiet* 28, 9-63.
- Bill, J. 1994. Iron Nails in Iron Age and Medieval Shipbuilding, in C. Westerdahl, *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology (Roskilde: Vikingeskibsmuseet), 55-64.
- Bill, J. 1997. *Small Scale Seafaring in Danish Waters AD 1000-1600*. Ph.D. dissertation (Copenhagen: Københavns Universitet).
- Bischof, D. 2008a. Werften und Wracks am Weserufer: Vorbericht über die Grabung Beluga auf dem Teerhof 2007, *Bremer Archäologische Blätter* 7, 93-110.
- Bischof, D. 2008b. Archäologische Nachweise vom Fischfang in Bremen, *Bremer Archäologische Blätter* 7, 207-214.
- Bleile, R. 1998. Maritimes Kulturgut aus Stadtkerngrabungen in Mecklenburg-Vorpommern, *Nachrichtenblatt Untewasserarchäologie* 4, 13-16.
- Brandt, K. H. 1979. Neue Ausgrabungen und Funde in Bremen (1978), *Bremisches Jahrbuch* 57, 317-334.
- Coates, J. F. 1977. Hypothetical reconstructions and the Naval Architect, in S. McGrail (ed.), *Sources and Techniques in Boat Archaeology*. British Archaeological Reports 29 (Oxford), 215-226.
- Crumlin-Pedersen, O. 1986. Aspects of Wood Technology in Medieval Shipbuilding, in O. Crumlin-Pedersen and M. Vinner, *Sailing into the past : proceedings of the International Seminar on Replicas of Ancient and Medieval Vessels, Roskilde, 1984*. (Roskilde: Vikingeskibsmuseet), 138-149.
- Elmshäuser, K. 2003. Bremen und seine Kaufleute – Konflikte und Kämpfe, in G. Hoffmann and U. Schnall, *Die Kogge – Sternstunde der deutschen Schiffarchäologie* (Bremerhaven and Hamburg: Convent), 206-233.
- Fawsitt, S. 2012a. *Rapport: Dronning Eufemiasgate Sorenga 9*. Arkeologisk Rapport 2012, 9 (Oslo: Norsk Maritimt Museum).
- Fawsitt, S. 2012b. *Rapport: Dronning Eufemiasgate Sorenga 10*. Arkeologisk Rapport 2012, 10 (Oslo: Norsk Maritimt Museum).
- Godal, J. B. 1995. The use of wood in boatbuilding, in O. Olsen, J. Skamby Madsen and F. Rieck, *Shipshape: Essays for Ole Crumlin-Pedersen* (Roskilde: Vikingeskibsmuseet), 271-282.
- Goodburn, D. M. 1991. New Light on Early Ship- and Boatbuilding in the London Area, in G. L. Good, R. H. Jones and M. W. Ponsford, *Waterfront Archaeology*. Proceedings of the third international conference on waterfront archaeology held at Bristol 23-26 September 1988 (London: Council for British Archaeology), 105-115.
- Goodburn, D. M. 1997. Reused Medieval ship planks from Westminster, England, possibly derived from a vessel built in the cog style, *The International Journal of Nautical Archaeology* 26.1, 26-38.
- Goodburn, D. 2003. Rare fragments of a 13<sup>th</sup> century clinker galley found in London and the use of the Irish wildwoods for shipbuilding, in C. Beltrame, *Boats, Ships and Shipyards*. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000 (Oxford: Oxbow Books), 289-295.
- Haneca, K., Čufar, K., Beeckman, H. 2009. Oaks, tree-rings and wooden cultural heritage: a review of the main characteristics and applications of oak dendrochronology in Europe, *Journal of Archaeological Science* 36, 1-11.
- Helm, K. 1955. Bremens Holzschiffbau vom Mittelalter bis zum Ausgang des 19. Jahrhunderts, *Bremisches Jahrbuch* 44, 175-243.
- Heußner, K.-U. 1999. Wieviel fehlt? - Ein Beitrag zur Genauigkeit von dendrologischen Datierungen, in E. Cziesla, T. Kersting and S. Pratsch, *Den Bogen*



- spannen...“ Festschrift für Bernhard Gramsch* (Weissbach: Beier & Beran), 523-525.
- Heußner, K.-U. 2009a. report 12.02.2009 (unpublished).
- Heußner, K.-U. 2009b. report 17.03.2009 (unpublished).
- Heußner, K.-U. 2009c. report 17.12.2009 (unpublished).
- Hoover, H. C. and Hoover, L. H. 1912. *Georgius Agricola — De Re Metallica* (London: Salisbury House).
- Koch, S. 2008. *Bericht über eine Untersuchung an einem Nagel- und einer Nietplatte des Beluga-Schiffes aus dem Mittelalter (15/16 Jb.)* (unpublished).
- Ladeburg, H. 1969, Untersuchung und Konservierung der Eisenteile der Bremer Kogge, in H. Abel, *Die Bremer Hanse-Kogge: ein Schlüssel zur Schiffahrtsgeschichte* (Bremen: Röver), 157-168.
- Lahn, W. 1992. *Die Kogge von Bremen. Band 1: Bauteile und Bauablauf* (Hamburg: Convent).
- Larsen, L. K., Baittinger, C. and Bonde, N. 2011. Reused boat timbers from Aarhus. *Maritime Archaeology Newsletter from Denmark* 26, 21-23.
- L'Hour, M. and Veyrat, E. 1994. The French Medieval Clinker Wreck from Aber Wrach, in C. Westerdahl, *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde 1991 (Oxford: Oxbow Books), 165-180.
- Marsden, P. 1996. *Ships of the Port of London*. English Heritage Archaeological Report 5 (London: English Heritage).
- McGrail, S. 1993. *Medieval Boat and Ship Timbers from Dublin* (Dublin: Royal Irish Academy).
- McGrail, S. 1998. *Ancient Boats in North-West Europe. The Archaeology of Water Transport to AD 1500* (London and New York: Longman).
- Milne, G. 2004. The fourteenth-century merchant ship from Sandwich: a study in medieval maritime archaeology, *Archaeologia Cantiana* 124, 227-264.
- Nævestad, D. 1998. Lokaliserte middelaldervrak i Øst-Norge. *Norsk Sjøfartsmuseum Årsbok*, 159-208.
- Nielsen, X., forthcoming, *Dock Island's Wreck 3: hull description and comparative analysis of a 15<sup>th</sup> century clinker built vessel, with a review of its documentation methodology*. Master's thesis (Esbjerg: Syddansk Universitet).
- Ortlam, D. 1996. Das mittelalterliche Flusssystem der Weser im Bremer Becken. Die Balge als Hauptstrom der Werra/Weser, *Der Aufbau* 51.1, 28-32.
- Piaskowski, J. 1982. Metallographische Untersuchungen zur Eisen- und Stahltechnologie in Haithabu, *Berichte über die Ausgrabungen in Haithabu* 17, 45-62.
- Salisbury, W. 1961. The Woolwich Ship, *The Mariner's Mirror* 47.2, 81-90.
- Sorokin, P. 2003. Staraya Ladoga: a seaport in medieval Russia, in L. Blue, F. Hocker, A. Englert, *Connected by the Sea*. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology (Oxford: Oxbow Books), 157-162.
- Steen, K. 2012. *Rapport: Dronning Eufemiasgate Sorenga 8*. Arkeologisk Rapport 8, 2012 (Oslo: Norsk Maritimt Museum).
- Thowsen, A. 1965. Foldrøyskipet: Et middelaldersk skipsfunn fra Vest-Norge, *Sjøfartshistoriske Årbog* (Bergen: Stiftelsen Bergens Sjøfartsmuseum), 38-57.
- Van't Hull, H. 2007. *Archäobotanisches Gutachten zur Ausgrabung Bremen 227 und 230 / Altstadt 2006-07* (unpublished).
- Wagner, P. 1984. Wood Species in Viking Age Shipbuilding, in O. Crumlin-Pedersen and M. Vinner, *Sailing into the Past*. The International Ship Replica Seminar, Roskilde 1984 (Roskilde: Vikingeskibsmuseet), 130-137.
- Watkins, D. R. 1994. *The Foundry Excavations on Poole Waterfront 1986/7*. Dorset Natural History and Archaeological Society Monograph Series 14 (Dorchester: Dorset Natural History and Archaeology Society).
- Ważny, T. 1990. *Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen*. Ph.D. dissertation (Hamburg: Universität Hamburg).
- Ważny, T. 2002. Baltic timber in Western Europe – an exciting dendrochronological question, *Dendrochronologia* 20.3, 313-320.
- Weidinger, U. 2002. Die Entstehung der Schlachte als mittelalterliche Hafenanlage Bremens, in K. Elmshäuser, *Häfen — Schiffe — Wasserwege. Zur Schiffahrt des Mittelalters*. Schriften des Deutschen Schiffahrtsmuseums 58 (Hamburg: Convent), 116-132.
- Wolf, T. 1986. *Tragfähigkeiten, Ladungen und Maße im Schiffsverkehr der Hanse. Vornehmlich im Spiegel Revaler Quellen*. Quellen und Darstellungen zur hansischen Geschichte (Neue Folge) 31. (Cologne and Vienna: Böhlau).

Zunde, M. 1998/99. Timber export from Old Riga and its impact on dendrochronological dating in Europe, *Dendrochronologia* 16/17, 119-130.

Zwick, D. forthcoming. A 15th-century shipwreck with Scandinavian features from Bremen:

Interpreting the 'Beluga Ship' in the context of late medieval clinker constructions in North-Western Europe. In: N. Mehler, E. Elvestad & M. Gardiner (eds.), *Germans in the North Atlantic 1400-1700*. Northern World Series (Leiden: Brill).

## Paper D

Zwick forthcoming: D. Zwick, Interpreting a Scandinavian-built shipwreck from Bremen in the context of late medieval clinker constructions and northern European timber trade. In: N. Mehler, M. Gardiner (eds.), *German Trade in the North Atlantic 1400-1700: Interdisciplinary Perspectives*. Arkeologisk museum Stavanger Skrifter. Stavanger.



# A 15<sup>TH</sup>-CENTURY SHIPWRECK WITH SCANDINAVIAN FEATURES FROM BREMEN — THE ‘BELUGA SHIP’ IN THE CONTEXT OF LATE MEDIEVAL CLINKER CONSTRUCTIONS AND TIMBER TRADE IN NORTHERN EUROPE.

## Abstract

While most of this volume’s contributions trace Hanseatic influences throughout the North Atlantic, this paper examines a possible counter-influence in the shape of a medieval shipwreck discovered in Bremen in 2007, the construction of which is reminiscent of the Scandinavian shipbuilding tradition. With its radially cleft planks, inlaid wool caulking and clinker-fastenings, the wreck displays a number of features that point typologically to a vernacular Scandinavian origin, however, the planks fall into two groups outside of Scandinavia: high quality wainscot planks cut in the Baltic region in the course of the fourteenth century, and a group of locally cut timber — arguably for repairs — dating from the second quarter of the fifteenth century. This period coincides with a peak of Baltic timber export, especially wainscot for shipbuilders. Hence the wreck is being discussed within the wider context of clinker-built wrecks from this period in general and wrecks built of Baltic oak in particular.

## Introduction

In the course of the rescue excavation<sup>199</sup> in the construction pit at Bremen’s Teerhof, a medieval shipwreck dubbed the ‘Beluga Ship’ was discovered in 2007. The site is located on a promontory dividing River Weser from a side arm. The Beluga Ship is the first medieval shipwreck in this city with notable traditional Scandinavian features.<sup>200</sup> It thus complements the great variety of shipwrecks discovered in Bremen so far (Illus. 1, no. 7). The

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<sup>199</sup> Excavation No. 230 “Altstadt Teerhof BA1”, feature No. 36 “Beluga Ship”.

<sup>200</sup> An anonymous reviewer criticised my use of the term “Scandinavian shipbuilding tradition”, as it allegedly contains a bias on origin, despite this is the established nomenclature for the observed construction method. It has been noted, however, that the ‘Nordic’ or ‘Scandinavian’ shipbuilding tradition should not be understood in a strictly ethnic sense, as it could also occur outside of the Scandinavian world (cf. Crumlin-Pedersen 2004, 43). This fact is also emphasised in this very paper.

presence of wrecks of both inland and seagoing craft emphasises Bremen’s role as international port of transshipment, connecting the hinterland with the North Sea. This paper is divided into three main sections, the first being a brief summary of technical details, followed by an evaluation in which the Beluga Ship is contextualised to other wrecks in northwestern Europe in terms of construction and timber provenances, and conclusively implications of the assumed Scandinavian origin and the local site context in the Lower Weser region are explored.

## Principal construction features of the Beluga Ship

Although only a slab of planking of ca. 7m length has survived, the inconspicuous wreck remains contain a multitude of information of the way of construction.<sup>201</sup> The wreck is a traditional lapstrake construction (Illus. 2), entirely clinker-built with radially cleft oak planks with widths ranging between 20 - 26cm and a mean thickness of 2.1cm. These are inter-connected with square-shanked clinker-nails (rivetted nails with rectangular roves) measuring ca. 2.5 x 2.3cm, with a thickness of 0.6cm. The lands<sup>202</sup> between the planks were waterproofed with tarred wool as inlaid caulking<sup>203</sup>. The waterproofing technique in vessels built of radially cleft planks was more difficult, as the surfaces were more uneven than sawn planks.<sup>204</sup>

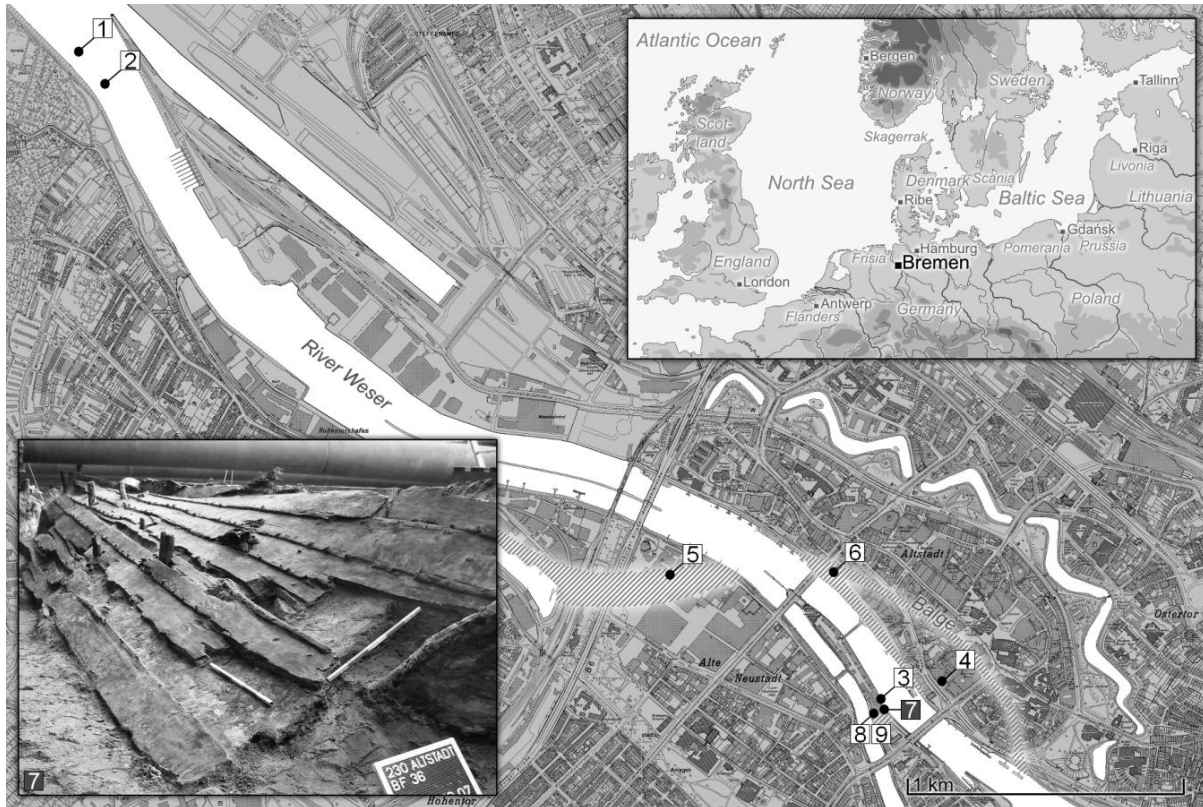
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<sup>201</sup> In this article only a brief summary of the technical details is provided. The construction method is discussed in more detail in Zwick 2010, 2012 and Zwick, forthcoming

<sup>202</sup> Lands are the overlapping edges of clinker planks or strakes.

<sup>203</sup> also known as luting, describing a procedure by which the caulking material is inserted before assembling the planks, rather than being driven in afterwards.

<sup>204</sup> Radial cleaving occurs along the grain, which is usually not as even as sawn cuts. Thus edge thicknesses vary slightly in such planks and are more difficult to waterproof when fastened edge to edge (Coates, 1977, 223)



*Illus. 1: Overview of medieval and post-medieval wreck finds in the City of Bremen: [1] Bremen Cog (ca. 1380) – discovered in 1962, [2] Parts of a pram (1070–1240) and a log-boat – discovered in 1972/78, [3] Teerhof-Ship I (ca. fifteenth century) – discovered in 1978, [4] Pram “Karl” (ca. 808) – discovered in 1989, [5] Becks-Ship (ca.1444) – discovered in 1989, [6] Schlachte-Ship (ca.1170) – discovered in 1992, [7] Beluga-Ship (early fifteenth century) – discovered in 2007, [8 and 9]: two river barges (late seventeenth century) – discovered in 2007. The Balge tributary — which still served as harbour for inland vessels up to the fifteenth century — and a former side arm of the Weser River are indicated by the area hachured in blue (Graph: Daniel Zwick, basis data from TopSoKa 1:10 000 ©Geoinformation Bremen, licensed on 22.07.2011).*

This explains the ample quantities of caulking material used. Evidence from Britain, Norway<sup>205</sup> and Denmark<sup>206</sup> has shown that the overlapping lands of clinker constructions were almost exclusively caulked with animal fibres up to the late medieval period, with the exception of scarfs.<sup>207</sup> The constructional characteristics observed in the Beluga Ship are typical for Scandinavia, to a certain extent the British Isles and other parts of northern Europe, and very distinctive to contemporary wrecks in the southern North Sea littoral. This includes also the keel and stem construction. Both components are connected by a diagonal scarf at a length of ca. 25cm. The absence of garboard rabbets<sup>208</sup> in the keel indicates a greater

deadrise angle<sup>209</sup> than would have been common with T-shaped or plank keels, with the garboards running almost vertically.<sup>210</sup> This would have added lateral stability to decrease side drift. Another criteria on seakeeping capabilities can be inferred from frame distances. Although none have survived, as they had been evidently removed for reuse — indicating that the vessel was scrapped —, rows of treenails indicate their former presence at intervals of 50cm, a very common distance for small and medium-sized vessels.

<sup>205</sup> Steen 2012, 50

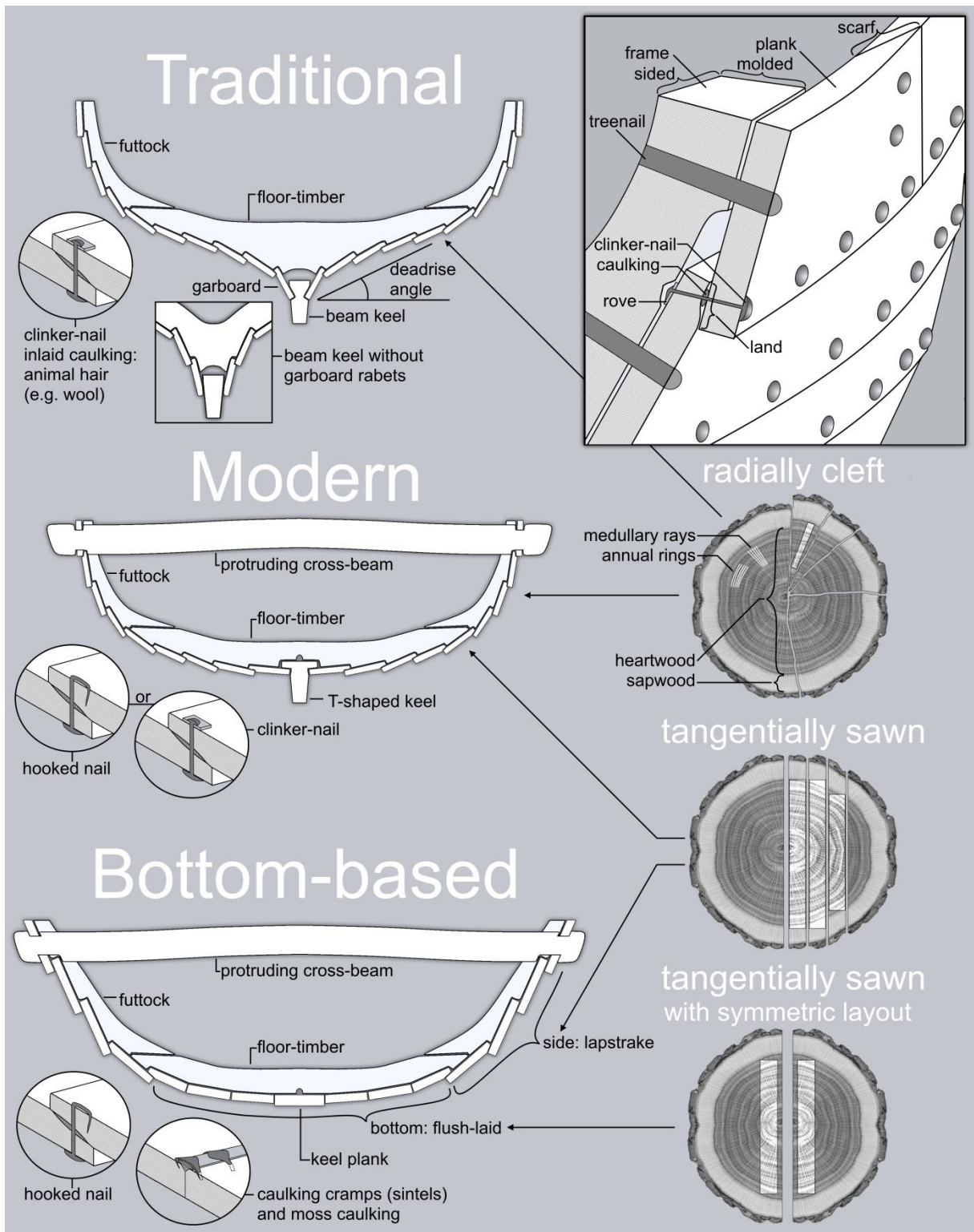
<sup>206</sup> Bill 1997, tab. 1

<sup>207</sup> e.g. Auer & Maarleveld 2013, 15; Thowsen 1965, 45

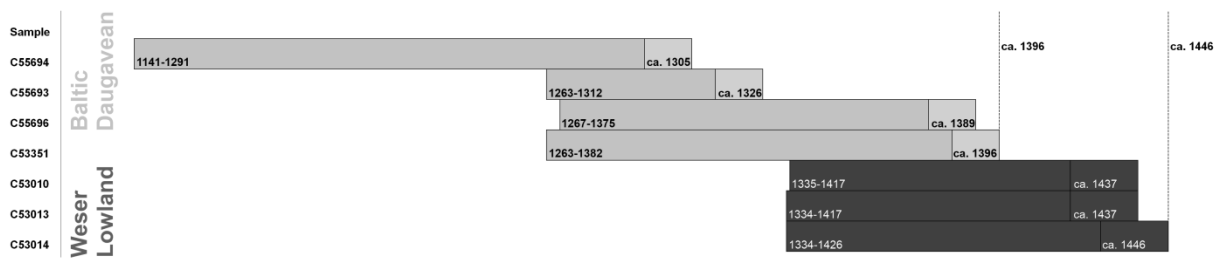
<sup>208</sup> a garboard is the first strake, i.e. all planks connected to the keel, and a rabbet is a notch to receive such a component (here: the plank edges of the garboard strake).

<sup>209</sup> the deadrise angle describes the shape of the underwater hull, e.g. flat-bottomed river barges have no deadrise and seagoing vessels with tapering fore-and aft sections and a S-shaped cross-section usually have great deadrise angles.

<sup>210</sup> The absence of a keel rabbet can be also attributed to the tapering end of the bow section. A rabbet could have been present in the unpreserved part of the keel at midship section, but this would imply that the Beluga Ship was considerably greater in length than the surviving fragment.



*Illus. 2. Schematic overview of the three principal late medieval lapstrake constructions. The distinction between 'traditional' and 'modern' types is based on Bill 2009b. The comparative part of this study only examines traditional and modern lapstrake constructions, but not bottom-based constructions (cf. Illus. 4, Tab. 1 and 3). The type representations are schematic and modular anomalies apply in several cases. The timber cross-sections as shown on the right side highlight the basic difference of radially cleft and tangentially sawn planks and their use in shipbuilding (Graph: Daniel Zwick).*



*Illus. 3. Bar diagram showing the dendrological results of the analysis of the Beluga ship, which fall into two groups: an earlier group of timber cut in the Baltic area (Heußner 2009b, c) and a later group from the Weser Lowland (Heußner 2009a), thus in direct proximity to where the ship was scrapped. Due to the lack of sapwood the cutting dates are approximate values, which may explain the great chronological gaps in the first group (Graph: Daniel Zwick).*

The interpretation of the Beluga Ship as visiting Scandinavian trader would have been straightforward, if not for the surprising result of the dendrochronological analysis: none of the analysed planks actually originated from Scandinavia. The first dendrochronological samples taken from the fragmentary upper planks yielded a result from the second quarter of the fifteenth century with a provenance from the Weser Lowland.<sup>211</sup> Wood in riverine lowland regions is subject to unique conditions which lead to a distinctive regional annual ring growth by which their provenance could be closely determined.<sup>212</sup> Further samples from the lowermost strakes were analysed and not only antedate the latter by a few decades, but originated from an entirely different region: the Baltic region (Illus. 3).<sup>213</sup>

None of the planks contained sapwood, so in neither case an exact felling date could be ascertained, for which reason a margin of 14 years was added for the Baltic planks<sup>214</sup> and the regular 20 year margin for the locally cut planks, which could have been both considerably greater.<sup>215</sup> Strikingly, the Baltic planks

feature great variations in start-end dates. This could be explained by the way planks were extracted from the parent tree: They might have been considerably dressed along the edges to fashion the planks in uniform widths. This would support the interpretation that this was import timber — such as wainscot — as vessels build of locally cut timber would feature a much more uniform pattern. The dimensions of wainscot planks were often standardised to make them suitable for exports, so the tree-trunk would have been seldom exploited to the maximum width. The Baltic region was heavily forested, so there was no necessity to make best use of the timber — i.e. to the last ring before the sapwood or even with sapwood — as in regions where timber scarcity prevailed.

The traditional — if not downright “antiquated” Scandinavian<sup>216</sup> — way of construction was to a certain extent preconditioned by the supply of suitable timber, which was of the highest quality oak, virtually knotless and straight-grained in the case of the Beluga Ship. The base material and workmanship of the planks is not a random construction feature, but of central importance for the wreck’s interpretation.

<sup>211</sup> Heußner, 2009a

<sup>212</sup> No matches were found with the master chronologies, so the dendro laboratory Preßler was consulted, which specialised in local wood (Karl-Uwe Heußner, pers. comm. 1.4.2009)

<sup>213</sup> Heußner 2009c

<sup>214</sup> the average number of sapwood rings in Southern Finland (closest proxy to the Baltic region where such data is available) is 13.85 according to an unpublished report by Keith Briffa (Haneca et al 2009, 5). This average is also comparable to present-day Poland, where oak trees have an average of 15 sapwood rings on average; 9-24 in the 90% confidence interval (Ważny 1990).

<sup>215</sup> Although 14 years appears very specific, it should not be over-interpreted, as it is in itself only a proxy for the average number of tree-rings in the sapwood, which could have been considerably greater given that no sapwood-hartwood line was determined. Sapwood rings could vary between 4 to over 50 rings (cf. Heußner 1999, 524)

<sup>216</sup> The conversion technique is often regarded as decisive criteria for establishing whether a vessel was built in a modern or traditional style. Sawing is regarded as modern and cleaving as traditional (cf. Bill 2009b, 433). Scandinavians were already making use of the more modern sawing technique since at least the 12th century, while the radial cleaving of planks is essentially Viking Age technology. The term “antiquated” was put into brackets, because this technique was by no means outdated, as it had several advantages, as will be stressed in the following section.



## The significance of the Baltic timber

While it is not possible to determine the exact provenance for Baltic oak timber,<sup>217</sup> not least due to the extensive hinterland where Baltic oak was cut and floated down the Daugava River to Riga,<sup>218</sup> the quality itself indicates that the timber was cut in a wildwood area. In such woods, the lower branches die off early and are grown over due to the overarching shade provided by treetops, leaving small knots only in the first few growth rings.<sup>219</sup> As opposed to the heavily branched trees in central European managed woodlands, these tall straight-grained trunks are easily cleft, and planks can be of much greater lengths.<sup>220</sup> Timber supply directly affects the type of timber conversion and ultimately the shipbuilding technique. If compared to the 'Bremen Cog' from around 1380, the Beluga Ship is not only distinctive in terms of construction, but also in terms of wood supply. The tangentially sawn timber used as planks in the 'Bremen Cog' were of such bad quality, that even during the initial construction some cracks needed to be patched.<sup>221</sup> Its planks were made of logs floated down the Weser River from the Weser mountains and reflects little choice in oak supply. These logs could not have been cleft in a similar way as those in the Beluga Ship, due to their knotty nature, which would have resulted in a contorted twisted plank with many weak spots. Thus, it would have been impossible to build the Beluga Ship with the kind of wood available to the builders of the 'Bremen Cog', so the reliance on high quality import timber from the Baltic was very much the precondition for this construction. Sawing is commonly regarded as the more modern way of timber conversion and associated to urban shipbuilding, whereas radial cleaving is often regarded as old-fashioned or traditional.<sup>222</sup> However, shipbuilding techniques perceived as innovative could have been primarily driven by cost-benefit assessments or scarcity of adequate timber, rather than a progression in technology in its own right, since both methods have advantages and drawbacks alike:

### Radial cleaving:

- allowed the planks to be thinner, as the medullary rays were left intact which add to the planks strength, thus making the planks more flexible and lighter

- radially cleft planks are watertight, thus regularly also used as barrel staves
- better nail hold in radially split edge-wood<sup>223</sup>

### Tangential sawing:

- as almost the entire diameter was used, the girth of the trunk could be fully exploited
- this decreased the number of lands and thus the effort to connect and caulk them
- the truncation of medullary rays was compensated by greater plank thicknesses, which accounted for greater overall robustness
- the processing of tangentially sawn timber arguably afforded lesser skills, and opened more options to work low-quality timber, like patching over cracks and knots

The comparatively modest dimensions of radially cleft planks do not necessarily point to a modestly sized vessel. Seán McGrail tentatively addressed the issue of estimating ship-sizes on the basis of dimensions of individual ship-timbers and interestingly did not include plank width as criteria,<sup>224</sup> probably for a good reason. The Dokøen 3 wreck<sup>225</sup> discovered in Copenhagen dates to ca. 1423 and is about 13m in length and likewise planked with imported wainscot boards with widths and thicknesses averaging 24 cm and 2.75cm, respectively.<sup>226</sup> And the clinker-wreck from Aber Wrac'k has very modest plank, keel and stem dimensions despite its great overall length of approximately 25m. Like the Beluga Ship, its hull was on the one side only preserved to the eighth strake, probably due to the sharp turn of the bilge at this point, but had as many as 24 strakes on the other side.<sup>227</sup> Since a great number of other clinker-built wrecks have been also built of imported timber, it becomes interesting to explore whether there is a link between the use of Baltic timber and constructional preferences in late medieval clinker-built vessels.

## Evaluating the link between Baltic timber trade and clinker-built vessels

With the demographic evolution in the densely urbanised Central Europe and the deforestation in its wake, suitable timber — particularly timber needed for shipbuilding — became a scarce resource. This prompted the emergence of extensive transport networks for timber, so shipbuilders in urban regions

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<sup>217</sup> cf. Ważny 2002

<sup>218</sup> cf. Zunde 1998/99

<sup>219</sup> McGrail 1998, 37

<sup>220</sup> Goodburn 2003, 293

<sup>221</sup> Lahn 1992, 44f.

<sup>222</sup> Bill 2009b, 433

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<sup>223</sup> Godal 1995, 274

<sup>224</sup> cf. McGrail 1993, 11 and 19ff.

<sup>225</sup> elsewhere also named as Dock Islands 3

<sup>226</sup> Nielsen forthcoming, 108

<sup>227</sup> L'Hour & Veyrat 1994, 170

with staple rights on timber, could choose from a wide range of sources. Shipbuilders from Newcastle, for instance, were able to buy timber from as many as 50 different sources.<sup>228</sup> While planks could originate from many different sources, framing timber was usually selected and cut locally.<sup>229</sup> This would have provided a good indicator of the place of construction of the Beluga Ship, but regrettably no frames were preserved.<sup>230</sup> Articulated slabs of planking without framing timber can often reveal more about timber trade patterns than the wreck's actual origin.

The use of timber exported from the eastern and southern coasts of the Baltic Sea<sup>231</sup> for the construction of clinker-built ships was not exceptional. Baltic timber trade started already in the

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<sup>228</sup> Tinniswood 1949, 281

<sup>229</sup> Daly 2007, 195

<sup>230</sup> This author intends to sample the keel and stem, but due to the current exhibition arrangement the wreck is inaccessible for further sampling.

<sup>231</sup> Timber provenances are often obfuscated by terminology. 'Baltic timber' or 'Baltic timber trade' is often used synonymously with the Baltic Sea rather than the Baltic region, meaning that 'Baltic timber' could originate from locations other than the Baltic region, e.g. Poland. Some authors imply a not closely defined Baltic Sea origin when they refer to 'Baltic' timber, so it can just as well include the southern Baltic Sea coast, despite it is outside of the Baltic region. Some other authors speak of a 'Polish provenance' which may include a regional bias too, as they might refer to locations in present-day Poland, like the Duchy of Pomerania, or the towns of Danzig/Gdańsk or Elbing/Elbląg, which used to be either independent from Poland or part of the territory controlled by the Teutonic Order. This denomination could be mixed up with timber that was actually hewn in the Poland of the Middle Ages, and floated down the Vistula River to Danzig, then under the rule of the Teutonic Order (1308-1454), as Polish merchants engaged in timber trade with the Teutonic Order on a great scale, as particularly highlighted by a treaty concluded in 1343 and by an armistice of 1391, in which Polish merchants were granted the right to engage in trade with Prussia "according to custom" with the export of their commodities via Danzig (cf. Ważny & Eckstein 1987, 510). Therefore some of the provenances taken from other reports have to be regarded with scepticism, as the respective authors have not elucidated their use of the term 'Baltic' or 'Polish'. To simplify matters, it is suggested here to introduce 'Vistulian' (the Vistula River basin, including Polish, Prussian, Pomeranian and Lithuanian provenances) and 'Daugavian' (the Daugava River basin, including the Baltic region, specifically Latvia or the historical province of Livonia, and Russia) as general terms or origin. 'Baltic timber trade' is kept as a generic term to indicate all timber trade from the Baltic Sea.

thirteenth century. Wreck fragments of Baltic oak are known from Dordrecht, the Netherlands, dating to the early thirteenth century,<sup>232</sup> numerous reused planks from the early fourteenth century in London's port,<sup>233</sup> and from herring vessels in Flanders from the late fourteenth century.<sup>234</sup> English inventories dating between 1272 to 1377 reveal the extent to which clinker-galley<sup>235</sup> shipbuilders relied on imported materials, like boards *de Estland* — from the eastern lands — traded by merchants with connections to Holland, Prussia and Sweden, which appear to have been used particularly for garboards and strakes near thereto, while the upper strakes were often augmented by locally cut wood of lower quality.<sup>236</sup> The same could have been the case in the Beluga Ship, where high quality Daugavian oak was used for the lowermost strakes where the bending stresses would have been the greatest. Knot-free straight-grained oak from Baltic wildwoods would have been also available in greater lengths and would have reduced the number of scarfs considerably, which would have been important for the submerged part of the hull.<sup>237</sup> Thus the planks from the upper strakes hewn in the Weser Lowland do not necessarily indicate a later repair, but could also reflect a very considerate cost-benefit assessment, in that the expensive wainscot planks were not wasted on less critical parts of the hull.

Timber exports via Danzig (Gdańsk) peaked in the fourteenth / fifteenth century<sup>238</sup> and shifted to Königsberg (Kaliningrad) and Riga in the course of the sixteenth century.<sup>239</sup> This is very much reflected by the provenances of oak planks of fourteenth / fifteenth century medieval shipwrecks found throughout the North Sea area (Illus. 4).

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<sup>232</sup> Vlierman 1996, 111ff; van de Moortel 2011, 95

<sup>233</sup> Marsden 1996, 117ff. and 188; 'Baltic' is used here in its unspecified sense, meaning timber from the Baltic Sea rather than the Baltic region — pers. comm., Peter Marsden (26.3.2014)

<sup>234</sup> Haneca et al 2005, 262

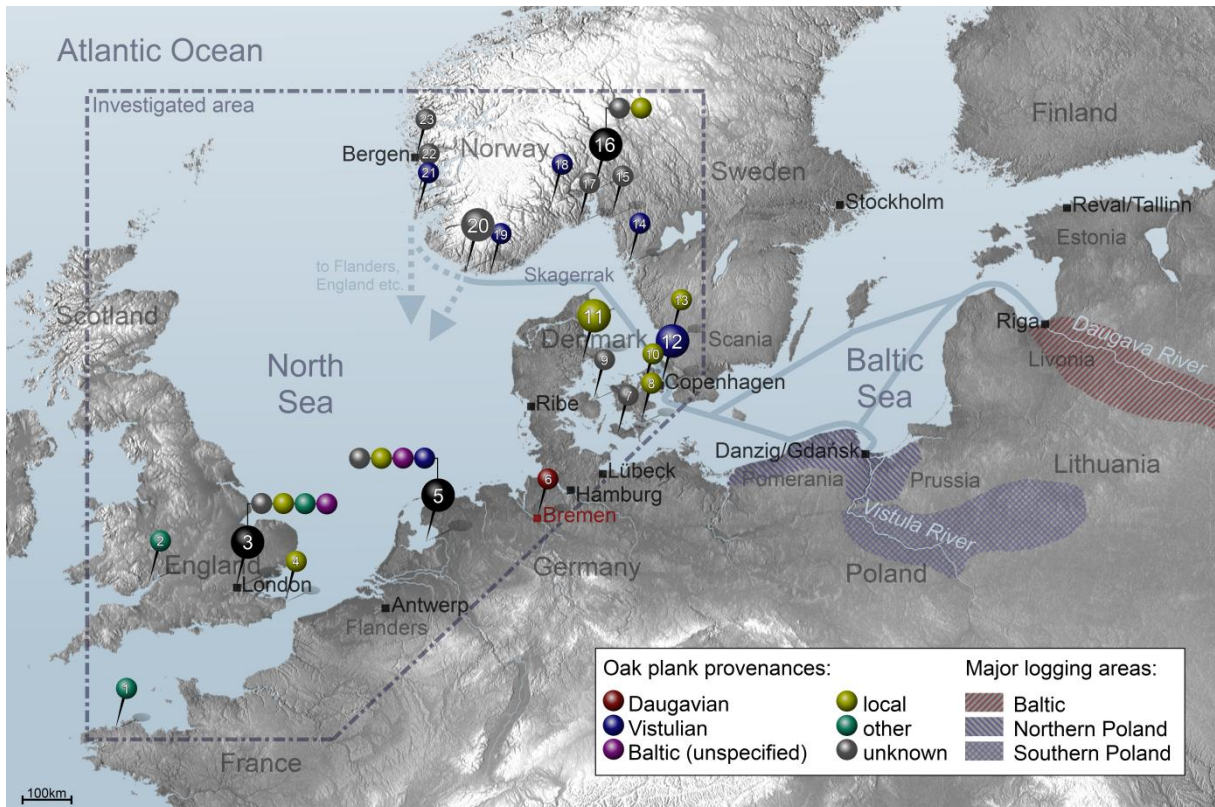
<sup>235</sup> The decisive hint that these galleys were clinker-built with rivetted nails is given by the remark that the *pichepotte* (pitch pot) must be kept hot at the insertion of each strake, indicating inlaid-caulking (luting), and moreover the mention of *clenchatores* (clenchers) and *tenenties contra*, *clenchatores* (holders), which describes the two workers needed for rivetting planks together (cf. Tinniswood 1949, 281).

<sup>236</sup> Tinniswood 1949, 282

<sup>237</sup> Wildwood boards were, however, not imported in greater lengths as a general rule. English finds indicate that long-distance trade boards were of relatively short dimensions (Damian Goodburn, pers. comm. 28.04.2014)

<sup>238</sup> Ważny & Eckstein 1987

<sup>239</sup> Zunde 1998/99



*Illus. 4: This overview shows the proveniences of oak planks from clinker-built shipwrecks dating between ca. 1300 to 1540. The numbers on the pins are itemised as # in illustration 1. 19 and 3. The comparison shows that the Beluga Ship (#6) is almost unique in having an ascertained Baltic Daugavean provenience, whereas in several all other cases they are either “unspecified Baltic” or of Vistulian provenience. The term ‘Baltic’ is used in the unspecified sense of originating from the greater Baltic Sea area. This can be attributed to the recent breakthrough in dendro-provenience, leaving some of the wrecks excavated several decades ago with less precise or no proveniences. In other parts dendrology has progressed to determine provenience on a regional scale, as between ‘northern Poland’ — roughly corresponding to Prussia and Pomerania under the rule of the Teutonic Order — and ‘southern Poland’ in the Kingdom of Poland. The trade routes from Riga and Danzig as indicated here correspond to the routes detailed in the *Hanseatic Sea Book* (ca. 1470) (Graph: Daniel Zwick).*

All major Baltic Sea ports where timber was exported were controlled by the Teutonic Order for most of the time span discussed here and, significantly, the Order was the only territorial power to be also a member of the Hanseatic League. In several instances Teutonic Order agents were directly involved in negotiating timber trade deals with Polish merchants,<sup>240</sup> and the *Großschäffer* who conducted trade and shipping in the Order’s interest was granted special trading privileges, most notably the monopoly on amber trade, but was also freed from all sorts of other export bans.<sup>241</sup> At the peak of the English-Prussian conflict (1385-1388), the Teutonic Order enforced a Hanseatic export ban on timber required for shipbuilding in 1386.<sup>242</sup> This highlights its central role as timber supplier within the Hanseatic League. Given that written sources indicate that timber from Danzig was principally exported to Flanders and England,<sup>243</sup> the share of wrecks built of Vistulian

timber along the Norwegian coastline — particularly in the Skagerrak and Kattegat region — appears disproportionately high at first glance (Illus. 4). The *Pfundzollliste* — i.e. pound-toll register — of Danzig for the year 1409 however mentions only three merchants directly engaged in trade with Scandinavia, one with Scania and two with Sweden,<sup>244</sup> so it seems unlikely that these vessels were locally operated. A possible explanation for this disproportionality is that these shipwrecks were long-distance traders, as indicated by their considerable sizes, namely the late fourteenth / early fifteenth-century wrecks of Bøle (length: +20m), Skjernøysund (+26m), Avaldsnes (22m) and Skaftö (25m) (Tab. 1).

<sup>240</sup> Kapfenberger 2003, 20

<sup>241</sup> Kapfenberger 2003, 73

<sup>242</sup> HR I.2, no. 329

<sup>243</sup> Dollinger 1998, 290

<sup>244</sup> Kapfenberger 2003, 56

Wreck	#	isolated planking <sup>245</sup>	articulated planking	shipwreck	Date + = terminus post- quem - = terminus ante quem	Estimated length (m)	Find location	Country	1 <sup>st</sup> Provenience	2 <sup>nd</sup> Provenience	radially cleft	tangentially cleft/sawn	plank width (cm) average value if no angle is given	plank thickness (mm)	plank length (cm) m= maximum a= average
Kingston <sup>246</sup>	3	X			1275 ± 25		London	UK			X	C		35	
TYT98 <sup>247</sup>	3	X			1276 ± 11		London	UK	E-Ireland		X			40-45	
Vestre Skars. <sup>248</sup>	7		X		1300	12+	Hölmünde	DK							
Halmstad <sup>249</sup>	13		X		1302	16	Halmstad	SE	W-Sweden		X				
Sørenga 3 <sup>250</sup>	16			X	1320 +	12+	Oslo	NO	S-Norway						
Bryggen <sup>251</sup>	23		X		1332 +		Bergen	NO					18-27		m250+
Roskilde Havn 1 <sup>252</sup>	10			X	1336	9	Roskilde	DK	E-Danmark		X				
Hundevika <sup>253</sup>	20			X	1340 ± 60	15	Farsund	NO					25-30	40	
Hays-Symonds Wharf <sup>254</sup>	3	X			1340+		London	UK	U-Baltic		X		17-30	35-58	
Southwark <sup>255</sup>	3		X		1344-1368 +		London	UK	U-Baltic		X			21-30	
Sandwich <sup>256</sup>	4		X		1347 ± 15		Sandwich	UK	S-England		X		30	40-60	m198
Sørenga 1 <sup>257</sup>	16			X	1350 +	12+	Oslo	NO							
Sørenga 2 <sup>258</sup>	16			X	1355 +	15+	Oslo	NO	SW-Sweden	E-Denmark			17-32	25	
Hays W-Abbots Lane <sup>259</sup>	3	X			1362+		London	UK	Engl., Germany	U-Baltic	X		17+	25-30	
Hays-W-G&S Wharf <sup>260</sup>	3	X			1370+		London	UK	U-Baltic		X		36	54-60	
Isegran <sup>261</sup>	15			X	1370 ± 50	15	Fredrikstad	NO					20-27		
Sundekilen <sup>262</sup>	17			X	1375 ± 70	15+	Sandefjord	NO				S	18-30	25-30	
Kerteminde 1 <sup>263</sup>	9		X		1380		Kerteminde	DK			X			28	
Bøle <sup>264</sup>	18			X	1386 ± 10	20+	Skienselva	NO	N-Poland			S			
Skjernøysund 3 <sup>265</sup>	19			X	1390	26+	Skjernøysund	NO	Poland		X	S	33-38	40-50	a870
Avaldsnes <sup>266</sup>	21			X	1392 +	22	Avaldsnes	NO	N-Poland				35	40	
Beluga	6		X		1396+/1446	7+	Bremen	DE	Baltic s	Lower Weser	X		20-26	21	m400+
Blackfriars 3 <sup>267</sup>	3			X	1398 ± 18	14.6	London	UK			X		23-27	25-50	
Dokøen 2 <sup>268</sup>	12		X		1405/1425	10+	Copenhagen	DK	N-Poland		X	S			
Ny Hellesund 2 <sup>269</sup>	20			X	1410	16+	Lindesnes	NO					45	40-50	
Århus Å <sup>270</sup>	11			X	1411 +	14+	Århus	DK			X				
Dokøen 4 <sup>271</sup>	12		X		1415		Copenhagen	DK	Poland		X				

<sup>245</sup> The information gained from this group needs to be regarded with caution. Although belonging into the same context, the planks were recorded as isolated finds and may have belonged to different constructions. Some of the details are not representative, as many observations stem from infrequent sampling. Summarising the observed criteria is not straightforward and were made at the author's discretion, by trying to isolate typical measurements either based on representativity or state of preservation. Some less representative measurements, e.g. in cases of fragmented pieces, are ignored as not to distract from general trends. Only dated material is taken into account.

<sup>246</sup> Goodburn 1991, 108ff.

<sup>247</sup> Goodburn 2003

<sup>248</sup> Bill 1997, 202f.

<sup>249</sup> Bill 1997, 171f.

<sup>250</sup> Nævestad 1998, 173ff.

<sup>251</sup> Bryggen strakes (numbers: 90151, 90152) from one wreck, Christensen 1985, 93, 99

<sup>252</sup> Bill 1997, 186f., Bill 2009b, 434

<sup>253</sup> Teisen 1994, Nævestad 1998, 200ff.

<sup>254</sup> Marsden 1996, 188f. (Hays Wharf to Symonds Wharf, 1988, site context: 141-168, 168, 175-164, 194-136, 196-120)

<sup>255</sup> Abbots Lane (context 185/64, 195/74), cf. Marsden 1996, 107ff., 188ff.

<sup>256</sup> Milne 2004

<sup>257</sup> Nævestad 1998, 171ff.

<sup>258</sup> Nævestad 1998, 172ff.

<sup>259</sup> Marsden 1996, 188f. (Hays Wharf to Abbots Lane, 1987, site context: 205-86, 187-66, 185-64, 195-74)

<sup>260</sup> Marsden 1996, 188f. (Hays Wharf to Gun and Shot Wharf, 1988, site context: 449-53-158/60)

<sup>261</sup> Nævestad 1998, 161ff.

<sup>262</sup> Nævestad 1998, 178ff.

<sup>263</sup> Bill 1997, 174f.

<sup>264</sup> Daly and Nymoer 2007, Nævestad 1998, 180ff.

<sup>265</sup> Auer and Maarleveld 2013

<sup>266</sup> Alopeus and Elvestad 2004

<sup>267</sup> Marsden 1996, 55ff.

<sup>268</sup> Eriksen 2001; Gøthche and Høst-Madsen 2001, 32ff.

<sup>269</sup> Nævestad 1998, 190ff.

<sup>270</sup> Bill 1997, 203f.

<sup>271</sup> Gøthche and Høst-Madsen 2001, 34

Foldrøy <sup>272</sup>	22		X	1420 ± 100		Foldrøy	NO					40-50	30/50	a940
G35 <sup>273</sup>	5		X	1422 ± 6	19	Zuiderzee	NL	Netherlands	Westphalia					
Dokøen 3 <sup>274</sup>	12		X	1423 ± 3		Copenhagen	DK	Poland		X	S	24	28	m687
Skafthø <sup>275</sup>	14		X	1430 +	25	Skafthø	SE	N-Poland		X		35-40	35-40	
Selør 4 <sup>276</sup>	16		X	1435 ± 25	20+	Oslo	NO					20-30	30	
Aber Wrac'h <sup>277</sup>	1		X	1435		Aber Wrac'h	FR	Basque ?		X		23	30	
Vedby Hage <sup>278</sup>	8		X	1435		Storstrømm.	DK	Sealand	Scania	X	C	20	25	a250-
Århus 1 <sup>279</sup>	11	X		1440		Århus	DK	E-Jutland <sup>280</sup>		X		25-28	25-35	m240+
Århus 4 <sup>281</sup>	11	X		1440		Århus	DK	E-Jutland <sup>282</sup>				12-14	35	m155
Århus 5 <sup>283</sup>	11	X		1440		Århus	DK	E-Jutland <sup>284</sup>		X				
Blackfriars 4 <sup>285</sup>	3		X	1450 ± 50		London	UK					23-30		
Ramslandsvåg <sup>286</sup>	20		X	1453 ± 18	5+	Lindesnes	NO					30		
Bankside <sup>287</sup>	3	X		1456 ± 30		London	UK	British Isles		X		13-19	15-36	
Newport <sup>288</sup>	2		X	1458 ± 10		Newport	UK	Basque ?		X		21	19-24	m451
B 36 <sup>289</sup>	5		X	1476	18+	Zuiderzee	NL	NW-Poland, U-Baltic	N-Scandinavia					
Sørenga 9 <sup>290</sup>	16	X		1477 ± 16	6+	Oslo	NO	SW-Sweden	Sealand		X	20-33	30	m470
Hays W-Morgans Lane <sup>291</sup>	3	X		1490+		London	UK	British Isles		X	X	24-25	18-36	
Sørenga 10 <sup>292</sup>	16	X		1493 ± 32		Oslo	NO			X		12-27	12-19	m220
Sørenga 8 <sup>293</sup>	16	X		1495 ± 7		Oslo	NO	S-Sweden			X	18-26	10-31	m467
Hays Wharf <sup>294</sup>	3	X		late 15 <sup>th</sup> c.		London	UK			X				
E 159 <sup>295</sup>	5		X	1506 ± 6		Zuiderzee	NL	Netherlands	Westphalia, S-Sweden					
U34 <sup>296</sup>	5		X	1528 ± 6	30	Zuiderzee	NL	SE-Poland <sup>297</sup>		X		30-40	43-53	50-60
M11 <sup>298</sup>	5		X	1532 ± 1	20	Zuiderzee	NL	Netherlands						
O28 <sup>299</sup>	5		X	1535 ± 5	17	Zuiderzee	NL	U-Baltic	Poland					
Hays W-B Factory <sup>300</sup>	3	X		1541+		London	UK	British Isles		X		50	30-32	
J137 <sup>301</sup>	5		X	1543 ± 3	24	Zuiderzee	NL	S-Sweden						

Table 1: Lapstrake constructions from ca. 1300 to 1540 in the North Sea region. The numbers (#) relate to the find locations as shown in illus. 4. The principal aim of this overview is to set the oak plank provenances in relation to the method of timber conversion and plank dimensions (Table: Daniel Zwick).

<sup>272</sup> Thowsen 1965

<sup>273</sup> Overmeer 2008, 51; forthcoming

<sup>274</sup> Nielsen, forthcoming

<sup>275</sup> von Arbin 2014

<sup>276</sup> Nævestad 1998, 195ff.

<sup>277</sup> L'Hour and Veyrat 1994

<sup>278</sup> Myrhøj 2000

<sup>279</sup> Larsen et al 2011

<sup>280</sup> pers. comm. Niels Bonde (1.4.2014)

<sup>281</sup> Larsen et al 2011

<sup>282</sup> pers. comm. Niels Bonde (1.4.2014)

<sup>283</sup> Larsen et al 2011

<sup>284</sup> pers. comm. Niels Bonde (1.4.2014)

<sup>285</sup> Marsden 1996, 105

<sup>286</sup> Nævestad 1998, 191ff.

<sup>287</sup> Marsden 1996, 192f. (37-46 Bankside, 1987, revet 21)

<sup>288</sup> Nayling and Jones 2014, Nayling and Susperregi 2014

<sup>289</sup> Overmeer 2009

<sup>290</sup> Fawsitt 2012a

<sup>291</sup> Marsden 1996, 192f. (Hays Wharf to Morgans Lane, 1987, site context: 735-123, 659-35, 625-13, 632/4-32/4, 837-50)

<sup>292</sup> Fawsitt 2012b

<sup>293</sup> Steen 2012

<sup>294</sup> Goodburn 1991, 111

<sup>295</sup> Overmeer 2006

<sup>296</sup> van Holk 2003; Reinders and Oosting 1989; Overmeer 2006, 66ff.

<sup>297</sup> The provenances for the tangentially sawn and radially cleft planks from the U34 wreck was stated as “southeast Poland / Baltic” (Overmeer 2006, 68). Upon request, this author learnt that this did not indicate two different felling regions, but it referred to an area somewhere between southeastern Poland and Lithuania (indicated as “Baltic”), thus constituting a single logging area, accessible via the Vistula River system and not the Daugava River. Moreover, only three samples were taken from the radially cleft planks, thus it is impossible to say whether the tangentially sawn planks originated from a different source (Alice Overmeer, pers. comm. 20.1.2015).

<sup>298</sup> Overmeer 2008, 51

<sup>299</sup> Overmeer 2008, 51

<sup>300</sup> Marsden 1996, 194f. (Hays Wharf to Butter Factory South, 1988, site context: 158-150/4, 118-49)

<sup>301</sup> Overmeer 2008, 51

If this was the case, they will have most likely frequented a major Hanseatic artery of trade, which carried Baltic bulk commodities — such as timber — and took further Norwegian export commodities on board — especially herring — which was then directly shipped to Flanders, England or other destinations.<sup>302</sup> The high concentration of shipwrecks clustering around Lindesnes (Illus. 4, #20) is no coincidence, as Lindesnes was — together with Skudenes — mentioned in the Hanseatic Sea Book of ca. 1470 (chapter XII.1-2) as important bearing positions for making a landfall for courses set from the coast of Flanders; i.e. the longest distance out of land-sight in the entire book.<sup>303</sup> While Skudenes on Karmøy marked the entry to Avaldsnes, Lindesnes marked the entry to the Baltic Sea. The central eastern European hinterlands were not the only sources for wildwood timber, as suggested by a slab of articulated planking of Irish oak from a late thirteenth-century clinker-galley discovered in Southwark, London, with plank lengths over 2.5m.<sup>304</sup> In contrast to Ireland, however, Baltic, Prussian and Polish timber could be supplied from a far more extensive hinterland, made accessible by the extensive river systems of the Vistula and Daugava and their numerous tributaries reaching deep into the Polish, Lithuanian and Russian hinterlands. Thus, the depletion of timber as a raw commodity was not an imminent concern, and an infrastructure for the seaborne export of timber could develop, as the foundation of a saw-mill in Danzig (Gdańsk) in 1338 shows, where the trunks floated down the river were converted into boards.<sup>305</sup> There is also documentary evidence from the Vistula River that logs were cleft and floated down as semi-products.<sup>306</sup> At the peak of Vistulian timber exports in the fifteenth century, saw-mills were founded in the logging areas further up the river, so *borte*, *brede*, *delen* were no longer fabricated in Danzig (Gdańsk) and other timber-exporting ports.<sup>307</sup> This seems to indicate that wooden products from the Vistula River basin were to a great extent sawn rather than cleft.

What can be said with some certainty is that the archaeological record corroborates the written records in that different categories of pre-fabricated timbers were exported, primarily defined by size. Three late medieval shipwrecks are known so far which cargo assemblage included timber products as export commodity. Interestingly, the timber dimensions in all three wrecks were fairly consistent, so that they could be divided into two principal

groups (Tab. 2). As all of the abovementioned timbers originated in northern Poland, or rather the Teutonic-ruled province of Prussia, and southeastern Poland in the Kingdom of Poland, it is apt to presuppose that most — if not all — of the abovementioned timber was floated down the Vistula River and transhipped via Danzig (Gdańsk). Danzig's *Pfundzollliste* of 1409 lists forty-one different categories of wooden export products, most of them are *dielen* with 261 items, second most are wainscot timbers with 193 items, the third product is generically described as 'wood' with 141 items, followed by wainscot-*brak*, i.e. lower quality wainscot with 60 items.<sup>308</sup> The *dielen* are described to be very thin, with a thickness of 2.6cm and less, but highly priced, which indicates that this must have been a product of exceptionally high quality.<sup>309</sup> The timbers summarised in group 1 would have had the adequate dimensions to be considered *dielen*, but they could have also been *bottichholz* i.e. barrel staves, which are listed as separate item in this register. The second group most likely correlates to wainscot<sup>310</sup>, given the dimensions of the planks and that they have been radially extracted from the trunk. In a mid-nineteenth century source wainscot was defined as being between 10 to 18 feet in length (3.14 - 5.65m<sup>311</sup>) and cleft<sup>312</sup> into four parts. The author of the source notes that the English refer to these quartered logs as *wainscot-logs*, but that locally — i.e. the Danzig area — also smaller *dielen* cleft from the wainscot-logs are called wainscot too, with widths to about 10 *zoll*, i.e. 26.2cm.<sup>313</sup> This may indicate that wainscot was exported to England as a semi-product, and not as ready-made planks as found in the wrecks of Skjernøysund, Gdansk W5 and Skaftö.<sup>314</sup> And 26cm is close to the average widths observed in the radial planking, as the width range clusters consistently in the 20 to 30cm margin for roughly four fifths of all planks (Tab. 3). This applies not only to planks with Daugavian or Vistulian provenances, but it demonstrates that the wainscot-format was most commonly used for planking late medieval clinker-built vessels.

<sup>308</sup> Kapfenberger 2003, 23f.

<sup>309</sup> Kapfenberger 2003, 24

<sup>310</sup> the term wainscot (German: Wagenschoß or Wagenschott) might not have applied to planks or boards before 1700, but to beams, as pointed out by Kapfenberger 2003, 24

<sup>311</sup> Kapfenberger 2003, 24

<sup>312</sup> the term richtspaltig indicates that they were cleft (spaltig) at a right angle (richt or recht), thus radially

<sup>313</sup> Hirsch 1858, 215; zoll-cm conversion by Kapfenberger 2003, 24

<sup>314</sup> Obviously this must not have been the case in the late medieval period, as the mid 19th-century source refers to an oral testimony of a contemporary wood expert, but it seems noteworthy anyway, since the preference for certain wooden products will have depended on differential regional practises in woodworking and shipbuilding.

<sup>302</sup> Norway's dependence on annual grain imports led to Hanseatic merchants gaining control of the Norwegian export trade (Hammel-Kiesow 2002, 74), thus the great number of wrecked cargo-carriers in this region built of Vistulian timber is not surprising.

<sup>303</sup> Sauer 1996, 160

<sup>304</sup> Goodburn 2003

<sup>305</sup> Ellmers 2006, 74

<sup>306</sup> Haneca et al. 2005, 262

<sup>307</sup> Ellmers 2006, 75

shipwreck with the listed timber cargo	date of the timber cargo	quantity	length (cm)	width (cm)	thickness (mm)	Prove-nance	quantity	length (cm)	width (cm)	thickness (mm)	Prove-nance
		group1						group2			
Skjernøysund 3 <sup>315</sup>	1394	9(6)	50-83	16 -	20-	N-Poland	13(8)	230	25-30	40-50	N-Poland
Gdansk W5 <sup>316</sup>	1405-1408 <sup>317</sup>	205	79-85	14.5-16	14-25	NE-Poland	79	250	30	20-45	NE-Poland
Skafthö <sup>318</sup>	1437-1441	3	85	15-17+	20-	N-Poland	4	137+	23-30	30-60	SE-Poland

Table 2: This table summarises the shipwrecks known to have carried timber as part of their cargo. All timbers were radially cleft. In the case of the Skafthö wreck only few timbers were recovered from the wreck and the data is therefore less representative. In the case of the Skjernøysund wreck many timbers have strongly deteriorated and are not all preserved to their original dimensions, so the number in the brackets represent the uncertain attributions<sup>319</sup>. The data suggests two major formats and in the case of the Skafthö wreck, a possible correlation between timber provenance and dimensions of the prefabricated timber (Table: Daniel Zwick).

Wreck	#	Scarf length (cm)	lands avg. (mm)	caulking material (lands)	caulking material (scarfs)	Plank-to-plank fasteners	naill shaft thickness avg. (mm)	rove avg. (mm)	treenail Ø (mm)	keel-stem scarf	keel-stem scarf length (cm)	keel shape (central)	keel length (cm)	keel width max (cm)	keel height max (cm)	frame scantlings: molded avg. (cm)	frame scantlings: sided avg. (cm)	frame spacings: centres avg. (cm)
		Waterproofing			Fasteners			Keel construction					Frames					
Kingston <sup>320</sup>	3	long		H		C										10 +	10 +	45
TYT98 <sup>321</sup>	3					C	8		25/28								20	40
Vestre Skars. <sup>322</sup>	7	long		W?		C					U		18				12-14	69
Halmstad <sup>323</sup>	13	15		H		C	7	23x30	28		U		12		15	20	44	
Sørenga 3 <sup>324</sup>	16					C							860					
Bryggen <sup>325</sup>	23	10-12				C												65
Roskilde Havn 1 <sup>326</sup>	10	14-26		H		C												80-102
Hundevika <sup>327</sup>	20		50-75	W		C										12-18	18-26	10-20
Hays-Symonds Wharf <sup>328</sup>	3	40-49	33-87	H/M	M	C	5-10		17-37									c. 25-45
Southwark <sup>329</sup>	3			H	H	C												
Sandwich <sup>330</sup>	4	28	21	H	H	C										23	33	52 ± 12
Sørenga 1 <sup>331</sup>	16					C												65
Sørenga 2 <sup>332</sup>	16					C					T	1002					12-22	80-90
Hays W-Abbots Lane <sup>333</sup>	3		44			C	8		25									12-26
Hays-W-G&S Wharf <sup>334</sup>	3	40	73-94	M		C	10		35									
Isegran <sup>335</sup>	15					C						1000+	16	25				45-55
Sundekilen <sup>336</sup>	17					H	7.5		30							12-15	12-15	55
Kerteminde 1 <sup>337</sup>	9	25		H		C					T		23	18				
Bøle <sup>338</sup>	18					C							1600	30				40-50

<sup>315</sup> Auer and Maarleveld 2013, 27ff.

<sup>316</sup> Litwin 1985, 46; Krapiec & Krapiec 2014, 147

<sup>317</sup> Ważny 2001 cited in Eckstein and Wrobel 2007, 13f.

<sup>318</sup> von Arbin 2014, 34

<sup>319</sup> These were made on own estimates on the basis of the data provided by the excavators, which unfortunately lacks the information which measurements refer to well-preserved planks and which to mere fragments, cf. Auer and Maarleveld 2013, tab. 1, p. 29

<sup>320</sup> Goodburn 1991, 108ff.

<sup>321</sup> Goodburn 2003

<sup>322</sup> Bill 1997, 202f.

<sup>323</sup> Bill 1997, 171f.

<sup>324</sup> Nævestad 1998, 173ff.

<sup>325</sup> Bryggen strakes (numbers: 90151, 90152) from one wreck, Christensen 1985, 93, 99

<sup>326</sup> Bill 1997, 186f., Bill 2009b, 434

<sup>327</sup> Teisen 1994, Nævestad 1998, 200ff.

<sup>328</sup> Marsden 1996, 188f. (Hays Wharf to Symonds Wharf, 1988, site context: 141-168, 175-164, 194-136, 196-120)

<sup>329</sup> Abbots Lane (context 185/64, 195/74), cf. Marsden 1996, 107ff., 188ff.

<sup>330</sup> Milne 2004

<sup>331</sup> Nævestad 1998, 171ff.

<sup>332</sup> Nævestad 1998, 172ff.

<sup>333</sup> Marsden 1996, 188f. (Hays Wharf to Abbots Lane, 1987, site context: 205-86, 187-66, 185-64, 195-74)

<sup>334</sup> Marsden 1996, 188f. (Hays Wharf to Gun and Shot Wharf, 1988, site context: 449-53-158/60)

<sup>335</sup> Nævestad 1998, 161ff.

<sup>336</sup> Nævestad 1998, 178ff.

<sup>337</sup> Bill 1997, 174f.

<sup>338</sup> Daly and Nymoer 2007, Nævestad 1998, 180ff.

Skjernøysund 3 <sup>339</sup>	19	50	70-80	H	M	C	10	35x45		v	26	B	1670	28	45	16-20	18-28	5-20
Avaldsnes <sup>340</sup>	21			M	M	C			25/33							14	14-20	20
Beluga	6	15-20	25+	W	W?	C	4-6	23x25	ca. 30	v	25	V	n/a	8	11	n/a	n/a	50
Blackfriars 3 <sup>341</sup>	3	30-34	70-80	H		C	7	30x45				F	43	14	17	9	47	
Dokøen 2 <sup>342</sup>	12	20-23		W		C							1000				20	60
Ny Hellesund 2 <sup>343</sup>	20					C						T			15	20		
Århus A <sup>344</sup>	11	23-35		H		C	7-8					T	12					75-80
Dokøen 4 <sup>345</sup>	12	22-25		M														60
Foldrøy <sup>346</sup>	22	50-55		H	M	C						B	1620		15	23-30	50-60	
G35 <sup>347</sup>	5			HWS		C												
Dokøen 3 <sup>348</sup>	12	21-25	50	WTM	HT	C	7	25x30				T	979	18	24	8-10	16-20	65-70
Skaftø <sup>349</sup>	14	50	60-100	H	M	C		30x40				F	1400+	45	15	10-12	11-19	35-40
Selør 4 <sup>350</sup>	16			M	W	C			25-30					12	22	20	20-22	50
Aber Wrach <sup>351</sup>	1	30-40			M	C						V	1000+	24	31	15	15-25	13
Vedby Hage <sup>352</sup>	8	20-30		W		C		30									15	38-54
Århus 1 <sup>353</sup>	11			H	H	C												50-60
Århus 4 <sup>354</sup>	11			HV		C												
Århus 5 <sup>355</sup>	11	15-37		H		C												62
Blackfriars 4 <sup>356</sup>	3		30-40			C						F	42	10	13			
Ramslandsvåg <sup>357</sup>	20					C						T	15					
Bankside <sup>358</sup>	3	14-28	13-19	H	H	C	5-6		17/23									
Newport <sup>359</sup>	2	38	50	WH	WH	C	12	36x43	30			V	2000+	27	24	21	26	37
B 36 <sup>360</sup>	5			M		C	6-7	28x32				B			12	9	55-70	
Sørenga 9 <sup>361</sup>	16	13	20-36	H		C			21/30								9	52-66
Hays W-Morgans Lane <sup>362</sup>	3	18-29	24-25	H			4-5		18-26									
Sørenga 10 <sup>363</sup>	16	7-12	52	W			4-7		23-25			T	22	9.5		8	90-100	
Sørenga 8 <sup>364</sup>	16	22-25		WH		C			23-30	v	14.7	T	19.5	12.6	10	10-12	50-65	
Hays Wharf <sup>365</sup>	3								36									
E 159 <sup>366</sup>	5			M		CT						B						
U34 <sup>367</sup>	5			MS		CT						B	2550	25	42	16-35	18-34	45-52
M11 <sup>368</sup>	5			M		CT						F						
O28 <sup>369</sup>	5			HM		C						B						
Hays W-B Factory <sup>370</sup>	3		36	H		C	7											133
J137 <sup>371</sup>	5			H		CH						B						

Table 3: Comparative overview of constructional properties and dimensions of lapstrake constructions from the investigated area (cf. Illus. 4). Abbreviations for caulking material: H = animal hair, M = moss, S = sintels & laths, T = textiles, V = vegetable fibre, W = wool. Abbreviations for plank-to-plank fasteners: C = clinker-nail, H = booked nail, T = treenail. Abbreviations for keel construction: v = vertical scarf, B = beam keel, F = flat, T = T-shaped, U = U-shaped, V = V-shaped (similar to B and U)<sup>1</sup> (Table: Daniel Zwick).

<sup>339</sup> Auer and Maarleveld 2013

<sup>340</sup> Alopeus and Elvestad 2004

<sup>341</sup> Marsden 1996, 55ff.

<sup>342</sup> Gøthche and Høst-Madsen 2001, 32ff.

<sup>343</sup> Nævestad 1998, 190ff.

<sup>344</sup> Bill 1997, 203f.

<sup>345</sup> Gøthche and Høst-Madsen 2001, 34

<sup>346</sup> Thowsen 1965

<sup>347</sup> Overmeer 2008, 51; forthcoming

<sup>348</sup> Nielsen, forthcoming

<sup>349</sup> von Arbin 2012, 2014

<sup>350</sup> Nævestad 1998, 195ff.

<sup>351</sup> L'Hour and Veyrat 1994

<sup>352</sup> Myrhøj 2000

<sup>353</sup> Larsen et al 2011

<sup>354</sup> Larsen et al 2011

<sup>355</sup> Larsen et al 2011

<sup>356</sup> Marsden 1996, 105

<sup>357</sup> Nævestad 1998, 191ff.

<sup>358</sup> Marsden 1996, 192f. (37-46 Bankside, 1987, revet 21)

<sup>359</sup> Nayling and Jones 2014, Nayling and Susperregi 2014

<sup>360</sup> Overmeer 2009

<sup>361</sup> Fawsitt 2012a

<sup>362</sup> Marsden 1996, 192f. (Hays Wharf to Morgans Lane, 1987, site context: 735-123, 659-35, 625-13, 632/4-32/4, 837-50)

<sup>363</sup> Fawsitt 2012b

<sup>364</sup> Steen 2012

<sup>365</sup> Goodburn 1991, 111

<sup>366</sup> Overmeer 2006

<sup>367</sup> van Holk 2003, Overmeer 2006, 66ff.

<sup>368</sup> Overmeer 2008, 51

<sup>369</sup> Overmeer 2008, 51

<sup>370</sup> Marsden 1996, 194f. (Hays Wharf to Butter Factory South, 1988, site context: 158-150/4, 118-49)

<sup>371</sup> Overmeer 2008, 51



Conclusively, the data compiled from late medieval clinker-built vessels in northwestern Europe suggests neither a decline in the use of radially cleft planks for a time span of nearly three centuries, nor the exclusive use in smaller vessels like the Beluga Ship. Even a fairly large ship built for the high seas (as indicated by the sturdy construction of closely-spaced frames) like the Skjernøysund Ship 3 was predominantly planked with radially cleft timber, while sawn planks were used for the internal timbering like stringers and ceiling.<sup>372</sup> So, the “antiquated” way of construction seemed to be oftentimes also the preferred way of construction, even when sawn planks were readily available. This might have been a preference of the shipbuilders, as cleft planks were much more flexible and therefore easier to bend, and Baltic wildwood timber was often also available in greater lengths, which would have reduced the number of scarfs in a strake. The peak of Baltic timber exports in the fifteenth century does not manifest in the relative share of plank provenances. Presently the archaeological evidence (Tab. 1) indicates that radially cleft planks were obtained from a range of different sources with no clear spatiotemporal pattern visible yet. It is arguably just a question of time when this will be the case.

## Putting the pieces together: The implications of a Scandinavian origin

Based on its typological characteristics, a building site in Scandinavia or Scandinavian-influenced territories like the British Isles remains most likely, although neither a Baltic nor a local building site can be entirely ruled out, as discussed in a previous article.<sup>373</sup> In this section however, the most likely scenario of a Scandinavian origin is explored, as there can be little doubt about the building tradition. The first indication is given by the use of square-shanked clinker-nails. Originally diagnostic for a Scandinavian origin, they have become a more widespread connection element in northern Europe in late medieval times.<sup>374</sup> Yet it would have remained still distinctive to the traditional way of fastening in Bremen and the southern North Sea coast, where double-hooked nails rather than clinker-nails were used. Particularly the wool caulking points to a southern Scandinavian origin, as almost all late medieval vessels with wool caulking were discovered in either Danish waters — as the wrecks of Vestre Skarsholm (ca.1300), Dokøen 2 (1405) and Vedby Hage (1435) — or southern Norwegian waters — as the wrecks of Hundevika (1340 ± 60), Sørenga 8

(1495 ± 7) and Sørenga 10 (1493 ± 32) (Table 3).<sup>375</sup> Small and medium sized vernacular clinker ships were almost only built of radially cleft planks in Denmark up to the post-medieval period.<sup>376</sup> Outside Scandinavia such planks were however not uncommon, as in London, where numerous radially cleft planks — some of a Baltic provenance — from the thirteenth to fourteenth century were either scrapped for re-use<sup>377</sup> or used in ship-constructions like the Blackfriars 3 wreck from the late fourteenth century.<sup>378</sup>

Another interesting comparison are frame-spacings, as they indicate the sturdiness of a vessel and thus indirectly reflect in what kind of marine environment the vessel was expected to operate. Vessels with great frame spacings usually operated in sheltered inland waters, whereas seagoing vessels had narrow frame spacings. The frame spacings of the Beluga Ship are most common and, as could be anticipated, would relate to a small to medium-sized vessel that would have been commonly found in local coastal trade. In the Bryggen excavations in Bergen, Norway, two major clusters of frame distances — measured from centre to centre — of 47 - 50cm and 63 - 65cm were noted, which may roughly relate to a medieval measure of a short ell (47.4cm) and a long ell (55.3cm) between the frame edges.<sup>379</sup> Although the sided dimensions of keel and stem of the Beluga Ship seem small in comparison to similarly built wrecks, the moulded dimension of the stem with almost 30cm suggests that it would have fulfilled the requirements of a seagoing vessel, as the keel would have increased the lateral plan and thereby reduced the side-drift.

The Scandinavian coast closest to Bremen is the Danish west coast of Jutland, particularly the city of Ribe as the only significant Danish port at the North Sea. Unfortunately, there is barely any comparative evidence, with the exception of some loose timbers, as from a keelson from the late thirteenth-century dredged up by a fisherman south off Fanø — at the access to Ribe — with the highest likelihood that its wood came from the Weser region.<sup>380</sup> Not surprisingly, Ribe had long-standing trade relations to Bremen. But did this also extend to Baltic timber trade?

<sup>375</sup> However, caulking or luting material generically summarised under the category “hair” may in fact be also wool, as differences between animal species can be only made when the material is well preserved.

<sup>376</sup> Bill 2009a, 256

<sup>377</sup> Marsden 1996, 107ff. see also Goodburn 2003

<sup>378</sup> Marsden 1996, 55ff.

<sup>379</sup> Christensen 1985, 202. The fact that the two groups do not match up perfectly can be probably explained by the practise of measuring frame intervals from centre to centre, while the gaps between the frames would be slightly smaller.

<sup>380</sup> Ejstrud & Maarleveld 2007, 135

<sup>372</sup> Auer and Maarleveld 2011, 13, 19

<sup>373</sup> Zwick 2010, 69f.

<sup>374</sup> Bill 1994, 60

Oak had in fact become a rare commodity in Jutland, which induced King Christian I of Denmark to forbid the export of oak from Ribe in 1480.<sup>381</sup> Danish shipbuilders acquired their timber mainly from their provinces in Scania, Blekinge and Halland.<sup>382</sup> Notwithstanding, historical records indicate that wainscot was exported via Riga to Denmark in the eighteenth century.<sup>383</sup> Documentary records from the fourteenth, fifteenth and sixteenth centuries indicate that merchants from Ribe maintained trading contacts to the Baltic,<sup>384</sup> although it remains unknown whether this included also timber at that time. The fact that the timber provenance of the Beluga Ship was Daugavian may provide a decisive cue, as it indicates that the builders of the Beluga Ship had a different access to a timber source. Livonian — i.e. Daugavian — forrest products were traded at least since the early fourteenth century at the Scania trade fair — in Skanör and Falsterbo — which was primarily renowned as herring market.<sup>385</sup> This would have been an important node, where Scandinavians and especially Danes would have had access to goods exported via Riga. The amalgamation of a Scandinavian-style construction and wainscot of Daugavian origin would point to this market, which sets the Beluga Ship apart from the main — i.e. Vistulian — timber trade network of the time.

Despite the distinctive access to a timber source, the Beluga Ship reflects a general trend in the use of imported timber. According to a statistical evaluation of wrecks in the area of medieval Denmark, the archaeological record seems to indicate that before ca. 1355 most vessels were built of timber from local or adjacent regions, but that a shift occurred thereafter which prompted the provenances to be more internationally composed, reflecting the increase of timber trade.<sup>386</sup> Moreover, traditionally lapstrake constructions like the Beluga Ship prevailed in the eastern part of medieval Denmark,<sup>387</sup> which included Scania. This is possibly of significance with regard to the abovementioned Livonian timber trade.

The *terminus post quem* of 1396 of the Beluga Ship (Illus. 3) would be consistent with this general trend, if indeed the ship was of Danish origin. After the Stralsund Peace of 1370 was signed, the City of Riga granted Danish merchants the same rights of trade it enjoyed before the war with the Hanseatic League.<sup>388</sup>

The fact that the Beluga Ship appears to have been not only scrapped in Bremen, but also repaired locally with timber from the Weser Lowlands, suggests that

if it was a Scandinavian vessel, it would have regularly frequented the port of Bremen. But Danes were certainly not the only Scandinavians with whom Bremen maintained trading relations. Since 1279, Bremen merchants enjoyed trade privileges in Norway. The ties between Bremeners and Norwegians were in fact so close, that Bremen usually sided with Norway when the Hanseatic League pushed sanctions against the Kingdom of Norway, and continued trade even when other Hanseatic cities blockaded Norwegian ports. As was recently pointed out, Bremen's status within the Hanseatic League is questionable as there are actually no indications for Bremen's participation in the Hanse Diet until 1358.<sup>389</sup> Bremen merchants concluded their trade relation with Norway independently from the rest of other Hanseatics, as confirmed by a treaty dating to 1321.<sup>390</sup> And in 1346 the Norwegian king granted that Bremen merchants should enjoy the same rights as that of the Hanseatic community, demonstrating the preminent importance of Bremeners, being perceived not part of the latter, but as a distinctive group.<sup>391</sup>

So could the Beluga Ship be also interpreted as a legacy of the longstanding ties between Bremeners and Norwegians, and could the Beluga Ship have been of Norwegian rather than Danish origin? On archaeological grounds, the way the Beluga Ship was constructed features also many similarities to Norwegian finds, regarding the wool caulking, or the use of radially cleft planks. Even the late medieval assemblage from the Bryggen-excavation in Bergen indicates that no significant changes in the tools or wood-working techniques have occurred since the Viking Age, where almost only radially cleft planks were used. The earliest water-powered saw-mills were built in Norway as late as 1520 to 1550.<sup>392</sup> On historical grounds, however, there is no documentary evidence to suggest that Baltic timber was imported to Norway in that period.<sup>393</sup>

While the absence of concrete evidence does certainly not preclude the possibility that any such trade may have occurred, this would have been an exception rather than the rule. Judging from the construction, or what is left of it,<sup>394</sup> it would have possessed good sailing qualities, which would have been important for crossing the Kattegat and whenever onshore winds turned the Jutland coast — which was poor in natural harbours and shelter — into a dangerous lee shore. To go even a step further, one could raise the

<sup>381</sup> Jahnke 2006, 88

<sup>382</sup> Fritzbøger 2004, 110

<sup>383</sup> Pāvulāne 1975, 46; Zunde 1998/99, 121

<sup>384</sup> Madsen 1999, 200; 2000, 255

<sup>385</sup> Tossavainen 1994, 23f.

<sup>386</sup> Bill 2009b, 430

<sup>387</sup> Bill 2009b, 435

<sup>388</sup> Olesen 2005, 187

<sup>389</sup> Elmshäuser 2003, 212f.

<sup>390</sup> BUB II, no. 217

<sup>391</sup> BUB II, no. 544-546

<sup>392</sup> Christensen 1985, 213

<sup>393</sup> Nedvitne 1983, 69-104, cited in Alopaeus and Elvestad 2004, 80

<sup>394</sup> this specifically refers to the great deadrise angle, which would have increased the lateral plane, counteracting the side drift on clause-hauled courses.

question whether Bremeners or other Hanseatic merchants could have obtained vessels from Scandinavian shipwrights for their own use? Although ship depictions on Hanseatic town seals consistently represent vessels built similar to the ‘Bremen Cog’, there is no reason to believe that the towns’ self-representation matched up with common practice. They could have relied on the local craft for lighter traffic, which would have been most suited to its respective environment. This would explain why ship-timbers associated with the Hanseatic tradition — as typified by the ‘Bremen Cog’ — were totally absent from the rich maritime archaeological material recovered from the Tyskebryggen excavations in Bergen,<sup>395</sup> even though Bergen was one of the *kontors* of the Hanseatic League. The recent recognition that Avaldsnes served not only as anchorage but also had some basic infrastructure for the storage of merchandise could point to a place of transshipment — a roadstead easily accessible for sturdy and large seagoing vessels like the Avaldsnes Ship, where cargo was unloaded onto smaller, more manoeuvrable vessels, which could navigate in the narrow fjords to Bergen with greater ease. The fact that the Beluga Ship was discovered in the City of Bremen at a time, when larger vessels were bound to anchor in the roadsteads in the Weser estuary, may be an indication that the Beluga Ship operated as part of Bremen’s lighter traffic,<sup>396</sup> a possibility that will be explored in the following section.

## Between shoals and pirates: Embedding the Beluga Ship into the local historical context of Bremen and its Lower Weser policy

In spite of its “foreign” Scandinavian construction, the Beluga Ship may not have been an uncommon sight to contemporaries outside of Scandinavia (Illus. 5). There are by now sufficient examples to indicate that the clinker-technique practised by Scandinavian shipwrights was not unknown at the southern North Sea coast, with corresponding finds from the Netherlands.<sup>397</sup>



*Illus. 5. A depiction of a clinker-built “birlinn” with 17 oarports on a gravestone slab of 1523 in Harris, Scotland. These types of vessels had a Norse ancestry and were widespread in the Hebrides and West Highlands. Although the stem shape and deadrise (as could be inferred from the strake contours) are compellingly similar to that of the Beluga Ship, this illustration was not included to suggest any direct correlation, but to highlight that traditional Scandinavian-style vessels were neither exclusive to Scandinavians, nor to the Viking Age (source: Crumlin-Pedersen 2010, fig. 3.41.).*

It was even suggested that there could be a link between Frisian and Scandinavian shipbuilders with reference to clusters of clinker-nails from early medieval Frisian find contexts from Wijnaldum in Oostergo, Beetgum-Besseburen and Oosterbeintum.<sup>398</sup> Although finds of clinker-nails are sparse, they are continuously present throughout the medieval period in Frisian populated areas,<sup>399</sup> which gave rise to the assumption that a technology transfer may have occurred as early as the fourth or early fifth century through visiting Scandinavian craftsmen.<sup>400</sup> However, this was rightly called into question on the basis that the absence of rove blanks in the finds collection does not provide any tangible proof that the clinker-method was practised in this area.<sup>401</sup> Visiting Scandinavian vessel could have simply been scrapped here. Nonetheless, clinker finds from the southern North Sea litoral are not restricted to Frisian areas, but also found in thirteenth century urban contexts from Vlaardingen, Tiel and Rotterdam,<sup>402</sup> Stade,<sup>403</sup> and the fourteenth to fifteenth century finds context from Harburg, including rove blanks,<sup>404</sup> so it

<sup>395</sup> Christensen 1989, 18

<sup>396</sup> Large sturdy seagoing vessels which could not easily access rivers were often bound to anchor in a sheltered roadstead at some distance to the cities and were loaded and unloaded by lighters (often also referred to as “bordings” in written sources), which operated between the roadsteads and the city quays.

<sup>397</sup> cf. van Holk 2003

<sup>398</sup> Reinders and Aalders 2007, 115

<sup>399</sup> Reinders and Aalders 2007, 117

<sup>400</sup> Reinders and Aalders 2007, 119

<sup>401</sup> van de Moortel 2011, 97

<sup>402</sup> van Holk 2001 cited in Reinders and Aalders 2007

<sup>403</sup> Andreas Schäfer, pers. comm.

<sup>404</sup> Several rivets were catalogued by this author who is currently researching the maritime find collection from the Schloßstraße-excavation in Harburg - Hamburg’s southernmost district south of the Elbe

can be asserted that such vessels were at least repaired locally. This may be also assumed in the case of the Beluga Ship, as the upper strakes were amended with planks hewn in the second half of the fifteenth century in the Weser Lowland (Illus. 3), which was a predominantly Frisian populated area. The fact that it was not only scrapped in Bremen, but apparently also repaired with timber coming from a source nearby, suggests that the vessel operated in this region for some time. Its light construction would have made it suitable to be operated not only under sails, but also under oars, and there are indications for such vessels in Hanseatic towns.<sup>405</sup> The Beluga Ship might have been identified by a range of names by contemporaries, for instance as *bardze* - which would have been a light raider which could be sailed and rowed.<sup>406</sup> Likewise *schnigge* or *smoke*, which appears to be the German equivalent to the Scandinavian *snekkeja* and used by Hanseatic towns for safeguarding its waterways, e.g. in Danzig for the year 1462.<sup>407</sup> Clinker-built vessels operating under oars are mentioned in documents from both English and Hanseatic ports.<sup>408</sup>

The possible use for such “light raider” becomes clear when illustrating the geo-political circumstances of the time. The Beluga Ship’s repair phase in the second quarter of the fifteenth century coincides with a period in which the City of Bremen lost its control of both Weser river banks. Around 1400 navigation on River Weser — Bremen’s international traffic

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which used to be historically independent from Hamburg. At least two rivets appear to be blanks, providing concrete evidence that rivetting occurred locally.

<sup>405</sup> Despite there are no archaeological remains of a plank with oar-holes, the Beluga Ship would have been predestined to be rowed, which also explains its find-spot some 50 km up the river at a time when most sailing vessels would have anchored at the Weser estuary and transhipped its cargo via lighter traffic to and from Bremen.

<sup>406</sup> Heinsius 1986, 209

<sup>407</sup> HUB VIII, no. 1150. The Scandinavian etymological origin is particularly thought-provoking with regard to the wreck’s Scandinavian means of construction.

<sup>408</sup> In England with oar-lengths of between 16 to 23ft (4.88-7.02m) (Tinniswood 1949, 285) and in Hamburg, close to Bremen, prices for oars were fixed by two categories, for oars measuring more than 20ft (5.72m) and less than 18ft (5.15m) in length (Hamburg foot = ca. 28.6 cm according to Kiesselbach 1901, 89). According to a rule of thumb of an oar length being 1.5 times the beam, these oars would be suited for vessels of a beam greater than 3.81m or lesser than 3.43m. In comparison, the Dokøen 3 wreck, which is very similar to the Beluga wreck in many respects, has a reconstructed beam of 3.83m at a length of 13m, (Nielsen forthcoming, 110) corresponding to an oar length of 5.75m.

artery — has become threatened: On the one hand an increased fluvial sedimentation leading to the silting up of parts of the river, which posed difficulties to mariners, as they had to avoid numerous new shoals as navigation channels became narrower. These problems are reflected by the city’s well documented effort to safeguard navigation by claiming the right to set navigation marks and bouys in the Lower Weser in 1410,<sup>409</sup> a duty that was soon thereafter — in 1426 — assigned to its merchant community.<sup>410</sup> Nonetheless large ships were increasingly required to anchor in the roadstead at the Weser estuary — probably near Blexen<sup>411</sup> — and transship their commodities via lighters to Bremen.<sup>412</sup> This, on the other hand, collided with the political destabilisation of the Frisian-populated Weser estuarine region. Since the second half of the fourteenth century, East Frisia had been characterised by the rise of Frisian chieftain dynasties, which were involved in conflict amongst each other and quite literally harboured Victual Brothers — pirates who were expelled in 1398 from the Island of Gotland — who were welcomed and redirected as “marine mercenaries” into the local Frisian conflicts.<sup>413</sup> This was perceived as such a threat to Bremen’s mercantile interests, that the city sought to exert direct territorial control over the Lower Weser area in a period from roughly 1400 to 1425, by assuming sovereignty over the Frisian land of Butjadingen — sanctioned by King Sigismund, by forming tight alliances with the Frisian territories Stadland, Lehe, Landwürden, and by regulating trade and salvage rights with the Frisian chieftain of Wursten in 1406<sup>414</sup> to safeguard River Weser as *libera et regia strata* — as a free and royal “road”.<sup>415</sup> At the same time, closer ties were formed with the Hanseatic League.<sup>416</sup>

In the early fifteenth century Bremen has succeeded in establishing complete territorial rule over both river banks (Illus. 6).<sup>417</sup> The newly gained territorial power in this region was set in stone by the building of *Vredeborg* Castle<sup>418</sup> near the estuary, evidently to protect Bremen’s roadsteads and the lighter traffic.

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<sup>409</sup> BUB IV, no. 406

<sup>410</sup> BUB V, no. 297

<sup>411</sup> Weidinger 2002, 127

<sup>412</sup> Hill 2004, 266

<sup>413</sup> Although it is argued that Bremen too maintained mutually beneficial links with the pirates — serving as market for robbed goods, or supporting Bremen’s war efforts against the chieftain of Rüstringen Edo Wiemken around 1400 — this must have destabilised the entire region and threatened trade (Elmshäuser 2003, 227)

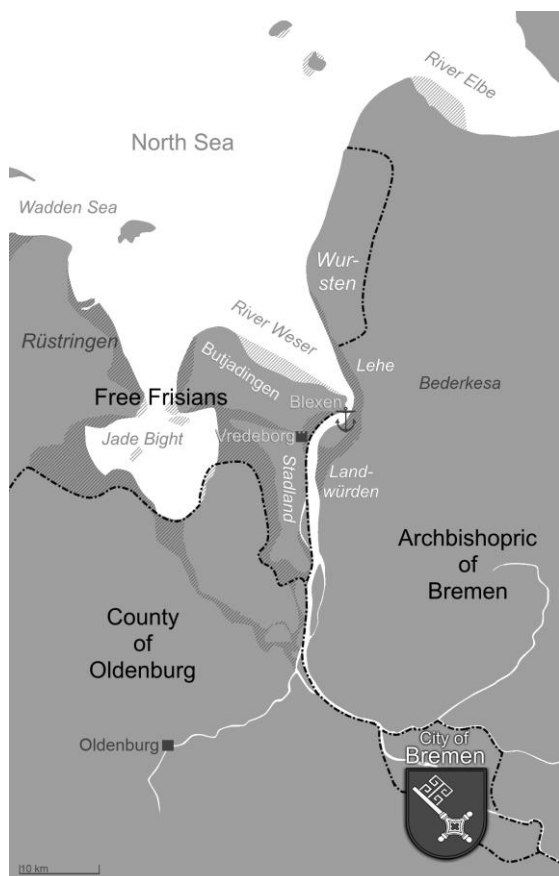
<sup>414</sup> HUB V, no. 701

<sup>415</sup> Hill 2004, 273f.

<sup>416</sup> Elmshäuser 2003, 228; Hill 2004, 287

<sup>417</sup> Schwarzwälder 1994, 4

<sup>418</sup> literally a castle to “pacify”



*Illus. 6: The local geo-political context of Bremen and the Frisian populated Lower Weser region. Territories temporarily controlled by — or associated to — the City of Bremen are marked in white letters. The hachured areas roughly indicate the reconstructed river course and coastline of the 15th century based on Bebre 2013, fig. 4 and Hill 2004, fig. 17 (Graph: Daniel Zwick).*

However, Bremen's regional supremacy was short-lived and Count Christian of Oldenburg in alliance with the chieftain of Rüstringen, Edo Wiemken, as well as rebels from Butjadingen destroyed *Vredeborg* in 1425<sup>419</sup> and — as consequence — Butjadingen and Stadland became eventually independent from Bremen.<sup>420</sup> The Weser estuary, however, remained Bremen's roadstead, as lighter traffic became important as it became increasingly more problematic to sail to Bremen in large seagoing vessels.<sup>421</sup>

<sup>419</sup> Hill 2004, 301

<sup>420</sup> Hill 2004, 308

<sup>421</sup> Documentary evidence suggests that this became imminent in the mid fifteenth century, when for instance in 1441 a kraier under the command of the Bremen skipper Claves Boller is mentioned, anchoring at "our deep" with a cargo of Bergen stockfish (BUB VII, no. 109), or the Hamburg skipper Dietrich van der Beerne, who in 1445 remained at the Weser to conduct legal transaction (BUB VII, no. 377). And in 1489 bordings are mentioned in the Kundigen Rolle, a type commonly

Thus, both the modest size and style of construction of the Beluga Ship may reflect the environmental and political struggle, in that vessels of more modest sizes and capable to operate under oars were used to overcome the geomorphological changes in the fluvial topography, as well as to gain control of river navigation in an era of political instability.

## Conclusion

In this paper the question was raised — possibly for the first time — whether there is a spatiotemporal correlation between late medieval clinker-built vessels in the North Sea area and Baltic timber imports. The evaluation has shown that there is indeed positive evidence to support the assumption, but it has also shown that the presently available data are not sufficient to establish more detailed constructional correlations. It could be however anticipated that different categories of import timber could be identified archaeologically by collecting statistical data on plank lengths. In the particular case of the Beluga Ship where only the bow section has survived, this would have made little statistical sense, as the longest planks are usually used in the midship section. Nonetheless there is a latent potential for a statistical evaluation, as has been demonstrated in the few known cases where planks were part of the cargo assemblage, which conversion and dimensions seem to match with timbers listed as export items (Table 2).

While only general assertions could be made on the correlation between clinker vessels and timber imports, one thing seems to be clear: The stereotypical impression of what constituted shipping in a Hanseatic port has to be revised and is certainly not adequately represented by ships like the 'Bremen Cog' alone.<sup>422</sup> While this volume highlights the far-flung Hanseatic trade network in North-Western Europe and thereby opens up a new chapter of Hanse Archaeology, the findings of this paper suggest that the trade network in the 'Hanseatic sphere' was not a one-way lane for a predominantly Low German

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associated with lighter vessels (Weidinger 2002, 127). As no toll registers have survived from this time it is not possible to get an impression of the loadbearing capacities of vessels operating on the Weser River at that time, but if compared to toll registers from nearby Hamburg of 1418, whose transport geography would have been similar to Bremen's, 56.5% of the port traffic was made up by small-scale shipping of less than 50 tons of capacity, engaged in regional coastal trade to the Flemish, Dutch and Frisian coasts (Weidinger 2002, 128).

<sup>422</sup> cf. Zwick 2014, 61ff.

mercantile and cultural influence, but that counter-influences will have occurred too.

The finding of the Beluga Ship may be testament to Danes, Norwegians or other foreigners conducting trade in a Hanseatic port, or possibly Bremen merchants or Frisian raiders who preferred Scandinavian-built vessels. The great maneuverability of such lightly constructed vessels with little draught would have not only been preferable in winding Norwegian fjords or the Frisian and Danish Wadden Sea with its many islands and shoals, but arguably also in the swiftly changing fluvial landscape of the Weser, which navigability has decreased dramatically in the course of the 15<sup>th</sup> century.

## Acknowledgments

I am indebted to Dieter Bishop for entrusting me with the recording, study and publication of this shipwreck. Damian Goodburn and Anton Englert gave me inspiring feedback and advice, and thereby contributed significantly to the discussion. The latter and Fred Hocker made some very important remarks on the correct use of terminology as devised by the Viking Ship Museum Roskilde, which helped this author to align this paper to what ought to become a common standard within the field of maritime archaeology. Thanks are also due to Xenius Nielsen, Toby Jones, Gustav Milne, Nigel Nayling, Waldemar Ossowski, Alice Overmeer, Staffan von Arbin and Maris Zunde for making available manuscripts prior to publishing or for sending me copies of hard-to-get publications, and — in many cases — for providing additional details not mentioned in the published work. For further personal communications I thank Niels Bonde, Karl Uwe-Heußner, Peter Marsden and Andreas Schäfer. Last not least I would like to thank Natascha Mehler and Endre Elvestad for inviting me to the highly interesting conference to Avaldsnes, Norway, to which it was a great pleasure to contribute this paper.

## Bibliography

Alopaeus, H. and Elvestad, E. 2004. Avaldsnesskipet - et "nordisk" skip fra Polen?, in T. Torfæus, *Mellom Vinland og "Ringenes herre"*, Karmøyseminaret 2004 (Karmøy: Karmøy Kommune), 73–86.

Auer, J. and Maarleveld, T. 2013. *Skjernøysund Wreck 3: Fieldwork Report 2011*. Esbjerg Maritime Archaeology Reports 5 (Esbjerg: Syddansk Universitet).

Behre, K.-E. 2013. Die Meeresspiegelschwankungen der vergangenen Jahrtausende und deren Bedeutung für das Siedlungsgeschehen an der deutschen Nordseeküste / The sea-level fluctuations over past millennia and their impact on the settlement process

along the German North Sea coast, *Siedlungs- und Küstenforschung im südlichen Nordseegebiet / Settlement and Coastal Research in the Southern North Sea Region* 36, 13–30.

Bill, J. 1994. Iron Nails in Iron Age and Medieval Shipbuilding, in C. Westerdahl, *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology (Roskilde: Vikingeskibsmuseet), 55–64.

Bill, J. 1997. *Small Scale Seafaring in Danish Waters AD 1000-1600*. Ph.D. dissertation (Copenhagen: Københavns Universitet).

Bill, J. 2009a. Zwischen Kogge und Kraweel. Traditioneller Kleinschiffbau in Südkandinavien in einer Zeit der Wende, in B. Scholkmann, C. Vossler and M. Wolf, *Zwischen Tradition und Wandel. Archäologie des 15. Und 16. Jahrhunderts* (Büchenbach: Verlag Dr. Faustus), 251–260.

Bill, J. 2009b. From Nordic to North European - Application of Multiple Correspondence Analysis in the Study of Changes in Danish Shipbuilding A.D. 900-1600, in R. Bockius, *Between the Seas. Transfer and Exchange in Nautical Technology*. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology (Mainz: Römisch-Germanisches Zentralmuseum), 429 - 438.

BUB - *Bremisches Urkundenbuch* (6-. 1873-). (Bremen: Müller).

Christensen, A. E. 1985. Boat finds from Bryggen, in: A. E. Herteig, *The Archaeological Excavations at Bryggen, The German Wharf, in Bergen 1955-68*. Bryggen Papers Main Series I (Bergen: Universitetsforlaget), 47-278.

Christensen, A. E. 1989. Hanseatic and Nordic Ships in Medieval Trade. Were the Cogs Better Vessels?, in C. Villain-Gandossi, S. Busuttill and P. Adam, *Medieval Ships and the Birth of Technological Societies* (Valetta: University of Malta), 17-24.

Coates, J. F. 1977. Hypothetical reconstructions and the Naval Architect, in S. McGrail, *Sources and Techniques in Boat Archaeology*. British Archaeological Reports 29 (Oxford), 215-226.

Crumlin-Pedersen, O. 2000. To be or not to be a cog. The Bremen Cog in perspective, *The International Journal of Nautical Archaeology* 29.1, 26–38.

Crumlin-Pedersen, O. 2002. Restoration, in O. Crumlin-Pedersen and O. Olsen, *The Skuldelev Ships I. Ships and Boats of the North 4.1* (Roskilde: Vikingeskibsmuseet), 87-96.

- Crumlin-Pedersen, O. 2004. Nordic Clinker Construction, in: F. M.Hocker and C. A. Ward, *The Philosophy of Shipbuilding: Conceptual Approaches to the Study of Wooden Ships*. (College Station: Texas A&M University Press), 37-63
- Crumlin-Pedersen, O. 2010. *Archaeology and the sea in Scandinavia and Britain. A personal account*. Maritime Cultures in the North 3 (Roskilde: Vikingeskibsmuseet).
- Daly, A. 2007. *Timber, Trade and Tree-rings. A dendrological analysis of structural oak timber in northern Europe, c. AD 1000 to c. AD 1650*. Ph.D. dissertation (Esbjerg: Syddansk Universitet).
- Daly, A. and Nymoen, P. 2007. The Bøle Ship, Skien, Norway—Research History, Dendrochronology and Provenance, *The International Journal of Nautical Archaeology* 37.1, 153–170.
- Dollinger, D. 1998. *Die Hanse* 5 (Stuttgart: Kröner).
- Eckstein, D. and Wrobel, S. 2007. Dendrochronological proof of origin of historic timber — retrospect and perspectives, in K. Haneca, A. Verheyden, H. Beekmann, H. Gärtner, G. Helle and G. Schleser, *TRACE - Tree Rings in Archaeology, Climatology and Ecology* 5, 8-20.
- Ejstrud, B. and Maarleveld, T. 2007. Et middelalderligt fragtskib - marinarkæologi i Knudedybet, *Sjæk'len. Årbog for Fiskeri- og Søfartsmuseet* (Esbjerg: Saltvandsakvariet), 132-141.
- Ellmers, D. 2006. Hansischer Handel mit Schiffsbauholz. Ein Beitrag zur Wörter- und Sachen-Forschung, in H.-P. Baum, R. Leng and J. Schneider, *Wirtschaft, Gesellschaft, Mentalitäten im Mittelalter*. Festschrift zum 75. Geburtstag von Rolf Sprandel (Stuttgart: Steiner), 63-78.
- Ellmers, D. 2010. Koggen kontrovers, *Hansische Geschichtsblätter* 128, 113-140.
- Elmshäuser, K. 2003. Bremen und seine Kaufleute – Konflikte und Kämpfe, in G. Hoffmann and U. Schnall, *Die Kogge – Sternstunde der deutschen Schiffarchäologie* (Bremerhaven and Hamburg: Convent), 206-233.
- Eriksen, O. H. 2001. *Dendrokronologisk undersøgelse af tommer fra skibsvrag fundet på Dokøen, København*. Nationalmuseets Naturvidenskabelige Undersøgelser rapport 23/2001 (Copenhagen: Nationalmuseet).
- Fawsitt, S. 2012a. *Rapport: Dronning Eufemiasgate Sorenga 9*. Arkeologisk Rapport 2012, 9 (Oslo: Norsk Maritimt Museum).
- Fawsitt, S. 2012b. *Rapport: Dronning Eufemiasgate Sorenga 10*. Arkeologisk Rapport 2012, 10 (Oslo: Norsk Maritimt Museum).
- Fritzboeger, B. 2004. *A Windfall for the Magnates: The Development of Woodland Ownership in Denmark c. 1150-1830* (Odense: Syddansk Universitet).
- Godal, J. B. 1995. The use of wood in boatbuilding, in O.Olsen, J. Skamby Madsen and F. Rieck, *Shipshape: Essays for Ole Crumlin-Pedersen* (Roskilde: Vikingeskibsmuseet), 271-282.
- Goodburn, D. M. 1991. New Light on Early Ship- and Boatbuilding in the London Area, in G. L. Good, R. H. Jones and M. W.Ponsford, *Waterfront Archaeology*. Proceedings of the third international conference on waterfront archaeology held at Bristol 23-26 September 1988 (London: Council for British Archaeology), 105-115.
- Goodburn, D. 2003. Rare fragments of a 13<sup>th</sup> century clinker galley found in London and the use of the Irish wildwoods for shipbuilding, in C. Beltrame, *Boats, Ships and Shipyards*. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000 (Oxford: Oxbow Books), 289-295.
- Gøthche, M. and Høst-Madsen, L. 2001. Medieval wrecks at Dock Island, Copenhagen, *Maritime Archaeology Newsletter from Roskilde, Denmark* 17, 28–33.
- Hammel-Kiesow, R. 2002. Lübeck and the Baltic Trade in Bulk Goods for the North Sea Region 1150-1400, in L. Berggren, N. Hybel and A. Landen, *Cogs, Cargoes, and Commerce: Maritime Bulk Trade in Northern Europe, 1150-1400* (Toronto: Pontifical Institute of Mediaeval Studies), 53-91.
- Haneca, K., Ważny, T., Van Acker, J., Beekman, H. 2005. Provenancing Baltic timber from art historical objects: success and limitations, *Journal of Archaeological Science* 32, 261-271.
- Haneca, K., Čufar, K., Beekman, H. 2009. Oaks, tree-rings and wooden cultural heritage: a review of the main characteristics and applications of oak dendrochronology in Europe, *Journal of Archaeological Science* 36, 1-11.
- Heinsius, P. 1986. *Das Schiff der hansischen Frühzeit* (Cologne and Vienna: Böhlau).
- Heußner, K.-U. 1999. Wieviel fehlt? - Ein Beitrag zur Genauigkeit von dendrologischen Datierungen, in E. Cziesla, T. Kersting and S. Pratsch, "Den Bogen spannen..." *Festschrift für Bernhard Gramsch* (Weissbach: Beier & Beran), 523-525.
- Heußner, K.-U. 2009a. report 12.02.2009 (unpublished).

- Heußner, K.-U. 2009b. report 17.03.2009 (unpublished).
- Heußner, K.-U. 2009c. report 17.12.2009 (unpublished).
- Hill, T. 2004. *Die Stadt und ihr Markt: Bremens Umlands- und Aussenbeziehungen im Mittelalter (12.-15. Jahrhundert)* (Stuttgart: Steiner).
- Hirsch, T. 1858. *Danzigs Handels- und Gewerbsgeschichte unter der Herrschaft des Deutschen Ordens* (Leipzig: Hirzel).
- Hocker, F. M. 2004. Bottom-based shipbuilding in northwestern Europe, in F. M. Hocker and C. A. Ward, *The Philosophy of Shipbuilding. Conceptual approaches to the study of wooden ships* (College Station: Texas A&M University Press), 65-93.
- HR - *Hanserezeise I* (1-8, 1870-1897). (Leipzig: Duncker & Humblot).
- HUB - *Hansisches Urkundenbuch* (1-11, 1876-1916).
- Jahnke, C. 2006. Dronningens skibe for kongens flåde. Dronning Dorothea af Brandenburgs skibsbygning omkring 1486, *Maritim Kontakt* 28, 85-94.
- Jahnke, C. and Englert, A. 2015. Historical research on merchant seafaring in Danish waters and in the western Baltic Sea. In A. Englert, *Large Cargo Ships in Danish Waters 1000-1250. Evidence of specialised merchant seafaring prior to the Hanseatic Period*. Ships and Boats of the North 7 (Roskilde: Vikingskibsmuseet), 17-54.
- Kapfenberger, D. 2003. *Holz und Holzhandel in Preußen von 1399 - 1409*. Unpublished master's thesis (Erlangen: Universität Erlangen).
- Kiesselbach, T. 1901. Grundlage und Bestandteile des ältesten Hamburgischen Schiffrechts. Ein Beitrag zur Geschichte des norddeutschen Seehandels und Seerechts. In: *Hansische Geschichtsblätter* 28, 49-93.
- Krapiec, M. and Krapiec, P. 2014. Dendrochronological analysis of the copper ship's structural timbers and timber cargo, in W. Ossowski, *The Copper Ship — A medieval shipwreck and its cargo / Miedzioniec — Wrak średniowiecznego statku i jego ładunek*. Badania Archeologiczne Narodowego Muzeum Morskiego w Gdańsku 2, (Gdańsk: Polish Maritime Museum), 143-160.
- Lahn, W. 1992. *Die Kogge von Bremen. Band 1: Bauteile und Bauablauf* (Hamburg: Convent).
- Larsen, L. K., Baittinger, C. and Bonde, N. 2011. Reused boat timbers from Aarhus. *Maritime Archaeology Newsletter from Denmark* 26, 21-23.
- Litwin, J. 1985. The Copper Ship of Gdansk Bay; recent discoveries from the wreck, cargo and site, in J. Heermann, *5<sup>th</sup> International Congress of Maritime Museums Proceedings 1984* (Hamburg: Museum für Hamburgische Geschichte), 42-49.
- L'Hour, M. and Veyrat, E. 1994. The French Medieval Clinker Wreck from Aber Wrac'h, in C. Westerdahl, *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde 1991 (Oxford: Oxbow Books), 165-180.
- Madsen, P. K. 1999. Ribe between West and East - a North Sea harbour and its Baltic connections 700-1600, in J. Bill and B. L. Clausen, *Maritime Topography and the Medieval Town*. Papers from the 5th International Conference on Waterfront Archaeology in Copenhagen, 1998. PNM Series: Studies in Archaeology & History 4 (Copenhagen: Nationalmuseet), 197-202.
- Madsen, P. K. 2000. Ribes baltiske handelsforbindelser, in P. Ingesman and B. Poulsen, *Danmark og Europa i senmiddelalderen* (Århus: Aarhus Universitetsforlag), 243-263.
- Marsden, P. 1996. *Ships of the Port of London*. English Heritage Archaeological Report 5 (London: English Heritage).
- McGrail, S. 1993. *Medieval Boat and Ship Timbers from Dublin* (Dublin: Royal Irish Academy).
- McGrail, S. 1998. *Ancient Boats in North-West Europe. The Archaeology of Water Transport to AD 1500* (London and New York: Longman).
- Milne, G. 2004. The fourteenth-century merchant ship from Sandwich: a study in medieval maritime archaeology, *Archæologia Cantiana* 124, 227-264.
- Myrhøj, H. M. 2000. The late medieval wreck from Vedby Hage, Denmark, in J. Litwin, *Down the River to the Sea*, Eight International Symposium on Boat and Ship Archaeology, Gdańsk 1997 (Gdańsk: Centralne Muzeum Morskie), 229-234.
- Nævestad, D. 1998. Lokaliserte middelaldervrak i Øst-Norge. *Norsk Sjøfartsmuseum Årsbok*, 159-208.
- Nayling, N. and Jones, T. 2014. The Newport Medieval Ship, Wales, United Kingdom, *The International Journal of Nautical Archaeology* 43.2, 239-278.
- Nayling, N. and Susperrigi, J. 2014. Iberian Dendrochronology and the Newport Medieval Ship, *The International Journal of Nautical Archaeology* 43.2, 279-291.



- Nielsen, X., forthcoming. *Dock Island's Wreck 3: hull description and comparative analysis of a 15<sup>th</sup> century clinker built vessel, with a review of its documentation methodology*. Master's thesis (Esbjerg: Syddansk Universitet).
- Olesen, J. E. 2005. Riga und Dänemark im Mittelalter, in I. Misāns and H. Wernicke, *Riga und der Ostseeraum. Von der Gründung 1201 bis in die frühe Neuzeit*. Tagungen zur Ostmitteleuropa-Forschung 22 (Marburg: Herder Institut), 180-192.
- Overmeer, A. 2006. Searching for the missing link? A research on clinker built ships in the 15<sup>th</sup> and 16<sup>th</sup> centuries, *SOJA-bundel* 2006, 63-72.
- Overmeer, A. 2008. Schepen van verre kusten? Overnaadse schepen in Nederland in de 15de en 16de eeuw, in R. Oosting and J. van den Akker, *Boomstamkano's, overnaadse schepen en tuigage*. Inleidingen gehouden tijdens het tiende Glavimans Symposium, Lelystad 2006 (Amersfoort: Glavimans Stichting).
- Overmeer, A. 2009. Scheepswrak aan het Wrakkenpad. Waardstellend onderzoek van scheepswrak B 36, gemeente Nordoostpolder, *Grondsporen: Opgravings- en onderzoeksrapporten van het Groninger Instituut voor Archeologie* 5 (Groningen: Rijksuniversiteit Groningen).
- Overmeer, A. forthcoming. *Dutch clinker-built ships in the 15th and 16th centuries*. Ph.D. dissertation (Groningen).
- Paulsen, R. 2010. Die Koggendiskussion in der Forschung. In: *Hansische Geschichtsblätter* 128, 19-112.
- Pāvulāne, V., 1975, Rīgas tirdzniecība ar meža materiāliem XVII-XVIII gs. (Rīga: Latvijas PSR Zinatnu Akademija Vestures Instituts).
- Pukiene, R. 2002. Oak annual radial growth chronology covering 1208–1408, *Dendrologia Lituaniae* VI, 102–107.
- Reinders, H. R. and Aalders, Y. 2007. Frisian Traders and the Clinker Technique, in T. Arisholm, K. Paasche and T. L. Wahl, *Klink og seil - Festskrift til Arne Emil Christensen*. (Oslo: Norsk Sjøfartsmuseum), 109-122.
- Reinders, H. R. and Oosting, R. 1989. Mittelalterliche Schiffsfunde in den IJsselmeerpoldern, in W. H. Zimmerman and L. Spath, *Ländliche und städtische Küstensiedlungen im 1. und 2. Jahrtausend*. Wilhelmshavener Tage 2, 107-122.
- Sauer, A. 1996. *Das „Seebuch“ - Das älteste erhaltene Seebandbuch und die spätmittelalterliche Navigation in Nordwesteuropa*. Schriften des Deutschen Schiffahrtsmuseums 44 (Hamburg: Kabel).
- Schwarzwälder, H. 1994. Bremen als Hansestadt im Mittelalter, *Hansische Geschichtsblätter* 112, 1-38.
- Steen, K. 2012. *Rapport: Dronning Eufemiasgate Sorenga 8*. Arkeologisk Rapport 8, 2012 (Oslo: Norsk Maritimt Museum).
- Teisen, M. 1994. A Medieval Clinker-Built Wreck at Hundevika, Norway, in C. Westerdahl, *Crossroads in ancient shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde, 1991 (Oxford: Oxbow Books), 73–76.
- Thowsen, A. 1965. Foldrøyskipet: Et middelaldersk skipsfunn fra Vest-Norge, *Sjøfartshistorisk Årbog* (Bergen: Stiftelsen Bergens Sjøfartsmuseum), 38–57.
- Tinniswood, J.T. 1949. English Galleys 1272—1377, *The Mariner's Mirror* 35.4, 276 - 315.
- Tossavainen, J. 1994. *Dutch Forest Products' Trade in the Baltic from the Late Middle Ages to the Peace of Munster in 1648* (Jyväskylä: Unpublished master's thesis).
- Van Holk, A. F. L. 2003. Clenched lap-strake boat finds from the Netherlands, between 1200 and 1600, in C. Beltrame, *Boats, Ships and Shipyards*. Proceedings of the ninth International Symposium on Boat and Ship Archaeology, Venice 2000 (Oxford: Oxbow Books), 296-305.
- Vlierman, K. 1996. *Kleine bootjes en middeleeuws scheepshout met constructiedetails*. Scheepsarcheologie 2. Flevovericht 404 (Lelystad: Rijksdienst voor de IJsselmeerpolders).
- Van de Moortel, A. 2011. Medieval boats and ships of Germany, the Low Countries, and northeast France – archaeological evidence for shipbuilding traditions, shipbuilding resources, trade, and communication, *Siedlungs- und Küstenforschung im südlichen Nordseegebiet = Settlement and Coastal Research in the Southern North Sea Region* 34, 67-104.
- Von Arbin, S. 2012. A 15<sup>th</sup>-Century Bulk Carrier, Wrecked off Skaftö, Western Sweden, in N. Günsein (ed.), *Between Continents*. Proceedings of the Twelfth Symposium on Boat and Ship Archaeology, Istanbul 2009 (Istanbul: Ege Yayınları), 67-74.
- Von Arbin, S. 2014. *Skaftövraket — ett senmedeltida handelsfartyg* (Uddevalla: Bohuslän Museum).
- Ważny, T. 1990. *Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen*. Ph.D. dissertation (Hamburg: Universität Hamburg).
- Ważny, T. 2002. Baltic timber in Western Europe – an exciting dendrochronological question, *Dendrochronologia* 20.3, 313-320.

- Ważny, T. 2005. The origin, assortment and transport of Baltic timber, in C. van de Velde, J. van Acker, H. Beeckman and F. Verhaeghe, *Constructing Wooden Images* (Brussels: Vrije Universiteit), 115-126.
- Ważny, T. and Eckstein, D. 1987. Der Holzhandel von Danzig/ Gdansk - Geschichte, Umfang und Reichweite, *Holz Roh- Werkstoff* 45, 509-513.
- Weidinger, U. 2002. Die Entstehung der Schlachte als mittelalterliche Hafenanlage Bremens, in K. Elmshäuser, *Häfen — Schiffe — Wasserwege. Zur Schifffahrt des Mittelalters*. Schriften des Deutschen Schifffahrtsmuseums 58 (Hamburg: Convent), 116-132.
- Weski, T. 1999. The IJsselmeer type: some thoughts on Hanseatic cogs, *The International Journal for Nautical Archaeology* 28.4, 360-379.
- Weski, T. 2006. Wurde wirklich eine Kogge gefunden? Spätmittelalterliche Funde der Schiffsarchäologie in Nord- und Ostsee, *Antike Welt - Zeitschrift für Archäologie und Kulturgeschichte* 1, 91-96.
- Wolf, T. 1986. *Tragfähigkeiten, Ladungen und Maße im Schiffsverkehr der Hanse. Vornehmlich im Spiegel Revaler Quellen*. Quellen und Darstellungen zur hansischen Geschichte (Neue Folge) 31. (Cologne and Vienna: Böhlau).
- Zunde, M. 1998/99. Timber export from Old Riga and its impact on dendrochronological dating in Europe, *Dendrochronologia* 16/17, 119-130.
- Zwick, D. 2008. Das Beluga-Schiff vom Bremer Teerhof. Vorläufige Untersuchungsergebnisse, *Bremer Archäologische Blätter* 7, 145-151.
- Zwick, D., 2010. Neues vom 'Beluga Schiff' – ein Bremer Klinkerwrack aus dem 15. Jahrhundert. *Nachrichtenblatt Arbeitskreis Unterwasserarchäologie* 16, 62-71.
- Zwick, D. 2012. Variationen in der mittelalterlichen Schiffbautechnik anhand von Wrackfunden in Bremen, *Holzbau in Mittelalter und Neuzeit*. Mitteilungen der Deutschen Gesellschaft für Archäologie des Mittelalters und der Neuzeit 24 (Paderborn: Deutsche Gesellschaft für Archäologie des Mittelalters und der Neuzeit), 283-298.
- Zwick, D. 2014. Conceptual Evolution in Ancient Shipbuilding: An Attempt to Reinvigorate a Shunned Theoretical Framework, in J. Adams and J. Rönby, *Interpreting Shipwrecks: Maritime Archaeology Approaches*. Southampton Monographs in Archaeology New Series 4 (Southampton: Highfield Press), 46-71.
- Zwick, D. forthcoming. A 15th-century shipwreck with Scandinavian features from Bremen, Germany. In: B. van Tilburg (ed.), *Ships and Maritime Landscapes*. 13th International Symposium on Boat and Ship Archaeology 8-12 October 2012, Amsterdam (Groningen: Barkhuis).

## Paper E

Zwick 2016: D. Zwick, Bayonese cogs, Genoese carracks, English dromons and Iberian carvels: Tracing technology transfer in late medieval Atlantic shipbuilding. In: *Itsas Memoria. Revista de Estudios Marítimos del País Vasco* 8. Donostia/San Sebastián : Untzi Museoa/Museo Naval.



# BAYONESE COGS, GENOESE CARRACKS, ENGLISH DROMONS AND IBERIAN CARVELS: TRACING TECHNOLOGY TRANSFER IN MEDIEVAL ATLANTIC SHIPBUILDING

In this synthesis divergent research strands are combined in order to gain a holistic perspective to what degree shipbuilders and mariners at the Atlantic coast where under a northern and southern European influence, how the differential implementation of innovations in shipbuilding became manifest, particularly where innovations are only partially adopted, and appropriated with technical solutions from the own tradition. A major emphasis of this study is the English-Basque maritime cooperation and the role of Basque shipbuilders in initiating a gradual transition from a shell-first to a skeleton-first principle.

## 1. Introduction

For the last decades the study of maritime affairs in medieval times remained largely the domain of historians, with an emphasis on written, iconographic and ethnological sources. As a maritime archaeologist, this author is struck with the impression that many historians have not given up their “claim” on having a monopoly on the narrative of how ship-types evolved over time, despite historical sources are mute on technical details and only indicate static type-labels, origin, sailing routes, and in rare cases details on cargo-bearing capacities and inventories. Shipwrecks, in contrast, are the tangible remnants of the maritime past, not restricted to the information contemporaries felt worth recording for legal or economic transactions. Admittedly, the corpus of shipwrecks studied in its pioneering phase was — until recently — considered not representative enough to infer general trends in technological development, and maritime archaeology therefore remained stuck in descriptive analysis. Mundane constructional features were not likely to add any deeper insights to the ‘big picture’ historians aspire to draw.

In recent times, however, maritime archaeology has entered a second phase, in which general patterns in construction have become more apparent, with a whole swathe of other information illuminating medieval shipbuilding practises that paint a rich picture of the past, indicating mundane aspects such as the availability and management of resources, particularly in terms of timber-supply, culturally inherited preferences in technical solutions and foreign influences, which were implemented with varying degrees of success. Realising this potential, this synthesis presents an effort to bridge several gaps

of scholarship that have divided a field of common interest. Most importantly, this study aims to combine a historical and archaeological approach in a meaningful sense, in that historical type-labels are not merely projected onto archaeological ship-remains, but the different source categories assessed on their true and restrictive informative value. As this study will show, type-labels are a floating concept and cannot be exclusively associated with ship-types in the constructional sense, although differences on a constructional level may indeed be implied. Another gap to be bridged is the linguistic gap between the Germanic and Romanic speaking world, which has artificially divided the discourse into a northern and a southern European narrative. It is striking how the academic discourse on cogs in particular has taken place in almost total isolation to southern European sources, and presented as exclusively northern European, Hanseatic or even Frisian ship-type.<sup>423</sup> Although this can be attributed in part to the fact that shipwrecks associated with the cog-type were exclusively discovered in northern waters so far, there is rich iconographic and written evidence that cogs were also built and crewed on the Iberian Peninsula and the north-western Mediterranean Sea region.

Thus, an attempt is made in this paper to re-evaluate the mutual influences in medieval and early modern shipbuilding techniques between northern and southern Europeans and the underlying dynamics affecting change, while not getting “hung up” on ambivalent historical type-labels. Especially from an archaeological point of view shipbuilding traditions are surprisingly static in many respects, but whenever change occurred it is sudden and linked to major societal changes, which are often explicitly echoed in historical sources. Although primarily concerned with the technicalities involved in ship construction of large seagoing ships that were at one point in time regarded as the cutting edge of technology — like cogs and carracks — more general aspects of medieval society are illuminated in the process: What were the driving forces behind technical innovation? How do aspirations to emulate a superior foreign technology become manifest? And, quite generally, what is the human capacity for innovation by adaptation? An emphasis is put on a period in which northern European shipbuilding technology was lagging behind to that of their southern European counterparts in many respects, emphasising the transience of the ‘powerhouses of innovation’.

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<sup>423</sup> cf. Crumlin-Pedersen 1965, 1983, Ellmers 2014

## 2. Northern crusader cogs in the Mediterranean Sea

The earliest references to cogs in the Mediterranean are connected to the crusades to the Holy Land predominantly of German, Frisian and Flemish origin. Although efforts have been made to trace the ‘cog’ etymologically in early medieval times, it has to be dismissed before the 12<sup>th</sup> century as being too ambivalent a term. For instance, the 9<sup>th</sup>-century term *cogscult* has been often interpreted as cog-tax, but may rather point to a *koke*, i.e. a judicial person in a regional Frisian dialect.<sup>424</sup> Possibly the earliest definite reference to a cog as ship-type can be found in the chronicles of the Flemish town of Nieuwpoort in 1163, mentioning *cogga*, alongside other vessels such as a *clincaboit*, *losboit*, *buza* and *scuta*.<sup>425</sup> Other early references are found in Wolfram von Eschenbach’s poetry, one of the most widely read works of the Middle Ages and thus a great source for the colloquial use of terms. Within the context of the crusades he mentions an extraordinarily large army being transported in *kielen* (keels), *treimunden*, *urssieren* and in *kocken* (cogs).<sup>426</sup> In another excerpt he mentions, amongst other types of vessels, *kocken*, *ússiere*, *seytiez* and *snecken* used to ferry a crusader army on horseback and on foot across the river.<sup>427</sup> Naturally, the largely legendary character of Eschenbach’s poems does not permit any conclusions on factual grounds, but he will have undoubtedly used terms familiar to his contemporaries. By listing a number of different vessels equivocally used to ferry an army across a river, it is safe to foreclose, that the reference did not touch on the vessels’ actual suitability to operate in a fluvial environment, but used instead to highlight the heterogeneity of the crusader contingents. Each vessel appears to be a stereotypical mode of transport for Europeans of different origin. For instance, the *snecke* appears to be a typical Scandinavian type. The Danish King Canute VI ordered in 1187 explicitly *snekker* for the impending

crusade.<sup>428</sup> Cogs on the other hand were initially associated with Germans, Flemings or Frisians<sup>429</sup> — all people from the southern North Sea coast. The saga of Olav Tryggvason — written after 1200 retrospectively — referred to a fleet of *kuggar* sent by German Emperor Otto I to Christianise Norway; *kuggar* being the generic term for a Hanseatic<sup>430</sup> ship at the time when the saga was written.<sup>431</sup> In 1210, the King of England used five Frisian cogs for warfare<sup>432</sup> and in 1217/18 German and Frisian crusaders are said to have sailed in cogs to capture Damiette in Egypt.<sup>433</sup> It is perhaps no coincidence that cogs are typically ascribed to people from the German Empire<sup>434</sup> in the same way as *snekker* are ascribed to the Danes, given that the earliest written sources on cogs are in Old and Middle High German.<sup>435</sup> The first reference to cogs in the Baltic Sea can be found for the year 1206 in Henry of Livonia’s chronicles,<sup>436</sup> written from the perspective of an eye-witness not long after the events occurred.<sup>437</sup> The notion that the first genuine references to ‘cogs’ date all around the same time, yet in vastly different geographical regions, is striking.

However, the Low German “monopoly” on cogs in the late 12<sup>th</sup> and early 13<sup>th</sup> century became swiftly obsolete: While a reference to four Danish cogs travelling to Tallinn in 1221<sup>438</sup> may be due to the chronicler’s Low German linguistic bias regarding the classification of ship-types, the earliest Danish source on cogs dates only few years later, when in 1224 King Valdemar II of Denmark pledges to join the crusades with *snekker* and *kogger*.<sup>439</sup> Albeit there is no evidence to suggest that the ships called cogs by Germans were similarly built to cogs called by the Danes thus, the sudden advent of the term ‘cog’ in written sources does not necessarily imply the development of an

<sup>424</sup> Fliedner 1969, 44; Heinsius 1986, 70

<sup>425</sup> Asaert *et al* 1976, 46. An even earlier mentioning in 1147 refers to Flemish cogs in the Second Crusade, named by Asaert *et al* 1976, 45. However no reference is provided here and therefore has to be dismissed as conventional perception. Perhaps the reference on the preceding page to Albertus Aquensis’ mentioning of Flemish and Frisian pirates helping the crusaders at the siege of Tarsus in 1097 have persuaded the authors to imply that their vessels must have been cogs.

<sup>426</sup> Wolfram von Eschenbach, Willehalm, I 9, ed. Kartschocke & Schröder 2003, 6

<sup>427</sup> “*Sie leisten swaz er in gebôt./ des wârt Plippalinôt/ dar nâch unmüezig schiere./ kocken, ússiere, seytiez und snecken,/ mit rôttê der quecken,/ beidiu z’orse und ze fuoz./ mit dem marschalch über muoz./*” Wolfram von Eschenbach, Parzival, XIII, 667f., ed. Bartsch 1871, 44

<sup>428</sup> Bill *et al* 1997, 111

<sup>429</sup> Frisia in present-day Germany and Holland was a semi-autonomous province of the German Empire

<sup>430</sup> The Hanseatic League was a Low German speaking confederation of merchants and later cities

<sup>431</sup> Falk 1912, 89

<sup>432</sup> Hutchinson 1994, 153

<sup>433</sup> Waitz 1880, 833f., see also Heinsius 1986, 74

<sup>434</sup> Frisia in present-day Germany, Holland and Denmark was an autonomous province of the German Empire

<sup>435</sup> Heinsius 1986, 73

<sup>436</sup> *Heinrici chronicon Livoniae* X 9 and X 12, ed. Bauer 1975, 56ff.

<sup>437</sup> Cf. Villads Jensen 2011, 246

<sup>438</sup> *Heinrici chronicon Livoniae* XXIV.7, ed. Bauer 1975, 267

<sup>439</sup> “*...kongen har lovet, at han vil tage korset og drage til undsatning for Det hellige Land og forlade sit rige i to år efter førstkommande august og føre 100 skibe, kogger og snekker regnet sammen, med sig på færd, så at han, om Gud vil, er i Spanien den første vinter efter sin afrejse og den nærmest følgende sommer kommer til Det hellige Land...*” Danmarks riges Breve 1.6.16, ed. Blatt & Skyum-Nielsen 1979.

entirely novel type of ship in the mid-12<sup>th</sup> century. The connotation of the term cog may have been an identifier on the origin — as we have just seen — or may have been used with the operational capabilities of the vessel in mind, more in terms of a function than construction. In late 12<sup>th</sup> century sources cogs were generically characterised in the sources as large vessels, as opposed to small vessels: „(...) *magnas naves, que koggen appellantur et minores quotcumque voluerint naves alias*»,<sup>440</sup> This remains also the case a century later, in which a Pomeranian document from 1281 refers to „*majoribus navibus liburnis, id est coggonibus*”.<sup>441</sup> It is not clear however, whether the sudden advent of the term cog in all European seas was primarily owed to an entirely new way of naval architecture, or a type or class of ship that became prevalent in the wake of new requirements in maritime logistics, such as armed long-distance voyages in the time of the crusades.

It is not inconceivable that the fleet of 36 ‘large ships’ from Frisia and Bremen,<sup>442</sup> anchoring off Lisbon in 1189 during the Third Crusade, would have been similarly built as ships later identified as cogs, but not yet commonly called so by contemporaries. Ships for the Third Crusade were built in different regions and towns and four left Cologne in 1189 with victuals for three years<sup>443</sup> and with 115 armed men.<sup>444</sup> Armed ships with sufficient victuals — «*navibus bellatoribus armis et cibariis sufficienter*»<sup>445</sup> — also left Bremen in the same year to join the crusade. Most references to ships remain generic. Is the term “cog” only a linguistic alteration for such large seagoing ships?

Although Wolfram von Eschenbach’s use of ship-types is mostly generic, he specifically ascribes to cogs the capability of carrying provisions for long voyages<sup>446</sup> and the transport of horses.<sup>447</sup> If this

premise is correct, cogs would have been the ideal long-distance vessels for armies, especially in waters foreign or hostile, in which there were but few suitable harbours. The two excerpts above stress that sufficient provisions for long voyages were taken onboard by the crusaders, which must have been a difficult task in terms of food preservation. One possible aspect of this high degree of seaborne self-sufficiency is the practice of keeping livestock on board of ships as source of fresh meat. Ships large and sturdy enough to transport horses could also transport livestock, and interestingly, archaeological evidence suggests that this practice was already known at this early time. The investigation of the mid-12<sup>th</sup> century Kollerup wreck, which may have been called a cog,<sup>448</sup> revealed that cattle was slaughtered on board the vessel.<sup>449</sup> Not unlike the crusader ships, which departed from Cologne, the Kollerup Ship is also likely to have departed from the Lower Rhine as indicated by pottery from the Low Countries and Rhenish slates.<sup>450</sup> It foundered during the failed attempt of circumnavigating Cape Skagen, a dangerous area with no natural harbours and thus no protection whenever onshore winds turned the coast into a dangerous lee shore. Ships travelling on routes with no possibility to make safe landfalls over a long period of time would have most likely kept a supply for fresh meat on board. Aside from meat, fresh water supply made landfalls necessary. Emo von Friesland recorded an eye-witness account of a Frisian crusader fleet entering 1217 the Ebro River near Tortosa in Spain — dividing Christian from Muslim lands — in order to replenish its water supplies after exertions and thirst.<sup>451</sup> This reflects the difficulty of replenishing supplies when sailing off hostile shores, in this case Granada, which was then under Saracen rule. In the later course of events some of the Frisian ships became unseaworthy, so Count William and parts of his contingent followed the

<sup>440</sup> Jordan 1949, 140

<sup>441</sup> Hansisches Urkundenbuch I, 884, ed. Höhlbaum 1878, 303

<sup>442</sup> Kurth 1911, 183

<sup>443</sup> “*Interim naves fabricabantur per diversas regiones et civitates in expeditionem, e quibus quatuor de Colonia moverunt, in quibus erant ad quindecim centum homines; tam hii quam ceteri omnes ad tres annos victualia copiose habebant, armis precipuis et omni genere resistendi muniti*” *Annales Colonienses maximi*, ed. Pertz 1861, 795

<sup>444</sup> *quindecim centum homines* has been previously translated as 1500 men in Heinsius 1986, 94f. and Vogel 1915, 127, which would have been perhaps rather expressed as *mille quingenti*. 1500 men divided on four vessels would have meant a crew of 375 per vessel, which – in addition to large enough provisions – would have been quite unlikely for that time. Either the chronicler exaggerated or the writer’s native tongue prevailed by translating ‘fifteen-hundred’ literally, and not by the correct Classical Latin ‘hundred fifteen’, i.e. *centum quindecim*.

<sup>445</sup> *Narratio Itineris Navalis ad Terram Sanctam*, ed. Chroust 1928, 179

<sup>446</sup> Wolfram von Eschenbach, *Parzival*, I, 58, 1-16

<sup>447</sup> Wolfram von Eschenbach, *Parzival*, X, 546, 1-30 (24)

<sup>448</sup> The Kollerup wreck is tentatively associated with this new cog-type and there is much to be said for it, given the novelty of hull construction coinciding spatiotemporally to historical cog-references since the mid-12<sup>th</sup> century (cf. Hocker 2004, 72ff.). However, it would be precipitant to refer to the Kollerup-type as ‘cog-type’, as historical ship-types were not necessarily synonymous to types in a constructional sense.

<sup>449</sup> Khortz Andersen 1983, 16. However, the evidence for on-board slaughtering could be also connected to the salvaging operations after the ship ran aground.

<sup>450</sup> Khortz Andersen 1983, 16

<sup>451</sup> (...) *tertio die Tortosam civitatem accessimus, ubi Errora fluvius, limes gentium et terminus fidelium, dulcibus aquis influens amaritudinem temperat et reddit potabilem. Ibi tandem Sarracenis a tergo relictis, libertatem consecuti et aquas potabiles, veteris veritate probata proverbii, quod libertatem estimat et precium ponit aque potabili, laudavimus inventorem.* cf. Röhrich 1879, 66

common practice of returning overland, leaving the ships behind.<sup>452</sup> Although the long-distance voyages with only few landfalls would have facilitated little direct contact, the prospect of crusaders choosing the land route back home would have nevertheless provided Mediterranean shipwrights ample opportunities to study the clinker-built wrecks of the northerners in more detail. However, there is no evidence to suggest that northern European shipbuilding has left any traces in local shipyards at that time. Even at the destination of most crusader fleets, i.e. the Levantine ports, it were the Mediterranean-built crusader ships that left a visual impact, judging from ship graffiti in Acre from the second half of the 13<sup>th</sup> century.<sup>453</sup> In fact, many central European — including German — crusaders boarding Levantine-bound vessels in Venice must have become more familiar with Mediterranean-built vessels than with northern European cogs. The ships in Venice were very distinctive in both construction and rigging.<sup>454</sup> Most German crusaders travelling via Venice to the Holy Land would have originated from the inland, and thus were not acquainted to the shipbuilding techniques of their countrymen on the distant northern shores. The German Emperor Frederick II himself appears to have used locally-built Mediterranean ships in the 1220's of the *chelandre* and *taride* type.<sup>455</sup> This may well be due to the fact that the personal ties to the Mediterranean of the Stauffer emperor were much stronger than to the northern fringe of his empire, due to his Sicilian roots.

One feature in particular, however, became synonymous with northern ships at that time: Rather than the clinker construction technique and hull design, it was first and foremost the single-masted square rig that was perceived as the most distinguishing characteristic for northern European vessels, forming a sharp contrast to the Mediterranean lateen riggers. This allowed Christian prisoners in Beirut 1197 to identify an approaching fleet with square-sails — *vela quadranguia* — as their own.<sup>456</sup> The shape of the sail must have been perceived as the most distinctive criterion in this period, as in 1232, when a Genoese referred to the seal of La Rochelle (Fig.1) thus: «*In alio vero sigilo erat imago cuiusdam ligni ad similitudinem Cochae cum arbore et vello quadrate expenso*».<sup>457</sup> This excerpt has been often mistaken as a reference to a cog depiction. But in verity, the description merely likens the single square

rig — *cum arbore et vello quadrate* — to that of a cog.<sup>458</sup> Thus, the cog was evidently perceived by the referrer as the most prominent or largest vessel to carry such a sail. An anonymous Teutonic Order chronicler described in 1245 retrospectively the siege of Acre of 1191, in which crusaders from Bremen and Lübeck are said to have used the sail of a ship called cog as canopy for a hospital.<sup>459</sup> This reference might stress the perceived exceptionalism of the northern cog in this region, not least because its square-sail would have been much better suited to be used as canopy than a lateen sail.



Fig. 1. La Rochelle seal of ca. 1200 (Graph: EWE 1972, cat. Nr. 89).

While 13<sup>th</sup>-century documents from the time of the crusades referred to them as *cocas* or *coggonas* that were brought in by northerners<sup>460</sup> they had evidently no perceivable influence on Mediterranean shipbuilding at that time, despite claims to the contrary.<sup>461</sup> A lasting “northern” influence occurred not before the early 14<sup>th</sup> century, however, and it seems important to stress that “northern” has to be redefined when it comes to shipbuilding, as will be elaborated in the following section.

### 3. The southern border of the northern shipbuilding tradition

From the mid 9<sup>th</sup> century onwards Norman pirate raids have depopulated the Asturian, Galician, Cantabrian and Basque coastline. But when the raids ebbed away and maritime trade took its place, coastal urban settlements emerged, as testified by archaeological excavations with habitation horizons in San Salvador for the 10<sup>th</sup>/11<sup>th</sup>-century and San

<sup>452</sup> Unger 2006, 268

<sup>453</sup> Kahanov & Stern 2008, 24ff.

<sup>454</sup> cf. Pryor 1984

<sup>455</sup> Pryor 1992, 127ff.

<sup>456</sup> “*Cum hec agerentur, navaiis exercitus prospere velificando urbi desolate appropriabat, in qua tantum captivi christiani remanserant. Qui videntes vela quadranguia, christiana inteiixerunt agmina*”. Arnoldi Chronica Slavorum V, 27, ed. Lappenberg 1869, 202

<sup>457</sup> Jal, Glossaire nautique, Paris 1840, 483

<sup>458</sup> Weski 1999, Ellmers 2011, 118

<sup>459</sup> Sarnowsky 2007, 13

<sup>460</sup> Friel 1994, 78

<sup>461</sup> cf. Heinius 1986, 79



Sebastián for the 11<sup>th</sup>/12<sup>th</sup>-century.<sup>462</sup> Shipyards in Bayonne are attested since 1131 after it was conquered by Alfonso I, King of Navarre.<sup>463</sup> It has been presupposed, however, that Bayonese shipbuilding became most influenced by Norman and English traders, especially when Aquitaine became an English fief in 1154 and when the English king granted fishing and whaling rights to the people of Bayonne in 1170.<sup>464</sup> Early on, Basque ships appear to have played an important mediating role in the coastal trade between England and its French possessions. In 1223, for instance, four *nefs* from Bayonne and one *coca* transported wine from Aunis near La Rochelle to Portsmouth.<sup>465</sup> The English influence is well reflected in historical sources regarding the close commercial links of the Cantabrian and Basque cities of Santander, Bilbao and San Sebastián to England since the early reign of Henry III (1216-1272).<sup>466</sup> This is also reflected by ship depictions on northern Iberian seals, resembling the ships of the Cinque Port seals in striking detail (Fig. 2).



Fig. 2. 13<sup>th</sup>-century seals of Sandwich (left) and San Sebastián (right) (Graph: EWE 1972, cat. Nr. 170, 171).

These iconographic representations are often associated with keels or *nefs*, which Scandinavian ancestry is ostensive. Thus it is not surprising that the northern Iberian Peninsula belonged to northern Europe in terms of shipbuilding and other aspects of culture. Ethnographic studies have revealed that the division line between the northern clinker tradition and the southern carvel tradition is marked by the Duoro River — Portugal's largest river: Boats in the northern rivers of Minho, Lima, Duoro are clinker-built, whereas those in the southern rivers of Nabao and Tejo are not.<sup>467</sup>

## 4. Pan-Iberian voyages of Basque and Cantabrian clinker-built cogs

The year 1304 is often perceived as key date, when Mediterranean shipbuilding became subject to an Atlantic influence, or as noted by the Florentine chronicler Giovanni Villani: «*At this time people from Bayonne in Gascony came with their ships, which they called Bayonese cogs, through the Strait of Gibraltar into the Mediterranean to privateer, and they caused a lot of damage. Since then, Genoese, Venetians, and Catalans started to use cogs and gave up shipping with their own large ships, because of the greater seaworthiness and lesser expenses of cogs. Through this, our ships have greatly changed, especially the hulls.*»<sup>468</sup> This was not a random event. It has to be seen as a punitive expedition in response to the alliance of France's King Philip IV with the Genoese, of which the latter disrupted English trade in Flanders with a galley fleet.<sup>469</sup> The Bayonese privateers can be perhaps understood as the long arm of English influence, seeking to disrupt the Genoese adversaries in their home waters.

As a matter of fact, pan-Iberian cog voyages from the Basque and Cantabrian region occurred already in preceding decades. The earliest Catalan reference dates to 1230, where a *coca* from Bayonne was hired for a voyage to Mallorca.<sup>470</sup> In 1277-78 Castilians are known to have hired Basque-owned and crewed vessels for service in the Mediterranean to secure the Guadalquivir River in the wake of the capture of Seville in 1248 and Sanlúcar in 1249 from the Saracens.<sup>471</sup> And the earliest known reference to “a cog as a Cantabrian and Biscayan type” in Lisbon dates to 1297.<sup>472</sup> Cogs are mentioned in the 1313 statutes of Genoa: «*Chuod aliquis patronus alicuius navis, cocbe, galee, etc.*»<sup>473</sup> In 1320-3, 1327, 1341 several instances are noted in which particularly Castilian and Basque corsairs were involved in several captures in the Balearic Sea, of which the Mallorcan trade of Catalans suffered substantially.<sup>474</sup> While the exact origin of the Castilian corsairs remains unmentioned,

<sup>468</sup> Own translation from a German translation in Ewe 1981, 24 from an Italian manuscript: Giovanni Villani, *Historia Fiorentina seu cronica* (Muratori *Rerum Italicarum scriptores* XIII, 412 D, E) VIII, cap. 77: „*In questo medesimo tempo certi di Bajona in Guascogna con loro navi, le quali si chiamavano cocche Baonesi, passaro per lo stretto die Silbilia e vennero in questo nostro mare corseggiando, e fecero danno assai; e d'all hora inanzi i Genovesi e Vinitianti e Catalani usarono di navigare con le cocche, e lasciarono il navigare delle navi grosse per più sicuro navigare, e perché sono di meno spesa. E questo fue in questa nostre marine grande mutatione di navilio.*“

<sup>469</sup> Ortega Villoslada 2008, 443

<sup>470</sup> Eberenz 1975, 104

<sup>471</sup> Rose 1999, 565

<sup>472</sup> Ortega Villoslada 2008, 432

<sup>473</sup> Heinsius 1986, 79 after Jal 1877, 483

<sup>474</sup> Santamaria-Arandez 1980, 91f.

<sup>462</sup> Alberdi Lonbide & Aragón Ruano 1998, 16

<sup>463</sup> Goyheneche 1990, 368

<sup>464</sup> Alberdi Lonbide & Aragón Ruano 1998, 17

<sup>465</sup> Goyheneche 1990, 368

<sup>466</sup> Hutchinson 1994, 80

<sup>467</sup> Filgueiras 1979, 45

it seems likely that they — like the Basques — originally came from the northern Iberian Peninsula, possibly Cantabria.

Ships and crews from the Bay of Biscay must have been considered an asset worth hiring. It is reasonable to suggest that all these vessels shared characteristics with the ‘Bayonese cogs’ mentioned by Villani. The latter also described how Count Guy of Flanders besieged a Dutch town with 1000 Flemish warriors and 80 castellated cogs ‘of the style of this sea’.<sup>475</sup> This, and the explicit mention of ‘Bayonese cogs’ suggests that regional differences were perceived in the way how a Flemish cog differed from a Bayonese cog. It even seems that a ‘Bayonese cog’ might have become a “brand”, which was not necessarily indicative of the vessel’s or owner’s actual origin. This is indicated by a reference from 1336, in which a Bayonese cog is said to be commanded by a Portuguese for a Mallorquin owner.<sup>476</sup> In the years 1321, 1324, 1332 and 1340 Portuguese cogs sailed against the Saracens, of which 1332 four in five were cogs specifically named to be Bayonese.<sup>477</sup>

Majorcan sources identify a whole range of Basque-Cantabrian towns as home port for cogs that have been chartered for the pan-Iberian route from Palma to Bruges and other Flemish towns for the years 1312, 1328, 1341, 1352, 1380, coming from Santander and Bayonne, while corsair cogs based in Seville were hired 1320 from Castro Urdiales and San Sebastián.<sup>478</sup> In 1320 the Mallorcan fleet was restructured, in which cogs and naos were replaced by galleys,<sup>479</sup> demonstrating that cogs were already in use, but were not the preferred vessels for all purposes, such as coastal defence. Basque shipping also played a central role in the alum trade from central Italy to north-west Europe in the 14<sup>th</sup> century.<sup>480</sup>

It is notable that cogs are sparsely mentioned in Castilian and Portuguese sources, were they are attributed mainly to a Cantabrian, German or English origin.<sup>481</sup> In Catalan sources, however, the term *coca*

features more prominently, and Santander, San Sebastián and Bayonne are usually mentioned as port of origin for cogs known to have entered the Mediterranean.<sup>482</sup> The absence of cogs in Castilian sources seems paradoxical, since Santander and San Sebastián formed part of the Kingdom of Castile, yet are said to originate from these cities in Catalan sources. This seeming paradox highlights that the term cog cannot be understood as an objectively fixed ship-type category. The difference may be purely owed to a regional dialect or difference in classifying ships, as the same three ships described 1320 in a Mallorcan source as *cocas* were described in a Castilian source as *carrucas*.<sup>483</sup> Majorcan records indicate a steady increase of cogs of Castilian and Portuguese origin from 1321 to 1340, with peaks in 1321 and 1330 and a total of 66 cog mentionings.<sup>484</sup> Ortega Villoslada points out that the *Bayonese* adjective could be only found in 1330 and 1332, whereas a Bayonese or Cantabrian origin was implied when the vessel was of Castilian denomination. There are instances where the master of the ship was said to be Bayonese, yet his cog not explicitly referred to as ‘Bayonese cog’.<sup>485</sup>

It is interesting to note, that the hired Biscayan cogs and other vessels were not serving the trade with their respective home ports, but operated on the pan-Iberian long-distance route, predominantly between Palma and Bruges. Both towns were often not the final destinations, as the goods were transhipped in Palma for Genoese and Venetian clients.<sup>486</sup> Biscayan cogs were continued to be individually hired, which also had — besides their great deadweight capacity — the advantage of sailing under a neutral flag during the conflicts between Genoa and the Crown of Aragon.<sup>487</sup> As the Aragonese-Genoese rivalry peaked in the early 15<sup>th</sup> century, the Castilians and Portuguese traded with Genoa, whereas Basque ships served the Aragonese-Catalan port of Barcelona, emphasising the great link between the Basque region and Aragon. Basque mariners also came in large numbers to Marseille, after the city’s fleet was destroyed in 1423 and in need of ships.<sup>488</sup>

Now the question arises what made these ‘Bayonese cogs’ so special? They were certainly distinctive from the local carvel-built Catalan ships, which were propelled by lateen-sails and oars, as the Culic VI wreck from the late 13<sup>th</sup> / early 14<sup>th</sup> century, or the Sorres X wreck from the late 14<sup>th</sup> century.<sup>489</sup> These

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synonymous to those from Bayonne, given that the latter was an English fief.

<sup>482</sup> Eberenz 1975, 104

<sup>483</sup> Ortega Villoslada 2008, 439

<sup>484</sup> Ortega Villoslada 2008, 435

<sup>485</sup> Ortega Villoslada 2008, 438f.

<sup>486</sup> Ortega Villoslada 2008, 434

<sup>487</sup> Soberón Rodríguez 2010, 150

<sup>488</sup> Santamaria-Arandez 1980, 90

<sup>489</sup> Soberón Rodríguez 2010, 150

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<sup>475</sup> „Messer Guido di Fiandra veggendolo venire, lasciò fornito in terra allo assedio di Silisea con 10000. Fiaminghi, & armò 80. Navi, overo cocche al modo di quello mare, fornite a Castella per battaglia, & in ciascuna almeno misse 100. huomini Fiaminghi & del paese”, Giovanni Villani, *Historia Fiorentina seu cronica* (Muratori *Rerum Italarum scriptores* XIII, 412 D, E) VIII, cap, 77, quoted by Eberenz 1975, 109f.

<sup>476</sup> “Consta que en 1336 Domingo Pérez de Lisboa patroneaba una coca bayonesa propiedad de los mercaderes mallorquines Joan Safont y Guillem Borsa (...)”, Santamaria-Arandez 1980, 99

<sup>477</sup> Santamaria-Arandez 1980, 99

<sup>478</sup> Ortega Villoslada 2005

<sup>479</sup> Santamaria-Arandez 1980, 68

<sup>480</sup> Loewen & Delhaye 2006, 100

<sup>481</sup> Eberenz 1975, 108f.; it would be an interesting question whether *cocas* described as English were also

local types, however, were deemed inapt to compete with Genoese ships and thus made it necessary to hire vessels from the Basque country.<sup>490</sup> What were the principal differences? A 14<sup>th</sup>-century depiction of a *coca ballonesa* in a Majorcan document sheds light on the issue; a potentially very insightful source, as Mallorca was a hub for Basque cogs (Fig. 3).

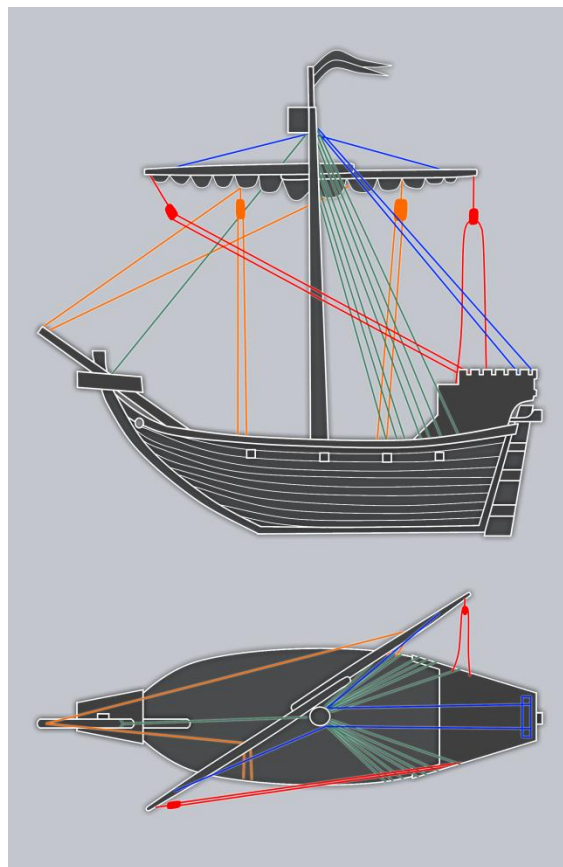


Fig.3. Interpretation of a “coca ballonesa” from a 14<sup>th</sup>-century document in the Historical Archives of the Kingdom of Majorca. Key: green: Forestay and shrouds, blue: halyards, red: braces, orange: bowlines (Graph: Daniel Zwick. Redrawn and interpreted on the basis of a line drawing in GOYHENETCHE, BEGLA 1998, 154).

An important feature might have been the advantageous stern or median rudder. Mediterranean ships, in contrast, usually had quarter rudders. Interestingly, the Sorres X wreck demonstrates a rare case, where both quarter rudders and a stern rudder were used, which may reflect a gradual transition which occurred at this time.<sup>491</sup> The highly detailed depiction of the rigging might not be accidental, as the drawer might have intended to demonstrate how square-rigged vessels could be sailed close-hauled, namely with bowlines, with which the windward luff was stretched via the bow-sprit to allow for close-hauled sailing. Mediterranean mariners accustomed to lateen sails — i.e. fore-and-aft type sails predestined for close-hauled courses — might have wondered

how northerners managed to sail close-hauled with square-riggers. This drawing might be testament to explain it. What made the *coca ballonesa* distinctive to northern European ships believed to be cogs — like ship-depictions on Hanseatic town seals — is the great and curved rake of the stem post. This would have reduced the lateral plane, which might have been considered an advantage when tacking, increasing the manoeuvrability. Naturally, it can be only hypothesised what exactly Giovanni Villani meant when he referred to the greater seaworthiness of the Bayonese cogs, but this inference would serve as an explanation. Another favourable characteristic of Basque cogs appears to be their capabilities as cargo carrier, specifically suited for equestrian transport. Written records of 1338 and 1343 indicate that Catalans used cogs for horse transport.<sup>492</sup> In terms of construction, Catalan sources indicate that at least some *cocas* were built in the northern European way by the occasional inclusion of the epithet *tinclat*. The etymology suggests that *tinclat* is the Mediterranean term for the clinker-technique,<sup>493</sup> i.e. in which the overlapping strakes are fastened with clinker-nails, i.e. rivets. This formed a stark contrast to Mediterranean shipbuilding, where planks were not only flush-laid — in a carvel fashion — but which entailed also the skeleton-first principle, which was almost complete absent in clinker vessels.<sup>494</sup> A *coccha tinclata* was mentioned in 1362 and a ship owner of a *coche tinclate* from San Sebastián was mentioned in 1374.<sup>495</sup> The epithet *tinclat* is regularly found in connection with cogs, but also with other vessels from the Iberian Atlantic coast, particularly the *barcha*, or *barxa tinclada*.<sup>496</sup> In 1380, Majorcan merchants were reportedly chartering a clinker-built vessel of Diego Diez from the Cantabrian town of Castro Urdiales to sail to La Alcudia and then to Flanders.<sup>497</sup> It is not astonishing that the vessels from the northern part of the Iberian Peninsula were clinker-built, as they shared a shipbuilding traditions with other northern Europeans. The similarities are not restricted to the Atlantic coast, as a relief of a ship in the Cathedral of Vitoria from the late 13<sup>th</sup> or early 14<sup>th</sup> century depicts a ship with an uncanny resemblance to the ‘Bremen Cog’ of 1380,<sup>498</sup> featuring clinker-planking, protruding cross-beams and straight stem and stern posts. Another similar ship depiction, but with a

<sup>492</sup> Ortega Villoslada 2008, 437

<sup>493</sup> Eberenz 1975, 105

<sup>494</sup> It would be inaccurate to address the clinker-technique as a pure shell-first technique, as temporary moulds and battens were used to render a desired shape to the hull. Moreover, as will be addressed further below, a case can be made for a transitional phase, in which aspects of the skeleton-first method pervaded the clinker-method.

<sup>495</sup> Eberenz 1975, 103f., 15.17, 15.24

<sup>496</sup> Eberenz 1975, 51, 105

<sup>497</sup> Ortega Villoslada 2005

<sup>498</sup> Alberdi Lonbide & Aragón Ruano 1998, 33

<sup>490</sup> Cf. Santamaria-Arandez 1980, 89

<sup>491</sup> cf. Raurich *et al* 1992

curved stem is to be found in the Cathedral of Bayonne from the late 14<sup>th</sup> century (Fig. 4).



Fig. 4. A modern ship-model based on the ship-depiction (top left) at a vault in Bayonne Cathedral, from the late 14<sup>th</sup> century (Source: Lizarraga, cf. [http://www.navalmodel.es/Naval\\_Model/La\\_afilada\\_pluma\\_de\\_Lizarraga.html](http://www.navalmodel.es/Naval_Model/La_afilada_pluma_de_Lizarraga.html)).

Despite many instances of cultural contact between northern and southern Europeans through mercantile cooperation and the crusades, this method seemed to be still considered alien in the Mediterranean, as the epithet appears to have been used as exceptional and non-local feature, as it was differentiated between «naves nostratae» — our ships — «et alie (...) tinclatae».<sup>499</sup> The presence of such “other” clinker-built vessels in Catalonia has been recently confirmed by archaeological evidence, namely by the discovery of two wrecks in Barcelona. The better preserved Barceloneta I wreck is a shell-first construction, in which the lands of the oak planks were luted with moss and connected by rivets.<sup>500</sup> The origin is almost certainly Basque or Cantabrian, as indicated by palyontological analysis and the negative result of a dendrological analysis, suggesting a timber provenance somewhere between Aquitaine and Porto;<sup>501</sup> i.e. one of the few regions which have been — until recently — lacking a timber chronology.<sup>502</sup> According to a C<sup>14</sup> of the moss, the Barceloneta I wreck was built around 1410 (Fig. 5). It was broken up somewhere between 1439 and 1477, as could be stratigraphically established by the construction of a wharf and a breakwater, respectively.<sup>503</sup> The presence of medium to large Basque ships in Barcelona is corroborated by written sources for the period

between 1438 and 1449.<sup>504</sup> For this period in particular, many vessels from the Biscay were registered in the *dret d'ancorage* records.<sup>505</sup> Although the clinker-technique is regularly associated with cogs, there is no compelling reason to imply that the Barceloneta I wreck would have been identified as such by contemporaries, as virtually all Basque ships from this period appear to be clinker-built.



Fig. 5. The Barceloneta I wreck: A slab of clinker-planking with joggled, closely-spaced futtocks (Photo: Mikel Soberón).

## 5. Catalanian and Italian cogs: A Mediterranean appropriation in carvel?

It has been argued that northern and southern cogs only share few common criteria, i.e. a square sail, a stern rudder, a full hull shape and a flat bottom.<sup>506</sup> Even this fairly minimal common denominator has been called into question regarding stern-rudders, as two rudders are listed in inventories for not few — especially small — *cochas*, which may be interpreted as the conventional Mediterranean side rudders.<sup>507</sup> However, such inventories often listed the entire inventory including materials for repair, so the presence of a second rudder may be also interpreted as spare rudder.

<sup>499</sup> Eberenz 1975, 224

<sup>500</sup> Pujol i Hamelink & Soberón Rodríguez 2011, 119

<sup>501</sup> Pujol i Hamelink & Soberón Rodríguez 2011, 121, 123

<sup>502</sup> Only recently, in the context of the Newport Ship research, new dendrological master curves for this region have been reconstructed, cf. <http://www.bbc.co.uk/news/uk-wales-south-east-wales-19646068>

<sup>503</sup> Pujol i Hamelink & Soberón Rodríguez 2011, 121f., Soberón Rodríguez 2010, 142

<sup>504</sup> Vela i Aulesa 2000, 633f.

<sup>505</sup> Vela i Aulesa 2000, 637ff.

<sup>506</sup> Friel 1994, 77ff.

<sup>507</sup> Nickel 1999, 73

There is a detailed inventory for a *cocha* named *Sent Climent* in Barcelona from 1331, which includes, amongst other things, two sails — *dos treos* — and two bonnets — *dues bonetes*.<sup>508</sup> Bonnets are commonly used in the Mediterranean to extend the sail area, whereas in northern Europe reef lines — with the first iconographic evidence around 1200<sup>509</sup> — were common, but inversely used to shorten the sail area. The presence of two sails and two bonnets may indicate a two-masted vessel, if one is willing to accept the premise that they were not spare sails. Canvas for repairs was in the inventory too — *un tros de canamas*.<sup>510</sup> The presence of multi-masted cogs is confirmed few years later by a Catalan reference from 1353, which refers to a *cocha* with bowsprit, a main mast and a mizzen mast.<sup>511</sup> Iconographic evidence suggests that besides the square main sail also other features from the cog were adopted, like the stern rudder and the capacious hull.<sup>512</sup> The advantages were recognized by a Genoese law of 1341, which refers specifically to the *coche baonesche* as having more loading capacity than other vessels and it was safer and cheaper to operate it.<sup>513</sup>

Cogs are mentioned in the Adriatic Sea as early as 1258, but not before the late 1340s Venetian shipbuilders are known to have built cogs in Ragusa's arsenal.<sup>514</sup> A shipbuilding contract from Ragusa dating to 1382 specified that a *navigium* built at the local shipyard should assume the "shape" of a cog — «*construendo... in formam coche*» — and that a sixth of the building costs was added for the additional effort of this new form — «*pro adicione nove forme ipsius navigii*».<sup>515</sup> The fact that the bottom width, the beam and the height of the hold were specified<sup>516</sup> strongly indicates that the vessel was built as skeleton-first construction in which all these parameters could be more easily predetermined. There is no evidence that a northern shipbuilding method was employed, but that merely shape and dimensions were modified for the construction of this *coche*. The additional specifications would have made the vessel's bottom wider and the sides steeper, thereby increased the

deadweight capacity. After this *coche* — named *Sanctus Nicolaus* — was launched, four caulkers were employed to finish the ship before its first voyage into the Levant.<sup>517</sup> The mentioning of caulkers after the hull was completed strongly indicates that the hull is a carvel construction, because in clinker constructions the overlapping seams and scarfs are luted during the process of adding planks. Apart from an *antenna* — a lateen mizzen — a later document refers to this ship as *navis quadra*, which is used in Dalmatia and Venice synonymous for cogs;<sup>518</sup> undoubtedly a reference to the characteristic northern square sail. Ship depictions that represent such square-rigged Mediterranean ships are shown on the portolan map of 1367 by the Italian Pizigani and the portolan map of 1426 by the Genoese Becharius (Fig.6).

A lateen sail — the typical Mediterranean sail — was evidently added as mizzen to one of the ships shown for better manoeuvrability, as it would have increased the weather helm. Moreover, the ship depictions on the portolan show also wales and skids, which are typical for carvel built hulls, giving strength to the structure, which becomes especially important whenever the ship is careened, a practice necessary to overhaul and caulk carvel-built ships from the outside (Fig. 7). It seems reasonable to suggest that the local carvel tradition was retained in Mediterranean-built *cochas* and that shipbuilding techniques remained essentially the same.

The differences between northern and southern ships in this transformational period is highlighted by two ship models from this era, i.e. the Ebersdorf model — a votive offering filled with gold donated by the German knight on a pilgrimage Wolf von Lichtenhagen after he barely survived a stormy passage from Acre to Venice,<sup>519</sup> and the Mataró model from a chapel near Barcelona (Fig.8).

<sup>508</sup> Cf. Eberenz 1975, 99. Eberenz's translation of the *bonetes* as lee sails on page 106 must be dismissed on the basis that they appeared several centuries later.

<sup>509</sup> Möller-Wiering 2003, 311

<sup>510</sup> Eberenz 1975, 106

<sup>511</sup> Friel 1994, 80

<sup>512</sup> Friel 1994, 78

<sup>513</sup> Friel 1994, 78

<sup>514</sup> Nickel 1999, 75

<sup>515</sup> Nickel 1999, 75

<sup>516</sup> The added specification in brackets: 12 *passo* length (+0,5 *passo*), 7 *piedi* (+0,5 *piedi*) bottom width, 17 *piedi* beam at deck level and 7,5 *piedi* (+0,5 *piedi*) height of the hold. On the assumption that the specifications are based Venetian *passo* and *piede* that would be 20,92 m (+0,87 m) length, 2,44 (+0, 17 m) and 5,92m beam and 2,61 m (+0, 17 m) hold height, according to the calculations of Nickel 1999, 74f.

<sup>517</sup> Nickel 1999, 76

<sup>518</sup> Nickel 1999, 74f.

<sup>519</sup> Steusloff 1983



Fig. 6. Ship depictions on an excerpt – from the left side – of Becharius's portolan chart of 1426, showing three square-rigged ships of which one – on the right side – also carried a lateen-rigged mizzen mast. Also the portolan itself is interesting: Note the astounding accuracy of the coastlines of the Mediterranean, Atlantic coast and the English Canal in contrast to the area beyond Flanders, where the accuracy ends abruptly. On the one hand this can be attributed to the extensive Mediterranean-Flemish trade and on the other hand to the scientific navigation method employed by the Italians, through which the coastline could be mapped accurately (Source: Bavarian State Library).

Both models are true miniatures. The amount of details suggests that the model-builders were professionals or at least acquainted to the methods employed in shipbuilding. The former model represents a Baltic type and obviously not a ship-type used by the knight on his return passage to Venice. Whether this type would have been called cog or hulk cannot be said for certain.<sup>520</sup> The Mataró model on the other hand is often described as nao<sup>521</sup> or carrack<sup>522</sup>. While nao was the generic term for a ship in the Mediterranean, the term carrack was used by the northerners for the Mediterranean *cocha*, which might have become current through the Spaniards

who used this term since the 13<sup>th</sup> century and who were significantly involved in the Genoese *coche* voyages to England.<sup>523</sup> In 1320, for instance, the same three ships referred to as *cocas* in a Majorcan source were referred to as *carracas* in a Castilian source.<sup>524</sup> These mix-ups in written sources are not uncommon with the advent of new ship-types. Whether *coca*, *cocha* or *coche* was just another term for an early carrack is however not the decisive question. The factual similarities and differences are far more interesting and render speculations on etymological similarities obsolete. These include the bulkiness of both hulls, with much freeboard and a very low length-to-beam ratio. This has been often attributed to stylistic

<sup>520</sup> Christensen & Steusloff 2012, 97

<sup>521</sup> Winter 1978

<sup>522</sup> Gardiner 1994, 81

<sup>523</sup> Hutchinson 1994, 43

<sup>524</sup> Ortega Villoslada 2008, 439

reasons, but some contemporary wreck finds indicate that this may in fact be a truthful representation. Both models are square-rigged and both are equipped with a stern-rudder. Both features are fairly recent in Mediterranean-built vessels; the stern-rudder was adopted for *cobas* not before the second half of late 14<sup>th</sup> century.<sup>525</sup> Stern-rudders could be more easily fitted to the straight raking sternposts as they were common in northern Europe. The curvature of the sternposts in Mediterranean craft may have delayed the introduction of this rudder. But this would not have been the only difference. The Timbotta manuscript, one of the earliest treatises on shipbuilding published in Venice somewhere between 1444 and 1447, indicates that the eventual introduction of the stern-rudder was facilitated by a skeg.<sup>526</sup>



Fig. 7. The practice of careening commonly used for the maintenance and caulking of carvel-built vessels as shown in this excerpt from Sandro Botticelli's "The Judgement of Paris", ca. 1445-1510 (Source: Cini Foundation, Venice).

Whether the Ebersdorf model had fore- and aftercastles — like the Mataró model — cannot be established, but the transom beam indicates at least the possibility of such superstructure. So, essentially, the main differences consisted in the preference of carvel-technique of Italian and other Mediterranean shipbuilders, while other northern "cog"-features were adopted. At the same time the Venetians tried to get hold of another foreign technology, which proved to be more influential than the northern tradition in

terms of hull construction: The skeleton-first procedure. It is not entirely clear when and where the first genuine skeleton-first procedure occurred, but the latest Byzantine wreck indicates the full completion of this development and the Venetians have probably inherited aspects of Byzantine shipbuilding technology when they occupied the shipbuilding area of Constantinople during the Fourth Crusade in 1204 and again around 1400 when 'Greeks'<sup>527</sup> were mentioned as formidable galley builders in the Venetian Arsenal.<sup>528</sup> There was a concerted effort to record and preserve features of existing vessels by means of simple sketches, which eventually led to the writing of several treatises since the early 15<sup>th</sup> century, of which the Timbotta manuscript was one.<sup>529</sup>



Fig. 8. Irrespective of the type-labels attached to the Ebersdorf "cog/holk" model of ca. 1400 (left) and the Mataró "carrack/nao" model from 1389-1449 (right), they appear very similar, judging from the stout impression rendered by the high freeboard, the short length-to-beam ratio and the curved stem. To contemporaries they might have appeared as a same category of ship, yet the underlying constructional principle of shell-first clinker in the former and skeleton-first carvel in the latter could not be more different (Source: left: Holger Strauß, right: Maritime Museum Rotterdam).

The carvel-technique originally encompassed — just like the clinker-technique — a shell-first building sequence, facilitated by the cumbersome mortise-and-tenon technique.<sup>530</sup> The Byzantine Yenikapı wrecks from the 10<sup>th</sup> to 11<sup>th</sup> centuries show the last transitional phase towards a pure skeleton-first principle.<sup>531</sup> This development entailed also the profession of caulkers, as planks that are fastened to the frames are not as tightly flush-laid as in the work intensive mortise-and-tenon technique, in which mortises were chiselled carefully for a tenon to be fitted in and butted with wooden pegs to hold the planks tightly together.<sup>532</sup>

<sup>527</sup> i.e. Byzantines

<sup>528</sup> Dotson 1994, 162

<sup>529</sup> Dotson 1994, 163; cf. Anderson 1925; cf. Lane 1934

<sup>530</sup>cf. Steffy 1994

<sup>531</sup> Kocabaş 2012, 12

<sup>532</sup> Pryor 1994, 66

<sup>525</sup> Hutchinson 1994, 43

<sup>526</sup> Nance 1955, 189, cf. Timbotta da Moda: manuscript, Venice 1444 oder 1447. British Museum Ms. Cottonian, Titus A 26, fol. 49

## 6. Genoese carracks in England: exposure to a foreign technology

Roughly a century after the building of *cochas* began in the Western Mediterranean and the Adriatic Sea, a Mediterranean type of ship challenged English shipwrights during the Hundred Years War. Shortly after King Henry V returned victorious from the Battle of Agincourt, the English seized 1416/17 eight Genoese carracks in French service. It is no coincidence that these were 'Genoese carracks', as this type seems to be a specific Genoese "brand", not unlike 'Bayonese cogs'. While there are several references to French and Venetian carracks, Genoese carracks feature most strongly in written sources and are also said to be the best in a reference from 1454.<sup>533</sup>

At this time, the English monarch has gained possession of wide parts of France, including Rouen in 1419, which had been a major French shipyard in which galleys with Genoese expertise were constructed, but which was burned down before the English could occupy it.<sup>534</sup> The captured carracks were regarded as an entirely new type of ship in England, primarily admired for their size.<sup>535</sup> *The Libelle of Englyshe Polycye* of 1436 referred to these Genoese carracks as being «*orrible, grete and stoute*» from a narrative in the context of the siege of Harfleur in 1415.<sup>535</sup> Their cargo capacity amounted to between 400 and 600 tons, whilst only few contemporary English ships exceeded 300 tons.<sup>536</sup> Six of the Genoese carracks bore next to the main mast a lateen-rigged mizzen mast as seen in the abovementioned *cochas*, like the *Sancta Maria & Sancta Brigida*, which was already seized in 1410. This mast was a novelty and it was not before 1420 that the term *mesan maste* (mizzen mast) was in use in England.<sup>537</sup> The carving of a two-masted carrack on a church pewage in King's Lynn of ca. 1415 testifies this early development, depicting the 'cutting edge' of naval technology<sup>538</sup> at that time (Fig.9).

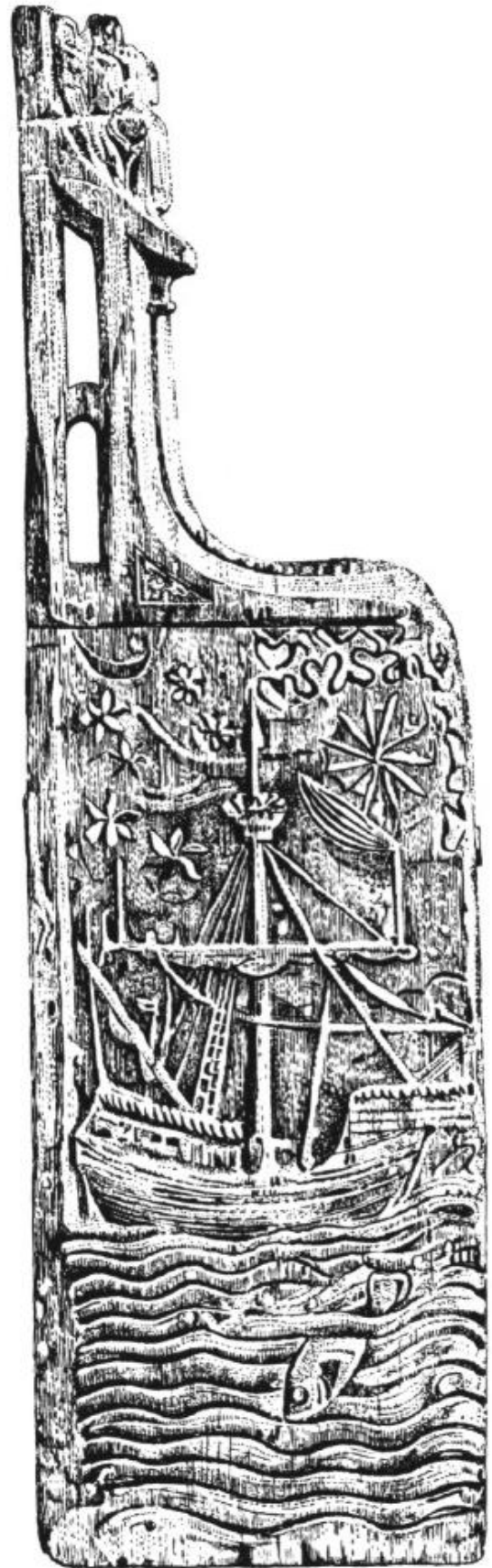


Fig. 9. A two-masted carrack with square-main sail and lateen mizzen is depicted on a pewage from ca. 1415 in King's Lynn, England (Source: HUTCHINSON 1994).

<sup>533</sup> Eberenz 1975, 94, see also Rose 1999, 573

<sup>534</sup> Runyan 1994, 56

<sup>535</sup> "And whan Harflew had his sege aboute / There came carikkys orrible, grete and stoute / In the narowe see wyllynge to abyde / To stoppe us there wyth multitude of pride" Warner 1926, 51, cf. also Friel 1994, 77

<sup>536</sup> Friel 1994, 85

<sup>537</sup> Friel 1994, 80; Hutchinson 1994, 44

<sup>538</sup> It would be an uncommon sight to find an aircraft carrier on a pewage in a modern Anglican church, but in those days, in which crowns were bestowed by the 'grace of god', the crown's worldly tools of power achieved prestige too in the ecclesiastic sphere, as is also reflected by the sacred names given to ships in this era.



Between 1416 and 1422 six royal English ships were rigged with a second mast, according to the Genoese model, in which also the *«flail»* — probably a Spanish windlass — was introduced to ease the hoisting of the mainsail.<sup>539</sup> But soon thereafter, a third mast was added. The earliest evidence indicates a date around a period of 1420-1436 in England,<sup>540</sup> not long after the earliest known illustration of a three-masted vessel from a Catalan document of 1406.<sup>541</sup> As could be anticipated after such a capital capture that incorporated advanced foreign technology, no efforts were spared to make use of the Genoese carracks for English royal service. But soon problems with the maintenance became apparent, when the keeper of the king's ships begged in a petition for the permission to hire *«carpenters and caulkers of foreign country[s]...for in this country we shall find few people who know how to renew and amend the same carrack.»*<sup>542</sup> It was an event when northern European shipwrights — being deeply imbedded in the tradition of clinker building — were faced for the first time with the substantially distinctive carvel technology. Although carvel-built ships were not new from the mere appearance, as Italian vessels sailed to Southampton since the late 13<sup>th</sup> century for trade,<sup>543</sup> this was probably the first direct exposure to this foreign technology. Thereupon Catalan, Venetian and Portuguese shipwrights and caulkers were contracted by the English to carry out the specialized maintenance works on the carracks. One of their specialties was the practice of careening (Fig. 7), which they carried out on the two carracks *George* and *Christofre*, i.e. a practice until then unknown in England.<sup>544</sup> For this purpose ships had to have skids<sup>545</sup> as vertical reinforcements, as could be seen on nearly all contemporary depictions of large carvel-built vessels like the *Mataró* model (Fig. 8) or the *Kraeck* (Fig. 14). Nevertheless, the maintenance costs were considered too high and both carracks were eventually sold in 1423 and 1424 to merchants, for just a fraction of the costs to which the upkeep has amounted to.<sup>546</sup>

## 7. English “dromons”: reaching the limit of clinker technology?

Already few years before the aforementioned Genoese carracks were seized, their terrifying sight in previous encounters must have inspired Henry V to build ships of similar or even greater dimensions. This resulted in — what could be confidently called — a naval arms race, which culminated in a shipbuilding

programme launched in 1413 for *dromons*, as they were retrospectively called in *The Libelle of Englyshe Polycye* from 1436.<sup>547</sup> It can be conjectured that the English *dromon* had nothing in common with this Byzantine type, but that the term was used generically for large ships<sup>548</sup> and possibly always for ships of war.<sup>549</sup> As such, it was already characterized by the 13<sup>th</sup>-century chronicler Matthew Paris as the largest type of ship: *«navis permaxima, quam dromundam appellant»*.<sup>550</sup> However, the use of such alien term — originally Greek or Byzantine — for a ship that *«passed other grete shippes of all the comons»* indicates a conscious break with the own practise of shipbuilding, and may even be seen as an attempt of elevating Henry V's rule by attributing *dromons* — a “legendary” type of ship that is mentioned in the contemporary English translation of the Alexander Romance<sup>551</sup> — to his fleet. Obviously, the English *dromon* would have looked very different to a Byzantine *dromon*. This point in particular illustrates that the use of ship-type labels in historical sources should not be taken at face value to infer constructional similarities. The *Grâce Dieu* — launched in 1418 — was the largest and last of Henry V's four great *dromons* with 1400 tons, which would have even outclassed the Genoese carracks in size.<sup>552</sup> A shipwreck in River Hamble in Hampshire, England, has been identified as the wreck of the *Grâce Dieu*.<sup>553</sup> Its study has revealed that the *Grâce Dieu* was built in the shell-first clinker technique. One might ask whether the difficulties to maintain the carvel-built Genoese carracks persuaded English shipwrights to build *Grâce Dieu* in a technology more familiar to them, yet appropriated to the new gigantic specifications.<sup>554</sup> The drawback of using this technique was the cumbersome triple-planking (Fig. 10). This unique feature can be doubtlessly explained by the limitations of the shell-first clinker technique for large hulls. It was opined that the triple construction was a longitudinal reinforcement to prevent hogging.<sup>555</sup> This is a feasible explanation for a construction based on the shell-first principle, for

<sup>547</sup> “Henry the fiftie, what was hys purposynge / Whan at Hampton he made the grete dromons, / Which passed other grete shippes of all the comons, / The Trinite, the Grace Dieu, the Holy Goste (...)”; cf. Warner 1926, 51

<sup>548</sup> Warner 1926, 98

<sup>549</sup> Weber 1810, 397f.

<sup>550</sup> Falk 1912, 87f.

<sup>551</sup> cf. Weber 1810, 233

<sup>552</sup> next to the TRINITY ROYALE of ca. 540 tons, the HOLIGHOST of 760 tons and the JESUS of 1000 tons (Friel 1994)

<sup>553</sup> Anderson 1934, 160

<sup>554</sup> Reminding of southern European shipwrights who acted similarly when they were required to build ships similar to Bayonese cogs: They were primarily inspired by visually deducible criteria, such as the square-sail and the hull shape, rather than the intrinsic technology employed in hull construction.

<sup>555</sup> Hutchinson 1994, 30

<sup>539</sup> Friel 1994, 80

<sup>540</sup> Friel 1994, 80

<sup>541</sup> Mott 1994

<sup>542</sup> Friel 1995, 173f.

<sup>543</sup> Hutchinson 1994, 35

<sup>544</sup> Friel 1995, 174

<sup>545</sup> also known as futtock riders or braces

<sup>546</sup> Friel 1994, 86

which there cannot be a slightest doubt, as demonstrably proven by wedges driven between the planking and the frames before trunnel-holes were drilled.<sup>556</sup> Hogging however, might not have been the main reason for this unique construction, as the hull could have been adequately supported by struts during the assemblage of the shell and — once the construction was finished — the longitudinal stresses of the shell could have been sufficiently compensated by the massive stringers and thick ceiling planking that were inserted afterwards.<sup>557</sup> The observation of the planks only measuring 6-7 foot on average<sup>558</sup> seems to be more significant in this respect to explain this unique triple construction. The availability of sufficiently long boards seemed to be a general problem in England,<sup>559</sup> as the use of imported wainscot timber from abroad indicates.<sup>560</sup> What is more, the use of iron was extremely wasteful, as each bolt-sized “nail” — 2 cm thick, 15 cm long and 20 cm spaced apart — had to protrude five layers of planking.<sup>561</sup> According to a documentary record, about 23 tons of iron were used for *roof & nayll* — i.e. roves and nails.<sup>562</sup> Although the captain of the Florentine galley fleet Luca di Maso degli Albizzi was visually impressed by the *Grâce Dieu*, exclaiming that he «never saw so large and so beautiful a construction»,<sup>563</sup> it can be doubted that the ship construction was regarded as overall success. Aside from the wasteful use of material for this triple-clinker construction and the obsolescence of great ships after the supremacy of the English Channel has been decided in England’s favour, a contemporary report of a mutiny onboard the vessel may be ascribed to the difficulty and danger in ship-handling, although there is admittedly no clear indication.<sup>564</sup> But it seems nevertheless conspicuous that *Grâce Dieu* had been permanently moored in River Hamble for almost 10 years for representational purposes when visited by Albizzi, without having seen much active service. Thus, the attempt to outclass the mastery of Genoese carrack-builders in the local clinker-technique was evidently not regarded as success, given that the triple-clinker method remained a unique feature. However, the attempt itself reflects a very genuine aspect in social learning called a ‘perceptual set’, where the mode of solving problems is guided by the habitual constraints of the own tradition, even when simpler solutions are possible.<sup>565</sup> Thus the triple-clinker can be seen as a genuine strand of development within the locally practiced clinker-

building tradition, but prompted by and erroneously appropriated to an external influence. Not only in England but also elsewhere, the same trend to larger clinker-built ships connected to the same constructional problems can be observed. So a German merchant in Bruges lamented in a correspondence dating to 1412 about how nefarious the construction of ships have become lately.<sup>566</sup> This may be linked to the limitations of building ever larger ships in clinker.

## 8. The English-Basque link: a common naval legacy?

Roughly simultaneous to the building of the *Grâce Dieu*, another building contract for a ship that would have even superseded the former was outsourced by King Henry V to Bayonne — his Basque enclave — as detailed in a letter from 1419. The building progress of this ship was described by the king’s inspector John Alcetre thus «xxxvij strakys in byth y borthyd, on the weche strakys byth y layde xj bemy» — i.e. 36 strakes in height and boarded, on the which strakes beeth there laid 11 beams.<sup>567</sup> This description too reflects the rationale employed in clinker construction, in which the shell is assembled with the strakes added first and, moreover, in which the finished shell is held together by protruding crossbeams, which are rebated in order to lock the curvature of the upper strakes. Protruding crossbeams were also present in the Aber Wrac’h wreck from ca. 1425, which was most likely also built in this region, and probably also in the *Grâce Dieu*, although they were initially interpreted as riders.<sup>568</sup> Also in terms of workmanship there are similarities, as radially cleft planks were used for the English-built *Grâce Dieu* (1418)<sup>569</sup> but also the Basque-built Barceloneta I (ca. 1410),<sup>570</sup> Aber Wrac’h (ca. 1425)<sup>571</sup> and Newport (after 1447)<sup>572</sup> wrecks, although tangentially sawn planks have been also used in the Aber Wrac’h wreck and the *Grâce Dieu*. The use of radially-cleft planks was not uncommon in northern Europe at that time: A study by this author has found that roughly three-quarters of over 50 clinker-built wrecks hitherto known from the extended North Sea area in the period between 1300 and 1540 were built with radially cleft planks.<sup>573</sup>

<sup>556</sup> Anderson 1934, 165

<sup>557</sup> stringer (11 x 4 inch) and ceiling (1.5 inch thick) according to Anderson 1934, 169

<sup>558</sup> Anderson 1934, 165

<sup>559</sup>Cf. Tinniswood 1949, 287

<sup>560</sup> Friel 1993, 5

<sup>561</sup> Anderson 1934, 160; Hutchinson 1994, 30

<sup>562</sup> Friel 1993, 5

<sup>563</sup> Rose 1977, 5

<sup>564</sup> Cf. Rose 1977, 5

<sup>565</sup> Morgan et al 1992, 130

<sup>566</sup> *Hanserecense* I. 6. 77, 1889, 80

<sup>567</sup> Loewen 1997a, 328

<sup>568</sup> cf. Anderson 1934, fig.9

<sup>569</sup> Hutchinson 1994, 22

<sup>570</sup> Soberón Rodríguez 2010, 147

<sup>571</sup> L’Hour and Veyrat 1994; also including tangentially sawn planks

<sup>572</sup> Nayling & Jones 2014

<sup>573</sup> Zwick, forthcoming

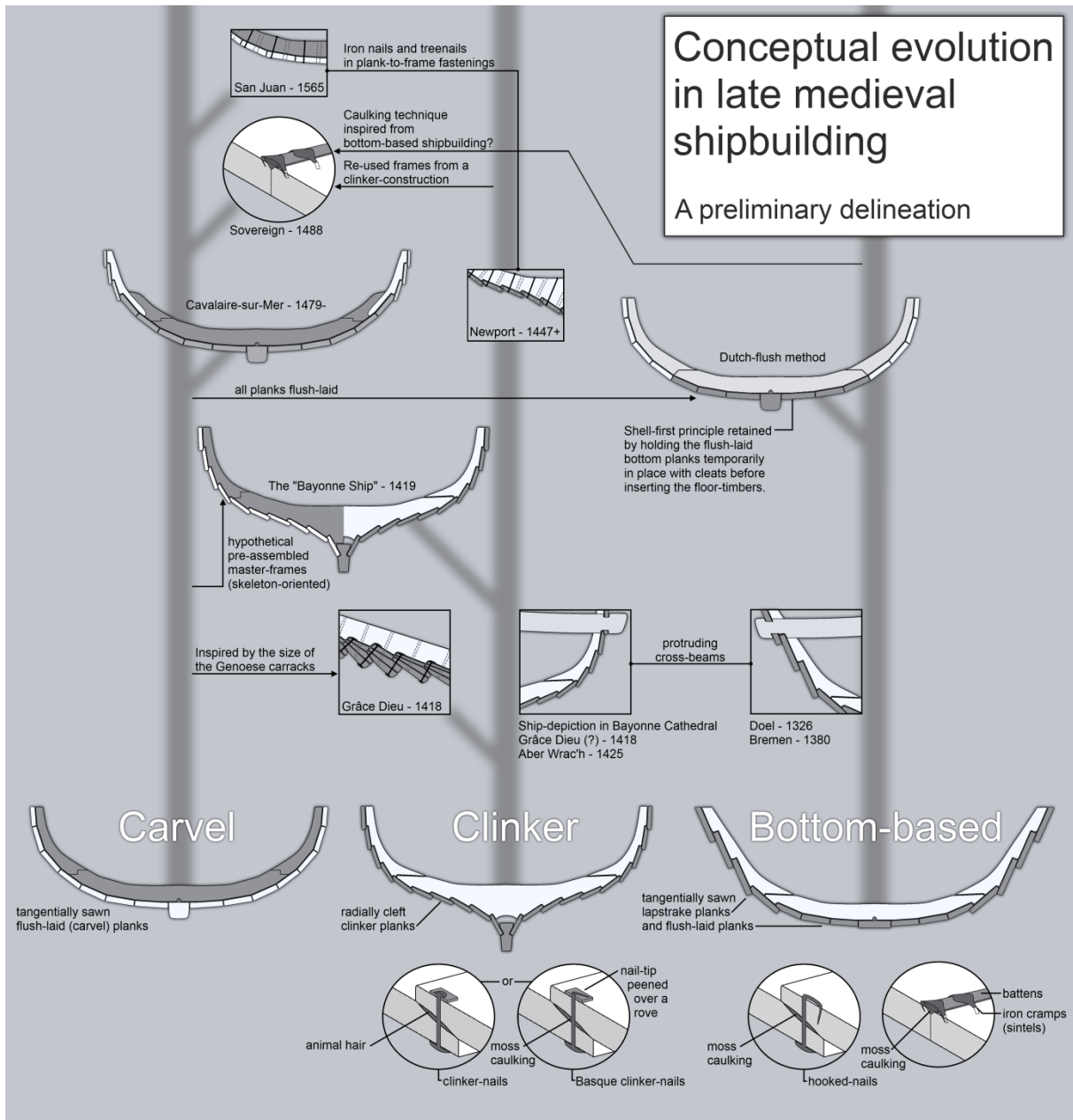


Fig.10. Schematic overview of coalescing influences within shipbuilding. The cross-sections are no accurate representation of the actual wrecks and merely meant to highlight primary constructional features. The sequence of construction is indicated by the *hachure* (darker = earlier) to emphasise the fundamental difference between a shell-oriented and a skeleton-oriented philosophy. The branches and arrows respectively reflect conceptual evolution and external influences, but the database of shipwrecks is not representative enough to infer definite links (Graph: Daniel Zwick).

Large bottom-based ships<sup>574</sup> in contrast — often perceived as the epitomisation of the ‘Hanseatic cog’<sup>575</sup> — were regularly built with very wide

tangentially cleft planks, as reflected by the wrecks from Bremen (1380)<sup>576</sup> or Doel (1326).<sup>577</sup> Although the lines of archaeologically verifiable shipbuilding traditions on the one hand and historically determinable ship-type categories on the other hand are blurred, this essential difference fuels the

<sup>574</sup> cf. definition Hocker 2004

<sup>575</sup> This is still subject to an ongoing debate. Several authors support the claim that bottom-based shipwrecks like the so-called ‘Bremen Cog’ (beware the bias of a self-fulfilling prophecy regarding the naming) represented a cog-type consistent to its original historical definition (e.g. Bill 2009, Crumlin-Pedersen 2000, Ellmers 2014, Hocker 2004, 72ff.), whereas other authors doubt that the cog-type is

defined as a category on the basis of constructional criteria alone (e.g. Jahnke 2011, Jahnke & Englert 2014, Paulsen 2010, Weski 1999, 2002, Zwick 2014, 61ff).

<sup>576</sup> Lahn 1992

<sup>577</sup> Vermeersch & Haneca 2014, 117

assumption that a ‘Bayonese cog’ might have indeed differed from a ‘Flemish cog’, as implied in Giovanni Villani’s earlier quoted reference.<sup>578</sup> Many aspects point to a shared clinker tradition that was shared between English and Basque shipbuilders, and arguably other coastal regions of the Atlantic such as the northern Iberian Peninsula, France and Ireland, and in the wider sense — as seen above — all of northwestern Europe. The outsourcing of building contracts of the English crown to Bayonne shipbuilders is a recurrent practise, particularly for large ships: From as early as the 13<sup>th</sup> century, galleys were built in Bayonne for the English. In 1302, King Edward II commissioned the building of a large nef of 300 tons at a time when the average tonnage of nefs was 180 tons, and in 1411 King Henry IV commissioned the building of a large ship of 60 m length.<sup>579</sup> The historical link between English and Basque shipbuilding is well testified for over two centuries, but it was not exclusive, at least in the earlier period, as other powers also made use of the Bayonese shipbuilding expertise: In the 13<sup>th</sup> century King Alfonso X of Castile used lumber and shipwrights from Bayonne, and King Philip of France had galley built in Bayonne.<sup>580</sup> This raises the question whether a discrete English-Basque shipbuilding tradition could be corroborated by archaeological findings. The westernmost extent of the clinker tradition can be arguably embraced as a discrete ‘Atlantic clinker tradition’ (Figs.11, 12). There is evidently no singular ‘Nordic’ or ‘Scandinavian’ clinker-technique, but spatiotemporary variations, as particularly well demonstrated by the range of forms of iron fasteners.<sup>581</sup> Although it has been claimed that ‘clenching’ and ‘riveting’ describe the fastening techniques for hooked nails and clinker-nails, respectively<sup>582</sup>, there is no etymological grounds for this definition, as the term ‘clenching’ has been historically used to describe clinker-fastenings.<sup>583</sup> This is highlighted by an English account from 1336, which distinguishes between *tenecium contra clenbatores*<sup>584</sup> — holders and clenchers. The presence of holders is a clear indication for what would be today called riveting. ‘Clenchers’ were involved in repairing *Grâce Dieu* and ‘clenchnaill, roeffs, spikes, bolts, bondes’ were made in the royal forge at Southampton in the same year.<sup>585</sup> *Clenchnaill* are obviously clenched nails and *roeffs* are roves,<sup>586</sup> and the latter are being typically associated with riveting. But not exclusively so! Normally the tip of the nails were pinched off and

the remainder deformed over a rove. However, there is also a variant where nail-tips were peened over roves, which McGrail associated with a French method.<sup>587</sup> This fastening method is in fact neither limited to France nor to shipbuilding, but it is a technique very common in Basque vernacular architecture, aside from shipbuilding.<sup>588</sup> Thus it is referred here as the “Basque clinker-technique” in order to highlight its distinctiveness (Fig.10). In the case of the Basque-built *Barceloneta I* wreck, the nails appear to be peened over a rove at a 90° angle.<sup>589</sup> At least one nail peened over a rove in this manner was also found in the 15<sup>th</sup>-century clinker-built *Drogheda Ship*, Ireland, while the strong concretions did not permit an assertion on whether this is also the case with other nails.<sup>590</sup> In the Newport ship the concretions were too severe to determine whether the tip of the nail were deformed or peened over the rove.<sup>591</sup> It has yet to be shown whether this way of fastening is a feature that can be consistently associated with a Basque, Biscayan or even Atlantic clinker tradition. Iron fasteners with roves may have been prematurely typified as generic clinker-fastenings in the past, as iron fastenings are usually strongly corroded. Another aspect in which the Atlantic clinker tradition is distinctive to Scandinavian shipbuilding are the massive scantlings of frames and small frame interspaces, which may be an indication for the gradual transfer of hull strength from a shell- to a skeleton-oriented principle. The *Barceloneta I*, *Aber Wrac’h* and *Newport* ships all have closely spaced frames, a feature that has been also observed in 13<sup>th</sup>-century clinker wrecks on the Island of Guernsey.<sup>592</sup> Despite the regional and cultural distance, English- and Basque-built ships may have become undistinguishable from each other at the time when *Grâce Dieu* was built due to longstanding historical links. It would be interesting whether Basque-built ships matched Henry’s expectations better than those built in England proper. This suggestion is not unreasonable, with regard to the prominence of Basque masters in English shipyards. As early as 1294, King Edward I of England had a clinker-built galley constructed in London by a Basque shipbuilder called Arnold de Bayonne,<sup>593</sup> another master shipwright from Bayonne was called into consultation in Southampton a little later, and the king considered to have galleys built in Bayonne in 1276.<sup>594</sup>

<sup>578</sup> cf. endnote 53

<sup>579</sup> Goyenette 1998, 153

<sup>580</sup> Goyenette 1998, 154

<sup>581</sup> Bill 1994

<sup>582</sup> Christensen 2002, 300

<sup>583</sup> McGrail 2004, 150, fig. 1.2

<sup>584</sup> Heinsius 1986, 112, cf. also Tinniswood 1949, 281

<sup>585</sup> Rose 1982, 115, 212f.

<sup>586</sup> Small rectangular metal washers with a hole on the inside plank, against which the nail’s tip is “anchored” by deformation.

<sup>587</sup> McGrail 2004, 149ff.

<sup>588</sup> Rieth 2006, 609

<sup>589</sup> cf. Soberón *et al.* 2012, 415; this has to be taken with reservation however, as the imprints of the heavily corroded angular roves were not very clear (Mikel Soberón, pers. comm.).

<sup>590</sup> Holger Schweitzer, pers. comm.

<sup>591</sup> Nigel Nayling, pers. comm.

<sup>592</sup> Adams and Black 2004, 242

<sup>593</sup> Rieth 2006, 611

<sup>594</sup> Tinniswood 1949, 294



◀ Fig. 11. Overview of 15<sup>th</sup>-century clinker-built constructions of a Basque-Cantabrian origin in the geopolitical context of the time. The wreck numbers are itemised in the table (Graph: Daniel Zwick. On the basis of the bathymetric map by Hastings et al. 1999, *The Global Land One-kilometer Base Elevation (GLOBE) Digital Elevation Model, Version 1.0*. National Oceanic and Atmospheric Administration, National Geophysical Data Center, 325 Broadway, Boulder, Colorado 80303, U.S.A.).

▼ Fig.12. Overview of predominantly Basque-built 15<sup>th</sup> century vessels with clinker construction in comparison to two large ships built for the English crown, one built in Southampton and the other in Bayonne. Key: C = radiocarbon, D = dendrological, H = historical, N = numismatic, P = pottery, S = stratigraphic (Compiled by Daniel Zwick).

		1	2	3	4	5	6	7
		Barceloneta I	Grâce Dieu	"Bayonne ship"	Aber Wrac'h	Newport	Urbietta	Cavalaire-sur-Mer I
Spatiotemporal context	construction	c. 1410	1418 (H)	1419 (H)	15 <sup>th</sup> (CPN)	1447+ (N)	c. 1455 (C)	1479- (D)
	abandonment	1439-1477 (S)	1439 (H)	-	1435 (H)	1469+ (SD)	-	-
	construction	prob. Basque-Cantabrian (D)	Southampton (H)	Bayonne (H)	Basque?	Basque (D)	Basque (D,T)	Basque (D,T)
	cargo	-	-	-	Castilia, Brittany (N), Brittany (P), English (H)	Portugal (P, N), Iberian Peninsula (P)	-	Savoy (D)
abandonment		Barcelona, Catalonia, Spain	Hamble River, England	-	Aber Wrac'h River, France	Newport, Wales	Gernika, Spain	Cavalaire-sur-Mer, France
Dimensions	preserved length	4.20m	38m	-	-	22.5m	5m	-
	total length	-	39.3m	56.7m	-	-	8.45m	-
	preserved beam	-	11.5m	-	-	7.65m	-	-
	total beam	-	-	12.5m	-	-	-	-
	displacement	-	1400 t	1826-1937 t	-	207 t	-	-
	plank radial width	20-24cm	ca. 30cm	-	23cm	17-25cm	18-21cm	19cm
	plank tangential width	-	-	-	-	-	-	34-39cm
	Frame spacings avg.	8-17cm	closely spaced	-	13cm	37cm	35-48cm	-
	Floor-timber: moulded/sided	-	-	-	15-25cm	21cm / 25cm	12-14cm	17cm / 17cm
	Futtock scantlings: moulded/sided	12-18 / 16-28cm	-	-	-	-	10-14cm	14cm / 14cm
Fastening	Clenched over square roves	Clenched over square roves	-	Clenched over square roves	Clenched over square roves	Clenched over square roves	-	
Caulking	moss	moss and pitch	-	moss	tarred animal hair	-	-	
References	Soberon Rodriguez 2010, Pujol, Hamelink 2011	Anderson 1934	Loewen 1997a	L'Hour, Veyrat 1994	Nayling & Jones 2014, Nayling & Susperregi 2014	Rieth 2006	Loewen, Delhaye 2007	

Basque shipbuilders were consulted whenever advice on the construction of galleys was needed and may have also affected the introduction of new types, like the balinger or the pinnace.<sup>595</sup> Also more than a century later, we see the same pattern. Shipbuilding in Southampton was still supervised by master shipwrights from Bayonne,<sup>596</sup> whilst privateers from Dorset and Devon collaborated in 1406 with pirates from Bayonne, who had a longstanding reputation in piracy.<sup>597</sup> This English-Basque link is also highlighted by archaeological evidence: The Aber Wrac'h wreck — which was most probably built in the Basque country — appears to be the wreck of an English merchantman foundered in 1435, as indicated by historical records.<sup>598</sup> Conclusively, it can be said that not only the attempt to maintain the carvel-built Genoese carracks were improvident, but also Henry V's clinker-built *dromons* — judging from the fate of the *Grâce Dieu* — might have been likewise considered an unsatisfactory attempt to emulate large ships in the clinker tradition. Whether the Basque-built ships for the English crown matched Henry's expectations more remains an interesting question. The interest to obtain Mediterranean technology was evidently unabated. In 1430, the captain of the Florentine galley fleet Albizzi visited Southampton and was dined aboard the *Grâce Dieu* by William Soper,<sup>599</sup> the keeper of the king's ships who — probably not incidentally — was the same individual who supervised the building of Henry V's great ships.<sup>600</sup> Very impressed by the large and splendid construction, Albizzi was even allowed to take measurements of the ship.<sup>601</sup> Was William Soper merely chosen as an adequate peer, or in the hope to extract some secrets of Italian shipbuilding, especially by closely following the reactions and comments of his Italian counterpart on board the *Grâce Dieu*? There seems to be an interesting pattern, as Soper was again chosen to host the captains of the Florentine galley fleet Martelli, della Stufa and Ridolfi in 1442-43. The Italians had no other choice than to be hosted by an Englishman due to the restricted residence permit for foreign merchants.<sup>602</sup> The true intentions can be only speculated upon, but there can be no doubt, that the English had a vested interest in obtaining Mediterranean technology at a time, in which other northern European sovereigns and cities had similar aspirations in obtaining large modern warships for their fleets.

<sup>595</sup> Hutchinson 1998, 188

<sup>596</sup> Hutchinson 1994, 23

<sup>597</sup> Rose 2000, 144

<sup>598</sup> L'Hour & Veyrat 1994

<sup>599</sup> Friel 1993, 17

<sup>600</sup> Friel 1993, 3

<sup>601</sup> Friel 1993, 17

<sup>602</sup> Ruddock 1946, 36

## 9. Iberian and Breton carvels in the north: adoption of a concept?

Around the mid-15<sup>th</sup> century a noticeable change occurred when shipwrights from the Atlantic coast were employed in northern European shipyards. Their mentioning by name in written sources is remarkable, demonstrating that those shipwrights were anything but ordinary craftsmen. The caravel appeared already in the 1430's in northern waters, which was probably square-rigged apart from a lateen mizzen, for the lack of iconographic evidence of a full Mediterranean lateen rig.<sup>603</sup> The name caravel already indicates the terminological origin of the carvel-method, which revolutionized northern European shipbuilding within a comparatively narrow time frame. This development can be traced in various written sources as summarized in the following, which undoubtedly only represents the tip of the iceberg (Fig. 13).<sup>604</sup>

In 1438-1440 a carvel was built in Sluis, Flanders,<sup>605</sup> and in 1439 the Count of Flanders commissioned the Portuguese shipwright Jehan Perouse to construct a nao and «une caravelle" in Brussels, which might have been eased through dynastic bounds, i.e. the marriage of Duke Philip of Flanders and the Portuguese princess Isabella.<sup>606</sup> Only after a quarter of a century after Henry's V extensive shipbuilding programme, carvel-built ships feature also strongly in English sources, but — as opposed to the "great ships" of Henry V — these were of modest dimensions and not built locally, but captured. Between 1443 and 1450 a chancery document refers to a carvel of Foway in Cornwall, in 1448 an English royal grant of protection was given to «a certain ship or barge called le *Carvell of Oporto*» of 80 tons, and in 1449 a Clais Stephen was named as master of a 60 ton *Carvel of Calais*, which formed part of the royal fleet, and in 1450 as privateer and master of — possibly the same — carvel in Portsmouth.<sup>607</sup>

<sup>603</sup> cf. McGrail 2001, 245

<sup>604</sup> Please note that carvel-planked vessels incorporating skeleton-first technology were also built in Roman provinces, with corresponding wreck finds from the Rhine area and England (cf. McGrail 2013), but it remains highly speculative what aspects of the technique were retained. While carvel planking could be encountered in bottom-based shipbuilding (cf. Hocker 2004), northern European vessels were essentially built in clinker technology until carvel technology was systematically introduced in northern European shipyards since the mid-15<sup>th</sup> century.

<sup>605</sup> Olechnowitz 1960, 10; Friel 1995, 177

<sup>606</sup> Sleswyk 1990, 345; Friel 1995, 177

<sup>607</sup> Friel 1995, 177

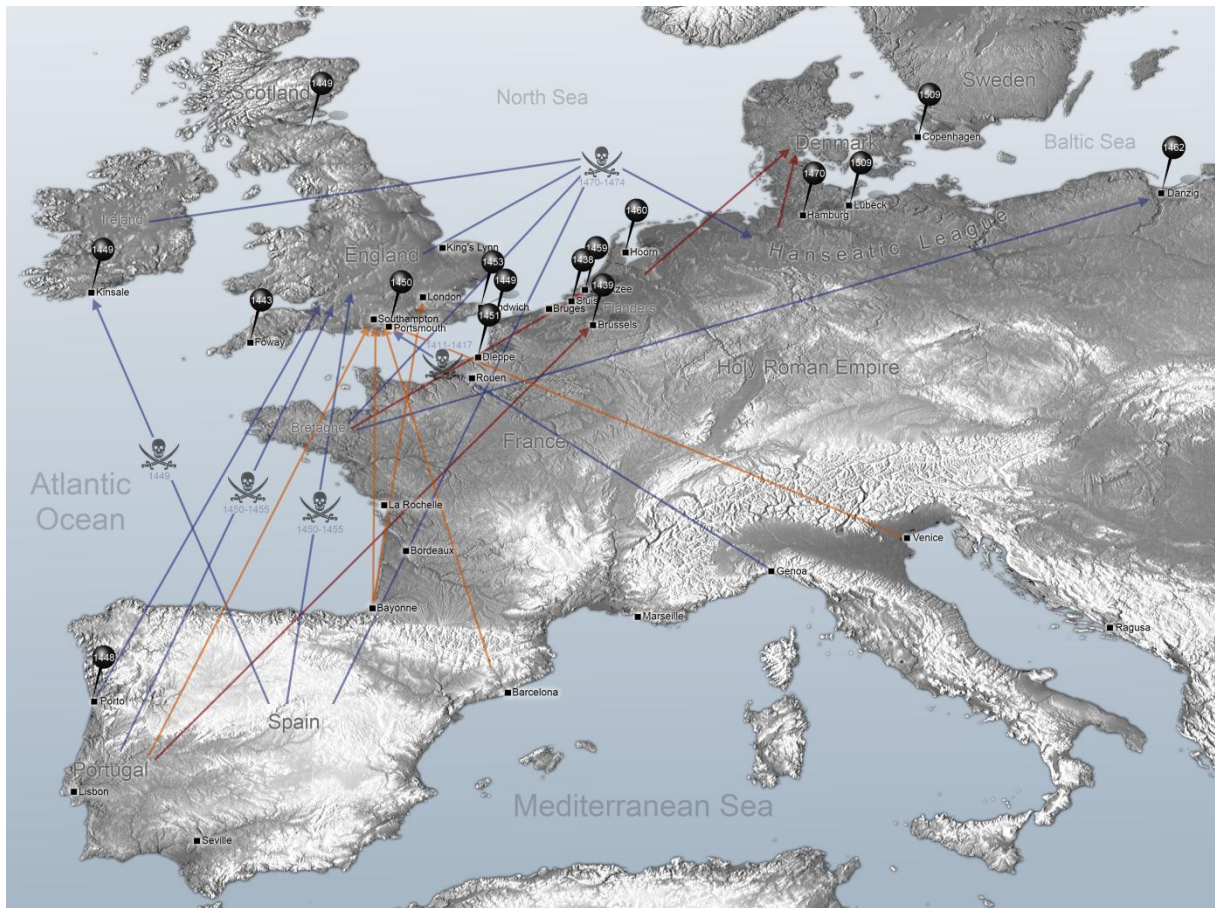


Fig. 13. The spread of carvel-technology in northern Europe. The black pins represent historical references to carvel, the blue arrows captures or travels of carvels, the red arrows the movement of shipwrights to spread carvel technology at the peak of the transition, and — in comparison — the orange arrows show the movement of shipwrights to help with the maintenance of the Genoese carracks captured by the English few decades before (Graph: Daniel Zwick. On the basis of the bathymetric map by Hastings et al. 1999, *The Global Land One-kilometer Base Elevation (GLOBE) Digital Elevation Model, Version 1.0*. National Oceanic and Atmospheric Administration, National Geophysical Data Center, 325 Broadway, Boulder, Colorado 80303, U.S.A.).

This new type of vessel became also known in wider parts of the British Isles: In 1449 a Spanish carvel of 55 tons was captured off the Irish coast and taken to Kinsale and between 1449 and 1450 a *kervel* of the King of Scotland underwent repairs.<sup>608</sup> Between 1450 and 1455, three Portuguese and one Spanish carvel were captured by English pirates, in 1453 William Lord Saye purchased a carvel — perhaps one of the captured prizes — in Sandwich, and in 1453-1466 documents indicate that over 20 carvels were in English ownership.<sup>609</sup>

Apart from Flanders and England, carvels could be also encountered elsewhere in northern Europe. In 1451, a *carvel* was built in Dieppe, Normandy, for a Breton owner and until 1484 Dieppe's municipal records indicate the construction and repair of 19 other carvels.<sup>610</sup> Also the late 15<sup>th</sup> century customs account of Bordeaux indicates that Bretons owned

many carvels.<sup>611</sup> Bretons seemed to have played a central role in spreading this new technology eastwards beyond the English Channel. In 1459, a carvel was built in the Dutch town of Zierikzee in Zeeland by Juliaen de Bretoen, which appears to be echoed by a mid-sixteenth century compiler of the *Chronicles of Zeeland*, stating that carvels instead of hulks and crayers were built at this time, by following the example of a Breton.<sup>612</sup> A strikingly similar development took place in Hoorn one year later, in which an early 17<sup>th</sup>-century chronicler retrospectively referred to events taking place in 1460: «(...) *boyers, smaacs and suchlike; until now they had nothing but hulks, square-sailed vessels and crayers that were all built with overlapping planks.*»<sup>613</sup> A quote from a later edition of

<sup>611</sup> Friel 1995, 178

<sup>612</sup> Cf. McGrail 2001, 245, Sleeswyk 1990, 345, Hagedorn 1914, 58

<sup>613</sup> Modified translation by Jeroen Vermeersch, cf. *"boyers, smacken en diergelijcke, daermen to vooren niet hadde dan hulken, raseylen en crayers, en die altemaal genracht crapschuytswijse met de planken op malcander"* in Velius 1617, quoted by Kammler 2005, 133.

<sup>608</sup> Friel 1995, 177

<sup>609</sup> Friel 1995, 177

<sup>610</sup> Friel 1995, 177

the same chronicle states that the old method incorporated only planks that were overlapping each other, but that one has started to built in *carviel* as was still practiced to the day on most shipyards.<sup>614</sup> But not all ships defined by historical sources as carvels were built the same. In the Noorderquartier — the northern Netherlands — an aspect of the bottom-based method<sup>615</sup> prevalent in the Hanseatic sphere was retained, i.e. bottom planks were laid out first, held together temporarily by cleats, until floor-timbers were inserted.<sup>616</sup> In contrast, in the southern region Maaskant, which formed part of the Spanish Netherlands since the mid 16<sup>th</sup>-century, a moulding system existed that adhered exactly to the Iberian method.<sup>617</sup> This suggests that the political circumstances were a decisive factor for local shipbuilding and the mobility of foreign shipwrights. Only two years after the significant change occurred, as mentioned in the Chronicles of Horn, the Breton carrack Saint Pierre de la Rochelle of 600 tons anchored off Danzig (today Gdańsk) in 1462 and was confiscated by the city when the owner went bankrupt. This year is often seen as a key date, in which three-masted *kraveels* or *kraffells* were first encountered in the Baltic Sea.<sup>618</sup> However, brick inscriptions from a monastery in Helsingør from the 1430's depict three-masted vessels already several decades earlier.<sup>619</sup> It seems very likely that the term carrack, carvel and caravel were synonymously used for multi-masted vessels with carvel planking. The most renowned depiction of a carrack was made by the Flemish engraver William A. Cruce (Fig. 14)<sup>620</sup> as draft for 30 gilded carrack models, designed for elaborate banquettes on the occasion of the marriage of Charles of Burgundy to Margaret of York in Brussels.<sup>621</sup> This reflects the high prestige that these novel multi-masted ships must have had, being not only the cutting edge of technology, but the pride of navies. Thus, it is not surprising that the said Breton carrack — renamed to Peter van Danzke and colloquially known as *det groote Kraveel* — was perceived by contemporaries as the mightiest ship of its age.<sup>622</sup> The *groote Kraveel* was fitted out as a privateer in the war of the Hanseatic League against England and France.

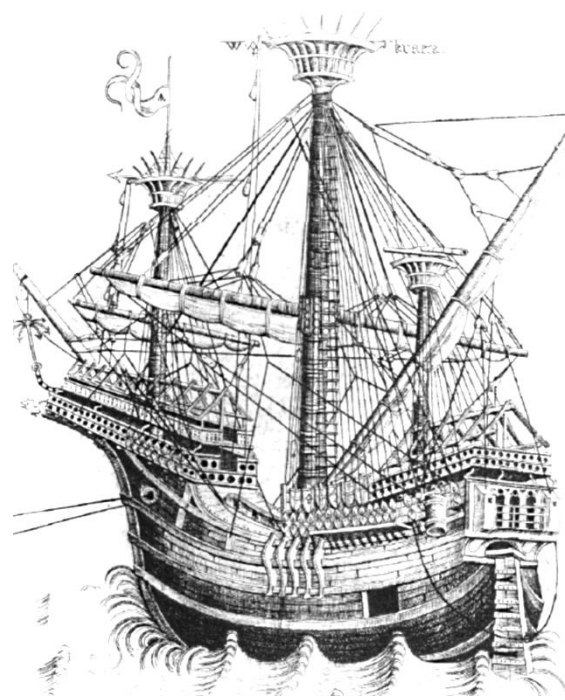


Fig.14. William A. Cruce's engraving of a Kraeck (ca. 1468) (Source: Ashmolean Museum Oxford, inv. PA 1310).

Its master Bernd Pawest reported to the City Council of Danzig the problems that the ship encountered during its privateering voyage in 1472: Although the vessel was caulked in the Zwin in the Low Countries,<sup>623</sup> great problems with water-tightness were still experienced soon thereafter. Pawest reported the formation of two great leaks in the night, which could not be brought under control even after a night of pumping. The distress is quite literally reflected in the description, according to which the crew used everything “they knew and could” to caulk the leak in a makeshift-manner, using tablecloth, pieces of wainscot, moss and tar, which seemed to have amended the situation little, as the main leak in the forepeak remained inaccessible for caulking from inside the hull, making the grounding or careening of the ship necessary.<sup>624</sup> Ironically, the *groote Kraveel's*

<sup>614</sup> “...altemaal gewracht Crapchunts nyse met de planken op malkander. Welke maniere van werk op desen tijd ook veranderd wird, en men begon voortaan Carviel=werk te maken; te weten, de planken te voegen nie top malkander, maar d'een tegen d'ander aen, met een naet tusschen beiden, gelijk noch bedendaegs in meest alle timmeragien van schepen het gebrunk is.” Velius 1740 quoted by Vogel 1915, 474, see also Olechnowitz 1960, 10.

<sup>615</sup> cf. definition by Hocker 2004

<sup>616</sup> cf. Maarleveld 1994, 155ff; Hocker 2004b

<sup>617</sup> Probst 1994, 143

<sup>618</sup> cf. Hagedorn 1914, 62, Vogel 1915, 475

<sup>619</sup> Winter 1978, 7

<sup>620</sup> Sleeswyk 1990, 348

<sup>621</sup> Sleeswyk 1990, 346, 349

<sup>622</sup> Olechnowitz 1960,10; Friel 1995, 177

<sup>623</sup> Hanserecesse II.6, Nr. 528, ed. von der Ropp 1890, 484

<sup>624</sup> “Ock wetet erszamen leven hern, dat ny am sonnavende up den sondach reminiscere in der nacht kregen **eyne grote leke**, alzo dat ny pompeden de nacht over und kondent nicht vormynnen und wart vo lenck yo groter und mehr, alzo dat ny in groter sorge und noet weren, ny hadden sorge, dat schip solde mit uns allen synken. Alzo dat ny lepen in de Dwnisz und rumeden dar tho. Wy hadden gebapet, ny volden ein hebben geholpen und brukeden allent dat ny wosten und konden, ny treden dar vor handoker, taflaken, haren und balden buten vor 1 bannit und makeden secke mit grotte und **volleden alle wrangen mit stucke wagenschattes, mosz und there**, und vorsachtent mancherley, alzo leven hern, dat ick grote sorge hadde, ny solden schipp und volk den Engelschen gebracht hebben, umme dat lieff tho bergen. (...) Alsus leven hern hefft uns de grote noet uth der ssee gedreven,



crew seem to have encountered similar problems as the English with their Genoese carracks half a century before. This comes not as a surprise, due to the vast differences in caulking clinker and carvel constructions. At the same time, other Hanseatics apparently appreciated the novel technology more than their trouble-stricken brethren from Danzig: Hamburg fitted out own carvels for war against England — *«dat grote Kraaveel»* and *«dat lutke Kraaveel»* — i.e. the great and the small carvel.<sup>625</sup> In the previous course of the war from 1470 to 1474, prizes from Spanish, Bretonic, English and Irish origin were taken, which reinforced the fleets of the Hanseatic League<sup>626</sup> and may have increased the familiarity and experience of maintaining or even constructing such ships.

The trend to fit out carvels for imminent wars is repetitive. In 1509, Lübeck prepared for war against Denmark and Holland and — aside from fitting out converted merchant hulks — also owned carvel-built warships referred to as *«des rades kraffell»* — the council's carvel — named *Marie*, which was the flagship, and the *Barthun* and *Spanniert*. The latter two names leave no doubt to the Breton and Spanish origin of these ships.<sup>627</sup> Denmark — likewise preparing for war — built in the same year two carvels as well.<sup>628</sup> Interestingly, carvel technology in Danish shipyards seemed to spread by the employment of German and Dutch shipwrights from 1485 to the 1560's, with a marked change to an influx of English and Scottish shipwrights thereafter.<sup>629</sup> With the rise of the kingdom of Sweden under the Vasa dynasty, a third power emerged in the Baltic Sea to employ carvel technology for naval warfare. Initially, this new player had to revert to hiring such ships from Lübeck, Danzig and other Hanseatic cities. A shipwreck in the Stockholm archipelago is tentatively identified as a ship described in written sources as one of his majesty's beste kraffwells sunk in 1525. The southern Baltic provenance of the planks cut in 1512 indicates that this might be one of the Hanseatic carvels hired by the Swedish king.<sup>630</sup> The transom-stern construction with curved fashion-pieces atop is an innovation that found entrance with the skeleton-first method (Fig. 15) and is comparable to the Red Bay wreck in Canada — tentatively identified as the Basque whaler *San Juan* sunk in

1565.<sup>631</sup> This construction was certainly an innovation in the Baltic Sea at that time, but — once again — slightly lagging behind the development in the North Sea, where it appeared several decades before, as indicated by a painting from St. Cosmas Church in Stade near Hamburg, dating before 1450.<sup>632</sup>

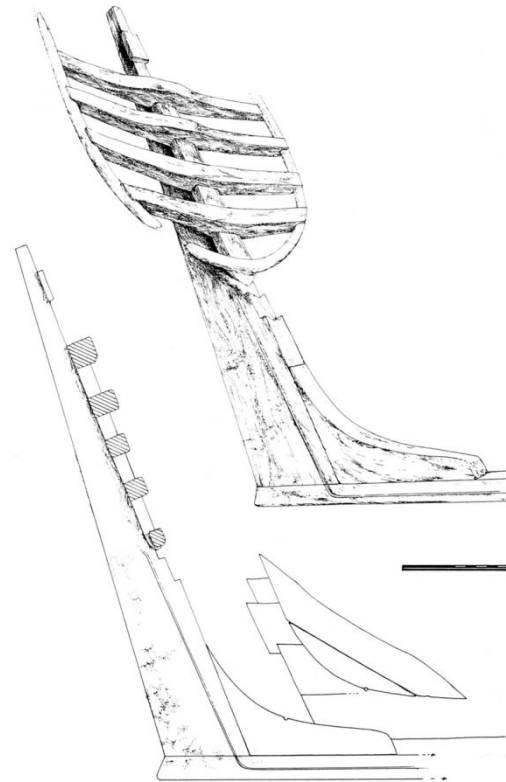


Fig. 15. Transom-stern of a carvel-built ship sunk in the Stockholm Archipelago in 1525 (Source: ADAMS, RÖNNBY 2013, fig. 5).

Despite earlier reservations concerning the employment of foreign shipwrights in Hanseatic ports — probably due to exclusively organised guilds — the restrictions were eventually lifted: Lübeck conceded in 1569 that skilled foreign shipwrights could work in Lübeck as long as they wanted, while Danzig did the same in 1552 and already few years later many foreign shipwrights, especially Dutch, worked there.<sup>633</sup> Nevertheless, the Polish king still reverted to contract particularly Venetian shipwrights in 1570 for the building of the first Polish galleon.<sup>634</sup> It becomes clear that there was more to it than the technical knowledge of building "Kraaveels" and that the technique itself did not automatically conveyed the whole secret and art of designing a hull.

While in previous decades small carvels have gotten into English ownership by capturing or acquiring

*und dat is all van gebrekes halven der tymmerlude, went ick mach dat jw in der warheit schriven, dat dat gude schip ny grunt geröret hefft, sedder dat ny van der Wysele segelden; und de grotteste leke is vor im peke unde der andern leke is suszt vele, und men kant van bynnen nicht beteren.* "Hanserecesse II,6, Nr. 538, ed. von der Ropp 1890, 500f.

<sup>625</sup> Kammler 2005, 132

<sup>626</sup> Kammler 2005, 130

<sup>627</sup> Kammler 2005, 138

<sup>628</sup> Jahnke 2006, 85ff.

<sup>629</sup> Bill 2009, 253

<sup>630</sup> Adams & Rönby 2013, 115

<sup>631</sup> Adams & Rönby 2013, 108

<sup>632</sup> Winter 1978, 8f. and tab. 6

<sup>633</sup> Olechnowitz 1960, 30

<sup>634</sup> Litwin 1991, 56

vessels from mainly the Iberian Peninsula, the new technology was now implemented in English shipyards. In 1463-1466 a three-masted caravel was built for Sir John Howard in Dunwich.<sup>635</sup> In 1487 and 1488, respectively, the *Regent* of 1000 tons and the *Sovereign* were launched for King Henry's VII royal fleet. The first was inspired by the French carrack *Columbe* and the king explicitly demanded that his ships should be built like her, i.e. in the "novel construction", which doubtlessly incorporated carvel technology, as *carvel nayles* were listed in the accounts.<sup>636</sup> Although there is no mention of foreign shipwrights when the *Regent* and *Sovereign* were built, it is testified that during Henry's VIII reign (1509-1547) many Venetian shipwrights were employed in the royal shipyards.<sup>637</sup> The Woolwich wreck has been identified as the abovementioned *Sovereign*, which frames feature bevelled notches as though it used to be a clinker-construction. This had been interpreted as re-planking a clinker-built ship in carvel,<sup>638</sup> but it appears that the *Sovereign* was in verity built as carvel construction from the very start, as the bevelled notches can be explained by the order of the kings' clerk to break up *Grâce Dieu*<sup>639</sup> for the «*making of his Ship cald the Souveraigne*». <sup>640</sup> Thus, the notches date from the *Grâce Dieu*'s clinker construction, which were evidently bevelled off before being reused for the *Sovereign*. The reuse of frames made from crooked timber was a very common practice at that time. It is not only the notched frames that illustrate in an exemplary way the gradual transition from clinker to carvel, however. The caulking of carvel-constructions remained a problem for northern shipwrights too, which led to a makeshift appropriation: Battens were nailed to the outside of the *Sovereign*'s hull to keep the caulking material in place.<sup>641</sup> Several decades later, this makeshift technique can be also observed in Swedish carvels: The seams of the *Stora Kraveln* — built around 1532 — were apparently covered by strips of lead after caulking<sup>642</sup> and carvel-caulkers explicitly mentioned,<sup>643</sup> and the *Elefanten* — another large Swedish warship built around 1554 — had battens between the frames.<sup>644</sup> The use of battens or caulking laths were not a novelty in northern Europe, as they were used already for centuries in bottom-based constructions, held in place by cramps or *sintels*, which could have been synonymous with the aforementioned 'strips of lead'. The fact that such

<sup>635</sup> Friel 1995, 178; he rightly points out however that the absence of clench-nails and roves alone does not necessarily imply that the vessel was built skeleton-first.

<sup>636</sup> Adams 2003, 66

<sup>637</sup> Rieth 2003, 27

<sup>638</sup> Salisbury 1961, 86

<sup>639</sup> i.e. the second *Grâce Dieu* of 1449

<sup>640</sup> Oppenheim 1896, 47, cited by Adams 2003, 66

<sup>641</sup> Salisbury 1961, 87

<sup>642</sup> Börjeson 1928, 155

<sup>643</sup> Börjeson 1928, 149

<sup>644</sup> Salisbury 1961, 87

makeshift aids were not used by accomplished carvel-shipbuilders reveals that northern Europeans still encountered problems in embracing the accumulated know-how of carvel-technology.

It can be conjectured that the introduction of the carvel technology in northern European shipyards occurred within a relatively short period, but that the transition to this new technology — as could be expected — did not occur wholesale and minor difficulties were overcome and amended with local techniques.

## 10. Evolution towards an alternating framing-style via a Basque hub?

Amongst historians, there is a common — yet unspecified — realisation that some kind of mixture between Atlantic and Mediterranean influences must have occurred in 15<sup>th</sup>-century shipbuilding, which created new types of ships that plied the seas in the beginning period of the great ocean explorations.<sup>645</sup> Although the details of this transition remain largely obscure, there are several indications in both historical and archaeological sources, which seem to reflect this transition. Not surprisingly, the Basque region appears to be yet again central to this development.

The introduction of carvel technology in northern Europe often seems to be tantamount to the breach with the local shipbuilding tradition, where foreign shipwrights were allowed to implement their own method from scratch. But this is only partly true, as some aspects of the local tradition were often retained and may have even abetted the adoption of carvel technology as a whole, like the Dutch-flush method in the northern Netherlands (Fig. 10).<sup>646</sup> Some evidence suggests that the Atlantic clinker tradition may have likewise abetted a smooth transitional process from shell-oriented clinker to skeleton-oriented carvel technology, often involving both methods in the same construction. This has been hypothesized for the aforementioned Bayonne Ship of 1419, for which construction the use of moulded frames was suggested (Fig. 10). Moulded frames would have been an uncommon feature in a shell-first clinker construction, where frame dimensions were conditioned by the shell, and inserted and fashioned by the rule of thumb once the shell had been completed. A skeleton-first feature, however, was inferred by the term *hameron*, which was interpreted as tailframe on the basis of etymological and contextual information,<sup>647</sup> for which fixed measurements were given, i.e. «...the mast beam is in

<sup>645</sup>cf. Goyenette 1998, 154

<sup>646</sup> cf. Maarleveld 1994

<sup>647</sup> Loewen 1997a, 329

length 41 common feet, and the beam of the hameron afore is in length 39 feet, and the beam of the hameron behind is in length 34 feet... ».<sup>648</sup> Can this be seen as evidence for a skeleton-oriented method for three masterframes? Not necessarily, as it can be objected that Alectre's 1419 letter to King Henry V was merely meant to inform him about the progress and *as-is* state of the building of his royal ship. The measurements taken at the mast and *hameron* beams may have been a generically agreed upon measure for principal dimensions, rather than a skeleton-first feature for hull control. Besides, why should Alectre include such mundane aspects in the report when the dimensions are understood to be predetermined?

While the question of whether the construction of the Bayonne ship of 1419 incorporated some skeleton-first principles has to remain hypothetical, the presumably Basque-built Cavalaire-sur-Mer wreck dating to 1479 *terminus ante quem* undoubtedly combines features from both techniques. The floor timber and first futtocks were pre-assembled, as evidenced by mortices, whereas second futtocks simply overlapped and were therefore added at a later stage (Fig. 10).<sup>649</sup> This coincides with tangentially sawn carvel bottom planking up to the water-line, continued by radially cleft clinker planking above. Roughly speaking, the building sequence was divided into two parts, the first being skeleton-based carvel and the second shell-based clinker construction. By analogy, this wreck would have looked similar to bottom-based ships from the Hanseatic sphere, but in verity, the sequence was inverted with a high degree of predefined geometry in the master frame,<sup>650</sup> which is not the case in shell-oriented bottom-based shipbuilding. The alternating framing style in conjunction with the hull design and consistent growing and harvest patterns for crooked timbers indicate that the Cavalaire-sur-Mer wreck is the product of a cohesive shipbuilding tradition and not a product of chance.<sup>651</sup> Moreover, the Cavalaire-sur-Mer's clinker-planking above the water-line was made with radially-cleft planks to which — in a true shell-first fashion — the second futtocks were inserted later. This reflects that the ship was built within a community with a clinker-tradition, but may have been retained for a practical reason: Planks above the water-line wore out faster than those below the water-line due to a constant change in weather, from rain and spray to sun radiation. Radially cleft planks were more durable than tangentially sawn planks, as they were less permeable and less susceptible to form cracks. A similar way of planking can be also observed a century later in the *Chalupa 1* wreck, the whaleboat of the Basque Whaler *San Juan* wrecked 1565 in the Red Bay, Canada, where the first three

strakes are flush-laid and the topmost two strakes are clinker-fastened.<sup>652</sup>

Unlike other Mediterranean ships, the Cavalaire-sur-Mer wreck is not a genuine skeleton-first construction, which raises the question of origin. In this respect, there is a current debate on moulding systems and its diverse traditions, which cannot deny a certain Venetian influence, whilst many other indications point to an independent Atlantic or Iberian tradition. The only common denominator of this debate is the realisation that the evidence is incomplete and sketchy, so it remains speculative how exactly the moulding systems spread. It is assumed that Venetian moulds must have had an impact on English ship design, as Mathew Baker noted in ca. 1570 that Venetian shipwrights have used twenty years earlier a master frame on the basis of four arcs of tangential circles of different radii.<sup>653</sup> This reference is credible, as Baker participated in his youth in 1550 in a training voyage for English navigators to the Mediterranean.<sup>654</sup> It was pointed out that the early moulds in the *Fragments of English Shipwrighty* are indeed similar to the Venetian moulds and that Baker might have used the Venetian style of 1550, though more clumsily.<sup>655</sup> More clumsily because it lacked the sheer-narrowing scale and hence might have rather resembled the method of 'whole moulding', which application in itself is highly obscure due to the lack of contemporary documentary evidence.<sup>656</sup> The origin of this technique is still a contested issue, believed by some to be Mediterranean<sup>657</sup> or of an Atlantic or even discrete Basque origin.<sup>658</sup> As the case may be, there seems to be a basic agreement on that Mathew Baker was at least initially inspired by the Mediterranean method that encompassed a master mould, a rising square and a sheer-narrowing scale, which indeed Baker recognised — implying that he knew at least a similar system — by commenting on the drawings of the Venetian main frame «*partysane and stely which we do call the riseng and narowing*».<sup>659</sup> However, the system applied by the English around 1570/1580 was neither the Mediterranean method nor 'whole moulding', but was based on tangent arcs within a grid of narrowings and risings, or in other words by 'hauling up/down' the futtock after which principle allegedly the *Mary Rose* was constructed.<sup>660</sup> Despite the shipbuilding centre of Bayonne ceased to be under English rule in 1451, a continuing link of England to its former enclave cannot be excluded.<sup>661</sup> In fact, the moulding

<sup>648</sup> Loewen 1997a, 329

<sup>649</sup> Loewen & Delhaye 2006, 101

<sup>650</sup> Loewen & Delhaye 2006, 101

<sup>651</sup> Loewen & Delhaye 2006, 99

<sup>652</sup> Moore 1998, 38

<sup>653</sup> Rieth 2003, 27; cf. Lane 1934

<sup>654</sup> Barker 1986, 161

<sup>655</sup> Barker 1991, 64; Barker 2003, 42

<sup>656</sup> cf. Rieth 2003, 29

<sup>657</sup> Rieth 2003

<sup>658</sup> cf. Loewen 1997b, 171; Barker 2003

<sup>659</sup> cf. Bellabarba 1993, 288

<sup>660</sup> Barker 2003, 33ff., 43

<sup>661</sup> Barker 2003, 35

systems between *Mary Rose* (1509) and the Basque whaler *San Juan* (1565) appears to be similar, as the futtocks were also ‘hauled up/down’.<sup>662</sup> In the *Mary Rose* the framing and planking advanced in an alternating fashion, as indicated by the timbers, of which only a few are actually fastened and scarfed together. The pre-fastening of few planks relieved the strain from the ribbands, which determined the shape of the frames in between the master frame and the tail frames.<sup>663</sup> The same procedure was applied to the *San Juan*, in which frames and planks were also installed in an alternating fashion and nail holes indicated the position of temporary ribbands or battens (Fig.16).<sup>664</sup>

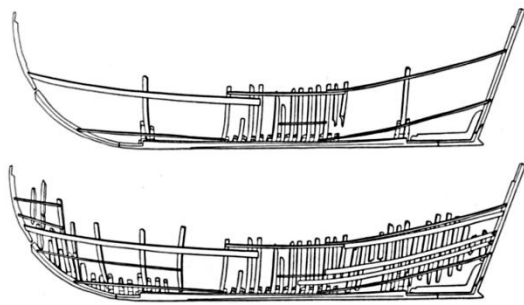


Fig.16. Alternating sequence in frame-led building of the Red Bay wreck — tentatively identified as the Basque whaler *San Juan* (1556) (Source: GRENIER, LOEWEN, PROULX 1994).

An alternating way of construction was also observed in *Grâce Dieu* (1418), where several futtocks were apparently inserted before their corresponding floor-timbers.<sup>665</sup> Not only in geopolitical terms, but also in climatic terms, the Basque region was an important hub in shipbuilding between the north and the south, as evidenced by the unique way of fastening frames to planks. While in northern Europe only treenails were used, in southern Europe iron nails were used, as softwood treenails would have deteriorated faster in warm waters. In the Biscay area, however, the frames of 16<sup>th</sup> century ships were fastened with two treenails as well as two iron nails. In the case of the wreck of the Basque whaler *San Juan*, however, the iron nails were driven in at the quick assembly of planks and frames, and later solidified by treenails.<sup>666</sup> The same “peculiar” feature was observed a century earlier in the Basque-built Newport ship, where iron spike nails were also used in addition to treenails in plank-to-frame fastenings.<sup>667</sup> This technical solution may be testament to the Basque’s mediating role between

northern and southern Europe, and the vastly different climate zones Basque ships were operating in.

## 11. Outdated clencher hulks: eclipsed by carvel technology?

The carvel revolution heralded in a new age in which large clinker-built ships were gradually superseded by carvel-built ships in many — though not all — northern European ports. In England the changes were so profound that between 1500 and 1510 no large clinker-built ships were used for royal service anymore and even dismissed as ancillary vessels. Some large German hulks described as *clenchers* were arrested on the Thames for royal service in late July 1545 and sailed to Portsmouth, where the Lord High Admiral rejected them as unsuitable for naval use: «*clenchers, both feeble, olde, and out of fashion*”.<sup>668</sup> While rejected in England, hulks were still used in the Baltic Sea in the 16<sup>th</sup> century. A war fleet summoned in Lübeck in 1509-1510 included both *hollicks* (hulks) and carvels.<sup>669</sup> This indicates that the term hulk was synonymous with that of a large clinker-built ship. The same distinction was made in the Swedish Navy under King Gustav Eriksson Vasa, in which the king’s favoured *keravels* sailed alongside the large *holks*.<sup>670</sup> Fernando de Oliveira referred unfavourably to a bowl-like hull shape of a 16<sup>th</sup> century hulk from Riga, anchoring off Belem, Portugal,<sup>671</sup> which reflects the absence of skeleton-oriented guiding principles. This bowl shape impression is not only caused by the absence of a tumblehome, but also the tapering bow and stern sections in a strong arch, as observable in the Ebersdorf model.<sup>672</sup> Despite these ships were disdained in places where the transition to carvel technology has been completed, large lapstrake constructions were continued to be built in the Baltic Sea region in particular.<sup>673</sup> The survival of such constructions can be ascribed to the mercantile nature of its use, where predominantly unfinished bulk commodities were transported, from rural communities that did not undergo the same pressures as the densely urbanised areas in the Low Countries and the English Canal, which fuelled innovation in the shape of carvel technology. Although hulks were occasionally fitted for war by Hanseatic merchants, the Dutch and Flemish in the 16<sup>th</sup> century,<sup>674</sup> the advances in naval artillery rendered them obsolete for close combat, but deemed sufficient as mere supply vessels. The number of ordnance in the hitherto customary arrangement above the gunwale — in the fore and aftercastles — was restricted by the

<sup>662</sup> Rieth 2003, 29

<sup>663</sup> Adams 2003, 71

<sup>664</sup> Grenier *et al* 1994, 138f.

<sup>665</sup> Anderson 1934, 166

<sup>666</sup> Loewen 1998, 193

<sup>667</sup> Nayling & Jones 2014, 255

<sup>668</sup> Friel 1995, 180

<sup>669</sup> Kammler 2005, 135

<sup>670</sup> Adams 2003, 86

<sup>671</sup> Vogel 1915: 384

<sup>672</sup> Steusloff 1983: 193

<sup>673</sup> Eriksson 2010

<sup>674</sup> Kammler 2005, 135

increased centre of gravity, jeopardizing the hydrostatic stability. The only viable solution of cutting gun ports below the deck would have weakened clinker-built shell-first structures considerably. The strategic necessity to deploy larger calibres of guns and to cut gun ports, however, became a driving force in Renaissance shipbuilding, especially in England. Although the Frenchman Descharges is often named as the inventor in 1501, the seal of Maximilian of Burgundy of 1493<sup>675</sup> and a ship depiction of 1497 from Hamburg's naval law shows gunports as well.<sup>676</sup> Documents indicate that the *Mary Rose* was rebuilt in 1536 and dendrochronological analyses revealed more specifically that riders, diagonal and vertical braces and heavy transom knees were added around that date alongside with massive deck beam knees, probably to bear the increased strain of artillery recoil on a continuous gun deck.<sup>677</sup> Although the early inventory of 1514 already indicated an impressive ordnance, the Anthony Roll lists an even heavier armament after her rebuilding with 6 bronze pieces of considerable size, 2 cannons, 2 semi-cannons and 2 culverins, which reflect great diversity of antiquated and modern guns.<sup>678</sup> While such rebuilding measures provided no structural problem in carvel-built ship — at least with regards to structural stability rather than hydrostatic stability — such measure would have posed a problem in clinker-built vessels: As shell-first structure, principle stresses are transferred via the shell, and cutting holes into it would have weakened the hull structure considerably, despite being reinforced by frames. This is probably the reason why the abovementioned Lord High Admiral had such a disdain for the German *clenckers*. Despite — or even perhaps — of the limited use of hulks for warfare, northern European merchants still relied heavily on hulks, particularly «*Hulkes of Dantsick, Easterlings Hulks, Hulks of Flanders*» and hulks are known to have sailed from Russia, Norway, Denmark, Friesland, Holland, Zealand and Brabant.<sup>679</sup> How widespread this ship still was, could be estimated on the basis of a late 16<sup>th</sup> century Iberian source, which notes that «*there is in Lisbon upon 80 sails of hulks from 100 tons to 800 tons, of Holland, Zealand, and Hamburg*».<sup>680</sup>

The flagship of the Spanish Armada's only northern European squadron of 1588 was the 650 ton merchant hulk *El Gran Grifón*, built in Rostock, which sailed with other hulks from the Baltic and the Netherlands.<sup>681</sup> Interestingly, only few additions were made to the hulks' light armament, and all ships of that squadron were used as troop carriers and supply vessels for the impending invasion, rather than for

naval action.<sup>682</sup> At the sight of these hulks, Sir Walter Raleigh noted that «*Easterling hulkes, who were wont to paint great red portholes in their broadsides where they carried no ordnance at all*».<sup>683</sup> The fake gun-ports painted onto the hulks' sides to deceive the English is another clear indicator that their hulls were not suited to cut gun ports into their sides.

This period is marked by the gradual establishment of professional navies and purpose-built warships. However, the practise of arresting merchant ships by sovereigns and city states to fit them out for war was still widespread, as illustrated above. By relying on the “outdated hulk”, merchants may have attempted to evade the arrest of their ships. Thus, the refusal to adopt modern carvel-built ships may have been a calculated choice rather than a sentimental adherence to the native shipbuilding tradition.

## 12. Conclusion

By examining trends in shipbuilding from a diachronic perspective of more than three centuries, several recurrent patterns crystallise in the way different ship-types were perceived by contemporaries in a different way than the modern observer may expect.

Historical ship-types are primarily indicative of origin rather than construction, but may have evolved into a “brand” in its own right, such as a ‘Bayonese cog’ or a ‘Genoese carrack’. These identification labels indicate that innovation in shipbuilding may have been driven decisively in a very regional — if not urban — context, rather than a general development on a broader scale, so gaining possession of cities or fiefdoms with renowned centres of shipbuilding — like Bayonne or Rouen — may have been a major strategic factor in an age in which city states and sovereigns aspired to safeguard trading routes. Ship-types should not be taken at face value, as they encourage stereotypical thinking: The distinction between late cogs and early carracks, for instance, might have been blurred by regional concepts, and archaeologists should therefore think outside historical type categories in tracing influences within shipbuilding. This study provided historical evidence, which supports that clinker-built and even carvel-built vessels were referred to as cogs in southern European sources, which should be incentive enough to stop referring to seagoing bottom-based vessels as “cogs in the archaeological sense”, which is plainly inaccurate, considering the accumulated evidence from an all European perspective.

Intrinsic insights in the mechanisms of the “naval arms race” can be gained by tracing modular solutions archaeologically, especially those that can be

<sup>675</sup> Litwin 1985, 140

<sup>676</sup> Kammler 2005, 151

<sup>677</sup> Dobbs & Bridge 2000, 258

<sup>678</sup> Guilmartin 1994, 148

<sup>679</sup> Nance 1912, 101

<sup>680</sup> Carr Laughton 1912, 156

<sup>681</sup> Martin & Parker 1988, 42

<sup>682</sup> Martin & Parker 1988, 42

<sup>683</sup> Nance 1912, 103

seen as flawed, anachronistic and transient, as they tend to reflect active phases of change by trial and error. Three major levels of technology transfer can be identified

### First level innovation

The first is exemplified by the *Grâce Dieu*, where a new construction is prompted to accommodate new specifications, inspired by foreign ship-design — i.e. Genoese carracks — but occurring within the boundaries of the own clinker tradition. This is the most isolated form of change and innovation.

### Second level innovation

The second level is exemplified by the gradual introduction of carvel technology in communities, where some form of skeleton-oriented construction was already practised, as hypothesised for the Basque case. This transition occurred simultaneously — but different — in other Northern European centres of shipbuilding, like in the northern Netherlands in which this technology is appropriated to the local bottom-based tradition, retaining an aspect of the shell-first method in the initial stage of construction, but admitting the permeation of skeleton-first technology into the “Dutch flush” method, aptly described as cross-fertilization,<sup>684</sup> and leaving an unmistakably local mark in the way of adoption. Other aspects of this technology — like the use of battens and cramps for the water-proofing of flush-laid plank seams — has also permeated the transitional phase. Ocularly, the transition to carvel-ships was complete, but not on a modular level, where several work processes were amended by familiar techniques carried out in the local shipbuilding tradition.

### Third level innovation

Genuine and complete adoption however, tended to occur only by the hiring of foreign shipbuilders who were allowed to implement their skeleton-first carvel construction method from scratch. The fact that they were mentioned by name in historical sources reflects their importance and social status, which is far beyond that of ordinary craftsmen. The high cross-cultural mobility of specialists appears like a strikingly modern concept, but it was not uncommon for the examined period.

The impulses of technology transfer changed from a north-south and later to a south-north direction, highlighting the transience of innovation centres. This is a stark reminder that we — speaking from a

northern European perspective — should not take our current state of affairs for granted in an ever more globalised world order, which may change swiftly beyond recognition within the rate of few decades and less.

## Acknowledgment

I am particularly indebted to Mikel Soberón Rodríguez for the excellent communication and elucidations on the Barceloneta I wreck and its context. I would also like to thank José Manuel Matés Luque for his kind help to establish and mediate the contact to the publisher of this volume, and for his literature recommendations. Nigel Nayling and Toby Jones kindly provided offprints of their papers prior to publishing. For linguistic questions I received invaluable help from Jeroen Vermeersch for a Dutch excerpt and my brother Tobias Zwick (alumnus of the Universidad de Granada) for Spanish texts. Moreover, I would like to thank Anton Englert, who provided suggestions and critical feedback on the draft. Wolfgang Steusloff and Klaus Kempf kindly helped me to obtain images and the permission for reprint.

## References

- ADAMS, Jonathan: *Ships, Innovation and Social Change. Aspects of Carvel Shipbuilding in Northern Europe 1450-1850*, Statens Maritima Museer, Stockholm, 2003.
- ADAMS, Jonathan, BLACK, Jennifer: “From Rescue to Research: Medieval Ship Finds in St Peter Port, Guernsey”, *The International Journal of Nautical Archaeology*, n° 33.2, 2004, pp. 230–252.
- ADAMS, Jonathan, RÖNNBY, Johan: “One of His Majesty’s ‘Beste Kraffwells’: the wreck of an early carvel-built ship at Franska Sternarna, Sweden”, *The International Journal of Nautical Archaeology*, n° 42.1, 2013, pp. 103-117.
- ALBERDI LONBIDE, Xabier, ARAGÓN RUANO, Álvaro: “La construcción naval en el País Vasco durante la Edad Media”, *Itsas Memoria. Revista de Estudios Marítimos del País Vasco*, n° 2, 1998, pp. 13-33.
- ANDERSON, Roger Charles: “Italian Naval Architecture about 1445”, *The Mariner’s Mirror*, n° 11.2, 1925, 158-163.
- ANDERSON, Roger Charles: “The Bursledon Ship”, *The Mariner’s Mirror*, n° 20.2, 1934, pp. 158-170.
- ASAERT, Gustaaf, et al.: *Maritieme Geschiedenis der Nederlanden I*, Bussum, 1976.
- BARKER, Richard: “Fragments from the Pepysian Library”, *Revista da Universidade de Coimbra*, n° 32, 1986, pp. 161-174.

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- BARKER, Richard: "Design in the Dockyards, about 1600", in REINDERS, R.; PAUL, K.: *Carvel Construction Technique*, Oxbow, Oxford, 1991, pp. 61-69.
- BARKER, Richard: "Whole-moulding: a preliminary study of early English and other sources", in H. NOWACKI, M. VALLERIANI, *Shipbuilding Practice and Ship Design Methods from the Renaissance to the 18th Century*, Max-Planck-Institut für Wissenschaftsgeschichte, Berlin, 2003, pp. 33-66.
- BARTSCH, Karl: *Wolfram's von Eschenbach Parzival und Titarel*, Leipzig, 1871.
- BAUER, Albert: *Heinrich von Lettland – Livländische Chronik*, Darmstadt, 1975.
- BELLABARBA, Sergio: "The ancient methods of designing hulls", *The Mariner's Mirror*, n° 79.3, 1993, pp. 274-292.
- BILL, Jan: "Iron Nails in Iron Age and Medieval Shipbuilding", in C. WESTERDAHL, *Crossroads in Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Roskilde, 1994, pp. 55-64.
- BILL, Jan: "Zwischen Kogge und Kraweel. Traditioneller Kleinschiffbau in Südkandinavien in einer Zeit der Wende", in SCHOLKMANN, B., VOSSLER, C., WOLF, M., *Zwischen Tradition und Wandel. Archäologie des 15. Und 16. Jahrhunderts*, Büchenbach 2009, pp. 251-260.
- BILL, Jan, POULSEN, Bjørn, RIECK, Flemming, VENTEGODT, Ole: *Danske Søfarts Historie n° 1: Fra Stammebåd til Skib. Tiden indtil 1588*, Copenhagen, 1997.
- BLATT, Franz, SKYUM-NIELSEN, Niels: *Danmarks riges breve*, n° I.6, Copenhagen, 1979.
- BÖRJESON, Hjalmar: "The Swedish Ship Stora Krafwelen of 1532", *The Mariner's Mirror*, n° 14.2, 1928, pp. 149-157.
- CARR LAUGHTON, Leonard George: "The hulk", in: *The Mariner's Mirror*, n° 2.2, 1912, p. 156.
- CHRISTENSEN, Arne Emil: "Review of McGrail, 2002", in: *International Journal of Nautical Archaeology*, n° 31.2, 2002, p. 300.
- CHRISTENSEN, Arne Emil, STEUSLOFF, Wolfgang: *Das Ebersdorfer Schiffsmodell von 1400*. Schriften des Deutschen Schiffahrtsmuseum, n° 70, Bremerhaven/ Wiefelstede, 2012.
- CHROUST, Anton: *Quellen zur Geschichte des Kreuzzuges Kaiser Friedrichs I. Monumenta Germaniae Historica Script. rer. Germ. N.S. 5*, Berlin, 1928.
- CRUMLIN-PEDERSEN, Ole: "Cog — Kogge — Kaag. Træk af en frisisk skibstypes historie", in: *Årbog Handels- & Søfartsmuseet på Kronborg*, n° 24, 1965, pp. 81-144.
- CRUMLIN-PEDERSEN, Ole: *From Viking Ships to Hanseatic Cogs*. Trustees of the National Maritime Museum. London 1983.
- CRUMLIN-PEDERSEN, Ole: "To be or not to be a cog: the Bremen cog in perspective", in: *The International Journal of Nautical Archaeology*, n° 29.1, 2000, pp. 230-246.
- DOBBS, Christopher T. C., BRIDGE, Martin: "Preliminary Results from Dendrochronological studies on the Mary Rose", in LITWIN, J., *Down the River to the Sea*. Proceedings of the Eighth International Symposium on Boat and Ship Archaeology, Gdańsk, 2000, pp. 257-262.
- DOTSON, John E.: "Treatises on shipbuilding before 1650", in GARDINER, R., UNGER, R. W., *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*, London, 1994, pp. 160-168.
- EBERENZ, Rolf: *Schiffe an den Küsten der Pyrenäenhalbinsel. Eine kulturgeschichtliche Untersuchung zur Schiffstypologie und -terminologie in den iberoromanischen Sprachen bis 1600*. Lang, Bern / Frankfurt a. M., 1975.
- ELLMERS, Detlev: "Koggen kontrovers", *Hansische Geschichtsblätter*, n° 128, 2011, pp. 113-140.
- ELLMERS, Detlev: "Kogge und Holk als Schiffe der Hanse", in: M. HUNDT, J. LOKERS, *Hanse und Stadt — Akteure, Strukturen und Entwicklungen im regionalen und europäischen Raum. Festschrift für Rolf Hammel-Kiesow zum 65. Geburtstag*. Lübeck 2014, pp. 53-67.
- ERIKSSON, Niklas: "Between clinker and carvel: aspects of hulls built with mixed planking in Scandinavia between 1550 and 1900", in: *Underwater Archaeology in the Baltic Region*. Archaeologia Baltica, n° 14, 2010, pp. 77-84.
- FALK, Hjalmar: "Altnordisches Seewesen", *Wörter und Sachen*, n° 4, 1912, pp. 1-121.
- FILGUEIRAS, Octávio Lixa: "A presumptive Germanic heritage for a Portuguese boat-building tradition", in: S. MCGRAIL, *The Archaeology of Medieval Ships and Harbours in Northern Europe*. British Archaeology Reports: International Series, n° 66, London, 1979, pp. 17-34.

- FLIEDNER, Siegfried: “‘Kogge’ und ‘Hulk’. Ein Beitrag zur Schiffstypengeschichte”, *Die Bremer Hanse-Kogge*. Röver, Bremen, 1969, pp. 39–121.
- FRIEL, Ian: “Henry V’s Grace Dieu and the wreck in the R. Hamble near Bursledon, Hampshire”, *The International Journal for Nautical Archaeology*, n° 22.1, 1993, pp. 3-19.
- FRIEL, Ian: “The Carrack: The Advent of the Full Rigged Ship”, in GARDINER, R., UNGER, W., *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*. Conway Maritime Press, London, 1994, pp. 77-90.
- FRIEL, Ian: *The Good Ship. Ships, Shipbuilding and Technology in England 1200-1520*. Johns Hopkins University Press, Baltimore, 1995.
- GARDINER, Robert: *Cogs, Caravels and Galleons: the sailing ship 1000-1650*. London, 1994.
- GOYHENECHÉ, Eugène: *Bayonne et la région bayonnaise du XII<sup>ème</sup> au XV<sup>ème</sup> siècle. Études d’histoire économique et sociale*, Universidad del País Vasco/Euskal Herriko Unibertsitatea, Leioa (Bizkaia), 1990.
- GOYHENETCHE, Manex: “La construction navale en Pays Basque Nord: état de la recherche et portrait chronologique”, *Itsas Memoria. Revista de Estudios Marítimos del País Vasco*, n° 2, 1998, pp. 147-168.
- GRENIER, Robert: “Basque Whalers in the New World: The Red Bay Wrecks”, in BASS, G., *Ships and shipwrecks of the Americas: a history based on underwater archaeology*. Thames and Hudson, New York, 1988, pp. 69-84.
- GRENIER, Robert, LOEWEN, Brad, PROULX, Jean-Pierre: “Basque Shipbuilding Technology c. 1560-1581: The Red Bay Project”, in WESTERDAHL, C., *Crossroads of Ancient Shipbuilding*. Proceedings of the Sixth International Symposium on Boat and Ship Archaeology, Oxford, 1994, pp. 137-141.
- GUILMARTIN, John: “Guns and Gunnery”, in R. GARDINER and R.W. UNGER, *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*. Conway Maritime Press, London, 1994, 139-150.
- HAGEDORN, Bernhard: *Die Entwicklung der wichtigsten Schiffstypen bis ins 19. Jahrhundert*. Karl Curtius, Berlin, 1914.
- PUJOL, HAMELINK, Marcel, SOBERÓN RODRÍGUEZ, Mikel: “El pecio de Barceloneta I, una embarcación atlántica del siglo XV en Barcelona”, in: *Actas de las Jornadas de ARQUA 2011*, Cartagena, 2011, pp. 117-123.
- HEINSIUS, Paul: *Das Schiff der hansischen Frühzeit*, Cologne/Vienna 1986.
- HOCKER, Frederick: “Technical and organizational development in European shipyards 1400 – 1600”, in: J. BILL and B.L. CLAUSEN, *Maritime Topography and the Medieval Town*, Copenhagen, 1999, pp. 95-108.
- HOCKER, Frederick: “Bottom-based shipbuilding in northwestern Europe”, in: F.M. HOCKER and C.A. WARD, *The Philosophy of Shipbuilding. Conceptual approaches to the study of wooden ships*, College Station, 2004, pp. 65-94.
- HÖHLBAUM, Konstantin: *Hansisches Urkundenbuch* n° I, Halle, 1876.
- HUTCHINSON, Gillian: *Medieval ships and shipping*, London, 1994.
- HUTCHINSON, Gillian: “Bayonne and beyond pivotal points in the transmission of medieval shipbuilding technology”, in: P. POMEY and E. RIETH, *Construction navale maritime et fluviale. Approches archéologique, historique et ethnologique*. Archaeonautica n° 14, 1998, pp. 185-190.
- JAHNKE, Carsten: “Dronningens skibe for kongens flåde. Dronning Dorothea af Brandenburgs skibsbygning omkring 1486”, in: *Maritim Kontakt*, n° 28, 2006, pp. 85-94.
- JAHNKE, Carsten: “Koggen und kein Ende: Anmerkungen zu den Thesen von Reinhard Paulsen und Detlev Ellmers“, in: *Verein fuer Luebeckische Geschichte und Altertumskunde. Zeitschrift*, n° 91, 2011, pp. 305-320.
- JAHNKE, Carsten, ENGLERT, Anton: “Historical research on merchant seafaring in Danish waters and in the western Baltic Sea”, in: A. ENGLERT, *Large Cargo Ships in Danish Waters 1000-1250. Evidence of specialised merchant seafaring prior to the Hanseatic Period*. Ships and Boats of the North, n° 7, Roskilde, 2014, pp. 17-54.
- JORDAN, Karl: *Die Urkunden Heinrichs des Löwen, Herzog von Sachsen und Bayern*, Stuttgart/Weimar, 1949.
- KAHANOV, Yaacov, STERN, Eliezer: “Ship Graffiti from Akko (Acre)”, in: *The Mariner’s Mirror* n° 94.1, 2008, pp. 21-35.
- KAMMLER, Andreas: *Up Eventur - Untersuchungen zur Kaperschiffahrt 1471-1512, vornehmlich nach Hamburger und Lübecker Quellen*, St. Katharinen, 2005.
- KARTSCHOKE, Dieter, SCHRÖDER, Werner: *Willehalm: Wolfram von Eschenbach*, Berlin, 2003.
- KOVRTZ ANDERSEN, Per: *Kollerupkoggen*, Thisted, 1983.
- KOCABAŞ, Ufuk: “The Latest Link in the Long Traditions of Maritime Archaeology in Turkey: The



Yenikapı Shipwrecks”, in: *European Journal of Archaeology* n° 15.1, 2012, pp. 1-15.

KURTH, Friedrich: *Der Anteil niederdeutscher Kreuzfahrer an den Kämpfen der Portugiesen gegen die Mauren*. Mitteilungen des Österreichischen Instituts für Geschichtsforschung, n° 8, Vienna, 1911, pp. 131-252.

L'HOUCHE, Michel, VEYRAT, Elisabeth: “A mid-15<sup>th</sup> century clinker boat off the north coast of France, the Aber Wrac’h wreck: A preliminary report”, in: *The International Journal for Nautical Archaeology*, n° 18.4, 1989, pp. 285-298.

L'HOUCHE, Michel, VEYRAT, Elisabeth: “The French Medieval Clinker Wreck from Aber Wrac’h”, in: C. WESTERDAHL, *Crossroads of Ancient Shipbuilding*, Oxford, 1994, pp. 165-180.

LANE, Frederic Chapin: “Venetian Naval Architecture about 1550”, in: *The Mariner's Mirror*, n° 20.1, 1934, pp. 24-49.

LAPPENBERG, Johannes: *Arnoldi abbatís Lubecensis Chronica Slavorum anno 1172-1209. Monumenta Germaniae Historica Scriptorum*, n° XXI, Hanover, 1869, pp. 100-250.

LITWIN, Jerzy: “The warship in the painting from Arthur's Court in Gdansk. An attempt at reconstruction”, in: C. O. CEDERLUND, *Postmedieval Boat and Ship Archaeology*. International Symposium on Boat and Ship Archaeology / British Archaeology Reports: International Series, n° 256, Oxford, 1985, pp. 137-154.

LITWIN, Jerzy: “The first Polish galleon and its construction register from 1570-1572”, in: R. REINDERS, K. PAUL, *Carvel Construction Technique*. Fifth International Symposium on Boat and Ship Archaeology, Oxford, 1991, pp. 56-60.

LIZARRAGA, J. M.: La Coca de Bayona. La Iglesia que guardó el Sello. 1ª parte, in: *Más Navíos*, pp. 22-27.  
[http://www.navalmodel.es/Naval\\_Model/La\\_afilada\\_pluma\\_de\\_Lizarraga.html](http://www.navalmodel.es/Naval_Model/La_afilada_pluma_de_Lizarraga.html)

LOEWEN, Brad: “Bayonne 1419. Lapstraking and moulded frames in the same hull?”, in: *The Mariner's Mirror*, n° 83.3, 1997a, pp. 328-330.

LOEWEN, Brad: “The master-mould-shipbuilding tool of the Renaissance”, in: *The International Journal of Nautical Archaeology*, n° 26.2, 1997b, pp. 169-172.

LOEWEN, Brad: “The Red Bay vessel. An example of a 16<sup>th</sup>-century Biscayan ship”, in: *Itsas Memoria. Revista de Estudios Marítimos del País Vasco*, n° 2, 1998, pp. 193-199.

LOEWEN, Brad, DELHAYE, Marion: “Oak growing, hull design and framing style. The Cavalaire-sur-Mer wreck, c. 1479”, in: L. BLUE, F. HOCKER, A. ENGLERT, *Connected by the Sea*. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology, Oxford, 2006, pp. 99-104.

MAARLEVELD, Thijs: “Double Dutch Solutions in Flush-Planked Shipbuilding: Continuity and Adaptations at the Start of Modern History”, in: C. WESTERDAHL, *Crossroads of Ancient Shipbuilding*, Oxford, 1994, pp. 153-163.

MARTIN, Colin, PARKER, Geoffrey: *The Spanish Armada*, London, 1988.

MCGRAIL, Seán: *Boats of the World*, Oxford, 2001.

MCGRAIL, Seán: “To Clench or to Rivet: That is the Question”, in: *The International Journal for Nautical Archaeology*, n° 33.1, 2004, pp. 149-153.

MCGRAIL, Seán: “The Transition from Shell to Skeleton in the Mediterranean and in North-West European Waters”, in: *The International Journal for Nautical Archaeology*, n° 42.1, 2013, pp. 188-189.

MÖLLER-WIERING, Susan: “Squares and Stripes: Remarks about Textiles Archaeology and Sails”, in: C. BELTRAME, *Boats, Ships and Shipyards*. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Oxford, 2003, pp. 310-313.

MOORE, Charles D.: “Reassembly of a Sixteenth-Century Basque Chalupa”, in: *Material History Review / Revue d'histoire de la culture matérielle*, n° 48, 1998, pp. 38-44.

MORGAN, David, MORGAN, Robin, TOTH, James: “Variation and Selection. The Evolutionary Analogy and the Convergence of Cognitive and Behavioral Psychology”, in: *The Behavior Analyst*, n° 15, 1992, pp. 129-138.

MOTT, Lawrence: “A Three-masted Ship Depiction from 1409”, in: *The International Journal of Nautical Archaeology*, n° 23.1, 1994, pp. 39-40.

NANCE, Morton: “A sixteenth-century sea-monster”, in: *The Mariner's Mirror*, n° 2.4, 1912, pp. 97-104.

NANCE, Morton: “The Ship of the Renaissance”, in: *The Mariner's Mirror*, n° 41.3, 1955, pp. 180-192, 261-295.

NAYLING, Nigel, JONES, Toby: “The Newport Medieval Ship, Wales, United Kingdom”, in: *The International Journal of Nautical Archaeology* 43.2, 2014, pp. 239-278.

- NAYLING, Nigel, SUSPERREGI, Josué: "Iberian Dendrochronology and the Newport Medieval Ship", in: *The International Journal of Nautical Archaeology* 43.2, 2014, pp. 279-291.
- NICKEL, Hans-Jochen: „Was macht ein Schiff zur Kogge?“, in: *Das Logbuch*, n° 35.2, 1999, pp. 72-76.
- OLECHNOWITZ, Karl-Friedrich: *Der Schiffbau der hansischen Spätzeit*, Weimar, 1960.
- ORTEGA VILLOSLADA, Antonio: *Las relaciones marítimo-comerciales entre el Mediterráneo y el Atlántico. El papel de Mallorca en el comercio entre Oriente y Occidente Siglos XIV y XV, en VIII Congreso de la Sociedad Española de Historia Económica*, Santiago de Compostela, 2005.
- ORTEGA VILLOSLADA, Antonio: "La coca en el intercambio mercante Atlántico-Mediterráneo", in: *Anuario de Estudios Medievales*, n° 38.1, 2008, pp. 429-444.
- PAULSEN, Reinhardt: "Die Koggendiskussion in der Forschung", in: *Hansische Geschichtsblätter*, n° 128, 2010, pp. 19-112.
- PERTZ, Georg Heinrich: "Annales Colonienses maximi", in: *Scriptores (in Folio) 17: Annales aevi Suevici*, Hanover, 1861, pp. 723-847.
- PROBST, Niels: "The Introduction of Flush-Planked Skin in Northern Europe – and the Elsinore Wreck", in: C. WESTERDAHL, *Crossroads of Ancient Shipbuilding*, Oxford, 1994, pp. 143-152.
- PRYOR, John: "The naval architecture of crusader transport ships: a reconstruction of some archetypes for round-hulled sailing ships", in: *The Mariner's Mirror*, n° 70.2-4, 1988, pp. 171-219, 275-292, 363-386.
- PRYOR, John: "The Crusade of Emperor Frederick II, 1220-29: The Implications of the Maritime Evidence", in: *The American Neptune*, n° 52.2, 1992, pp. 113-132.
- PRYOR, John: "The Mediterranean Round Ship", in: R. GARDINER, R.W. UNGER, *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*, London, 1994, pp. 59-76.
- RAURICH, Xim, PUJOL, Marcel, MARTÍN, Albert, JOVER, Anna, IZQUIERDO, Pere, GARRIDO, Ernesto: *Les Sorres X. Un vaixell medieval al Canal Olímpic de Rem, Castelldefels, Baix Llobregat*, Barcelona, 1992.
- RIETH, Eric: "La méthode moderne de conception des carènes du "whole moulding": une mémoire des chantiers navals méditerranées du Moyan Age", in: H. NOWACKI, M. VALLERIANI, *Shipbuilding Practise and Ship Design Methods from the Renaissance to the 18th Century*, Berlin, 2003, pp. 17-32.
- RIETH, Eric: "L'épave d'Urbietta (Gernika): une embarcation à clin du milieu du XVe siècle. Étude préliminaire", in: *Itsas Memoria. Revista de Estudios Marítimos del País Vasco*, n° 5, Donostia-San Sebastián, 2006, pp. 603-616.
- RÖHRICHT, Reinhold: *Quinti belli sacri scriptores minores sumptibus Societatis illustrandis Orientis latini monumentis*, Geneva, 1879.
- ROSE, Susan: "Henry V's Grace Dieu and Mutiny at Sea: Some new evidence", in: *The Mariner's Mirror*, n° 63.1, 1977, pp. 3-6.
- ROSE, Susan: *The Navy of the Lancastrian Kings*, London, 1982.
- ROSE, Susan: "Islam Versus Christendom: The Naval Dimension, 1000-1600", in: *The Journal of Military History*, n° 63.3, 1999, pp. 561-578.
- ROSE, Susan: "Bayonne and the King's Ships", in: *The Mariner's Mirror*, n° 86.2, 2000, pp. 140-147.
- RUDDOCK, Alwyn: "Alien Hosting in Southampton in the Fifteenth Century", in: *The Economic History Review*, n° 16.1, 1946, pp. 30-37.
- RUNYAN, Timothy: "The cog as warship", in: R. GARDINER, R.W. UNGER, *Cogs, Caravels and Galleons. The Sailing Ship 1000-1650*, London, 1994, pp. 47-58.
- SALISBURY, W.: "The Woolwich Ship", in: *The Mariner's Mirror*, n° 47.2, 1961, pp. 81-90.
- SANTAMARIA-ARANDEZ, Alvaro: "La reconquista de las vias marítimas", in: *Anuario de Estudios Medievales*, n° 10, 1980, pp. 41-133.
- SARNOWSKY, Jürgen: *Der Deutsche Orden*, Munich, 2007.
- SLEESWYK, A. W.: "The Engraver Willem A. Cruce and the Development of the Chain-Wale", in: *The Mariner's Mirror*, n° 76.4, 1990, pp. 345-361.
- SOBERÓN RODRÍGUEZ, Mikel: "El port baixmedieval de la ciutat de Barcelona: una visió des de l'arqueologia. L'Escullera de 1477 i la troballa d'un vaixell tinglat", in: *Quarhis*, n° 6, 2010, pp. 134-163.
- SOBERÓN RODRÍGUEZ, Mikel, PUJOL, Marcel, LLERGO, Yolanda, RIERA, Santiago, JULIÁ, Ramon, DOMÍNGUEZ, Marta: "El Barceloneta I. Una embarcación medieval a tingladillo en Barcelona", in: *Itsas Memoria. Revista de Estudios Marítimos del País Vasco*, n° 7, Donostia-San Sebastián, 2012, pp. 411-422.

- STEFFY, Richard: *Wooden Ship Building and the Interpretation of Shipwrecks*, London, 1994.
- STEUSLOFF, Wolfgang: “Das Ebersdorfer Koggenmodell von 1400”, *Deutsches Schiffahrtsarchiv*, n° 6, 1983, pp. 189-207.
- TINNISWOOD, J. T.: “English galleys, 1272-1377”, *The Mariner's Mirror*, n° 35.4, 1949, pp. 276-315.
- UNGER, Richard: “The Northern Crusaders: the logistics of English and other Northern Crusader fleets”, in: J.H. PRYOR, *Logistics of Warfare in the Age of the Crusades*, Aldershot / Burlington, 2006, pp. 251-274.
- VELA I AULESA, Carles: “Naves y marinos vascos en Barcelona a partir de los registros de cosas vedades (1438-1449)”, in: *Itsas Memoria. Revista de Estudios Marítimos del País Vasco*, n° 3, 2000, pp. 629-648.
- VERMEERSCH, Jeroen, HANECA, Kristof: “Construction Features of Doel 1, a 14<sup>th</sup>-Century Cog found in Flanders”, in: *The International Journal for Nautical Archaeology*, n° 44.1, 2015, 111-131.
- VILLADS JENSEN, Kurt: “Bigger and Better. Arms Race and Change in War Technology in the Baltic in the Early Thirteenth Century”, in: M. TAMM, L. KALJUNDI, C.S. JENSEN, *Crusading and Chronicle Writing on the Medieval Baltic Frontier: A Companion to the Chronicle of Henry of Livonia*, Farnham / Burlington, 2011, pp. 245-264.
- VOGEL, Walter: *Geschichte der deutschen Seefahrt*, n° I, Berlin, 1915.
- VON DER ROPP, Goswin: *Hansereceise von 1431-1476*, Leipzig, 1890.
- WAITZ, Georg: “Chronica regia Coloniensis cum continuationibus in monasterio S. Pantaleonis scriptis aliisque Coloniensis monumentis partim ex monumentis Germaniae historicis recusa”, *Monumenta Germaniae Historica. Scriptores rerum Germanicarum*, n° 18, Hanover, 1880.
- WARNER, George: *The libelle of Englyshe polycye: a poem on the use of sea-power 1436*, Oxford, 1926.
- WEBER, Henry William: *Metrical Romances of the Thirteenth, Fourteenth, and Fifteenth Centuries: Published from Ancient Manuscripts*, Edinburgh, 1810.
- WESKI, Timm: “The IJsselmeer type: some thoughts on Hanseatic cogs”, in: *The International Journal for Nautical Archaeology*, n° 28.4, 1999, pp. 360-379.
- WESKI, Timm: “Anmerkungen zur spätmittelalterlichen Schifffahrt auf Nord- und Ostsee”, in: K. ELMSHÄUSER, *Häfen Schiffe Wasserwege – Zur Schifffahrt des Mittelalters*. Schriften des Deutschen Schifffahrtsmuseums, n° 58, 2002, pp. 143-159.
- WINTER, Heinrich: *Das Hanseschiff im ausgehenden 15. Jahrhundert*, Bielefeld, 1978.
- ZWICK, Daniel: “Conceptual Evolution in Ancient Shipbuilding: An Attempt to Reinvigorate a Shunned Theoretical Framework”, in: J. ADAMS, J. RÖNNBY, *Interpreting Shipwrecks: Maritime Archaeology Approaches*. Southampton Monographs in Archaeology - New Series, n° 4, Southampton, 2014, pp. 46-71.
- ZWICK, Daniel: “A 15<sup>th</sup>-century shipwreck with Scandinavian features from Bremen —The ‘Beluga Ship’ in the context of late medieval clinker constructions and timber trade in northern Europe”, in: M. GARDINER, N. MEHLER, *German Trade in the North Atlantic, 1400-1700: Interdisciplinary Perspectives*. Northern World Series, Leiden, forthcoming.