DEVELOPMENTS IN HARBOUR CONSTRUCTION, INFRASTRUCTURE AND TOPOGRAPHY ON THE EVE OF THE EARLY MODERN AGE IN THE BALTIC (1450-1600)

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Abstract

Ships are no Flying Dutchmen! They need a harbour. Therefore, the development of ship construction is pretty much connected with that of harbour construction, and beyond this, they influence the topography and infrastructure of a harbour. The transition between the Medieval period and the Early Modern Age is a period of great change in the development of larger ships, even in the Baltic. Furthermore, the internationalisation of Baltic trade took place. In Medieval times, ship construction followed conditions in the harbours. In the Early Modern Age, it was the other way round. Now, harbour construction, topography and infrastructure follow the development of ship construction. The paper focuses on the deep impact that larger multi-mast sailing ships had on the development of Baltic harbours.

Key words: harbour construction, moles, topography, seaways, navigation, digging, harbour cranes.

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Introduction

The great German novelist Stefan Zweig considered the Early Modern Age to be a time of great change, and a major revolution in human existence. He compared the transition process from the Medieval Period to the Early Modern Age to the discovery of fire and industrialisation in the 19th century (Zweig 1995, 24-29). This 'revolution' was mainly in the maritime realm. A new image of the world became apparent on the decks of multi-mast celestially navigated ships made with new construction techniques. What happened in the Baltic in those times, when the Hanseatic League gradually lost its power, is not very well researched. How was the Baltic influenced by this revolution? Should we also call it a 'Baltic revolution', or was it an evolutionary process that followed the great economic success of the German Hansa? When speaking about ships and the maritime factor in these big changes, we should bear in mind that a ship was not the Flying Dutchman! Ships needed harbours for maintenance and supplies. Even the new kind of multi-mast ships, which formed a micro-cosmos of their own, needed warehouses, whether they were unloaded in the harbour or not. As well as dealing with towns in the hinterland, the Hansa network needed port towns, the greatest of them on the Baltic (Holbach 2014, 71-81). New items that were available in the Western world entered the Baltic mostly through port towns. Even the ships themselves, as symbols of a new technique, technology and evidence of the change from an empirical to a more conceptual attitude in shipbuilding, influenced the shipbuilding process and woodworking techniques, through their maintenance in the harbours, and therefore also in the regions. If we want to find out what role these port towns played in the transition process, we should first determine when those changes began, and find out if there were distinct differences between the Baltic, and Western and Central Europe.

Historians always try to connect the beginning of a revolutionary process, in other words the beginning of a new epoch, to a special date. Even in Europe, the Medieval period ended and the Early Modern Age started with a maritime event, the rediscovery of the 'New World' by Christopher Columbus in 1492. We learned at school that the Baltic stood outside this tremendous development. But that is not true. Beside the fact that even Columbus' discovery did not come from nowhere, maritime activity in the Baltic in the 15th century was already closely connected with that in the Western world, especially with the Iberian Atlantic cultural connection.[1] This interweaving not only deeply influenced maritime commerce, and through that political and socio-cultural aspects of the Baltic region, but also the infrastructure and topography of port towns. With my contribution, I want to give some examples of ways in which those changes were visible, and how they were induced.

From my point of view, this interweaving and influence are verifiable much earlier than the discoveries by Co-

[1] Some expeditions were financed by German merchants who were deeply involved in the maritime trade in the Baltic, like the Fuggers and their involvement in the Hungarian copper trade via Danzig (for this see: Hümmerich 1922; Kellenbenz 1979, 58ff.).

Fig. 1. Line shipping with grain from Prussia to West European entrepots; and vice versa, the transport of salt and spices from Portugal and France.

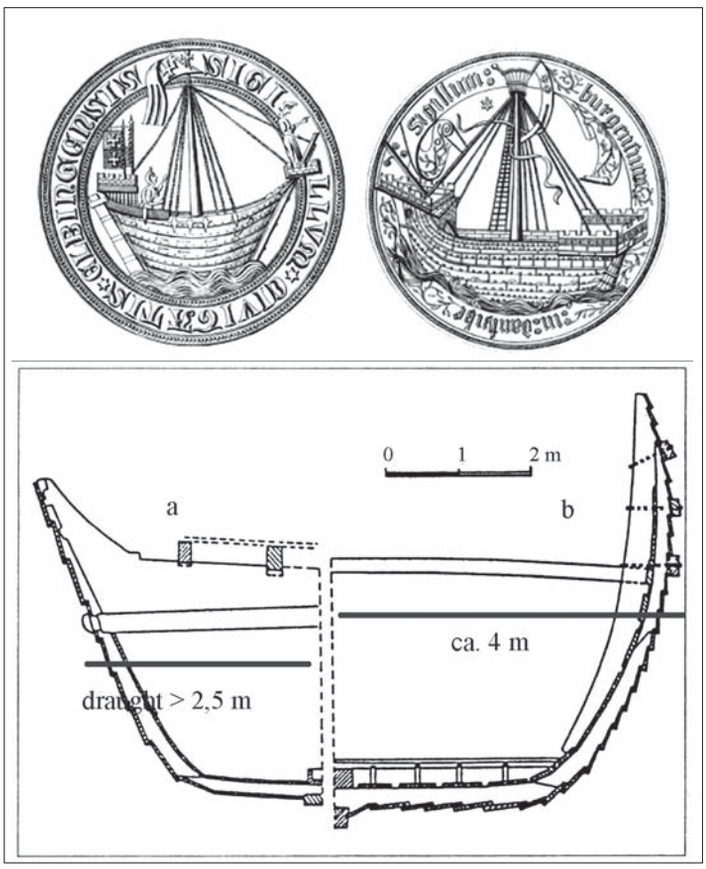

Fig. 2. The 15th century is characterised by the transition process from V-shaped 'cog' forms, with straight hulls, symbolised by the seal of Elblag from 1350 and the Bremer find, dated 1380 (left), to rounded U-shaped 'hulks', verifiable in the seal of Danzig from 1400, and the remains of the U 34 wreck from the Netherlands (Ijsselmeer). As a result of this transition, the size and the draught of the ships increased (after Litwin 1985).

lumbus. These changes and acculturations are connected with the *Baientransportsystem* in the early 15th century. This transport system was developed as a reaction to the increase in grain shipments from Poland and Prussia due to overproduction. Large fleets transported rye from Prussian castles to Western entrepots on the Dutch coast. The ships took *marais salant*, sea salt from France, back to Danzig (Agat 1904; Jenks 1996, 257-285) (Fig. 1).

This commerce was not organised in the traditional Hanseatic way of shipping, with the 'uniform' cog shape, in which Hanseatic traders would carry distributed goods. The *Baientransportsystem* offered something new, because it was determined mostly through line shipping with bulk goods as mono-merchandise (Springmann 2011, 34-94; 2014, 87-99). Also, the shape of the ships changed, from a more V-shaped to a more U-shaped hull. The size grew, and so the capacity increased from around 40 Last to around 100 Last. Thomas Wolf called the new ships 'Giants of the Ocean' (Wolf 1985, 490ff.) (Fig. 2).

Considering this fact, we should not be surprised that people in those times found another word for these ships. The term 'hulk' displaced the term 'cog' in written sources from the beginning of the 15th century (Weski 2002, 143-159). Along with *Baientransport*, the organisation of shipping was changed. For safety reasons, as a precaution against piracy, Hanseatic sailors always tried to sail in fleets. But now the quantity also determined a new quality of organisation of shipping. In former times, fleets were no bigger than four or five ships. Now *Baienfleets* were sometimes stronger than 50 ships.[2] The growing size and capacity also involved a doubling of the draught. This influenced deeply not only the navigation system. Land-oriented systems, especially those of the port towns, became rather complex as well. Therefore, I would like to concentrate more on the development of harbour topography and

[2] *Anno 1473: Item Montag noch pasca segelte ein schone flat schiffe von dantzke wol gemant in flandern, holandt, seheland zu vil neuer schiff und war vil preusch bier mitte geschifft, wol 50 schiffe in alles. Caspar Weinreich's Danziger Chronik*, Hirsch, Vossberg (eds.), 1885, § XVII.

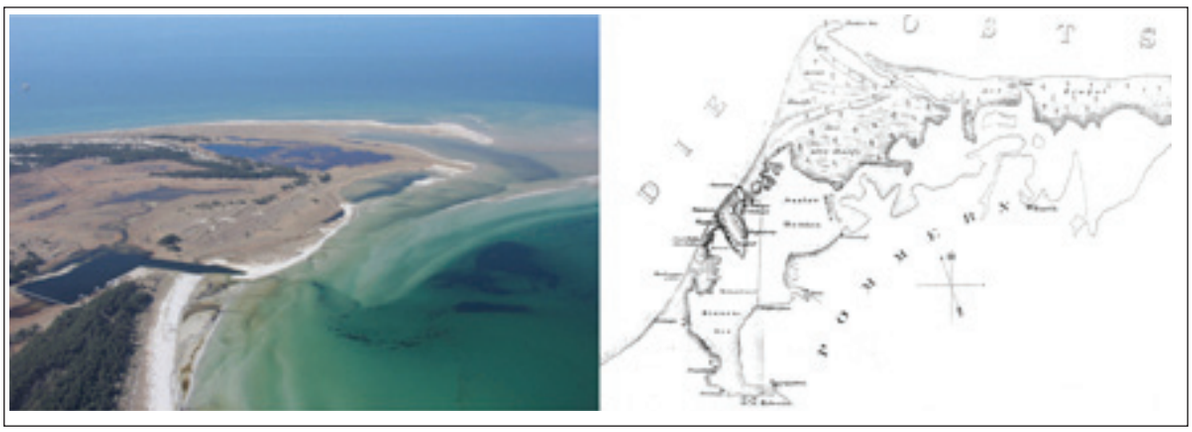

Fig. 3. In comparison with the stony coasts of the Scandinavian and Estonian archipelagos, the sandy beaches of the southern Baltic were much shallower. This coastline is characterised by moving sandbanks, as the changes in the Darß Peninsula over the centuries makes it evident.

Fig. 4. Fire beacons and sound beacons were set up on hills, as the large number of such navigation marks on the island of Poel in front of the harbour of Wismar demonstrates (Wismar Archive).

organisation, which have not yet been the focus of scientific research.

With an approximate draught of four metres or more, the sailors of the hulks had to be informed much earlier where exactly they were, especially if they came closer to the flat southern sandy coast, with its meandering banks, the 'Platen', which were situated in front of harbour entrances near river outfalls (Fig. 3).

To make such harbours more attractive to Western shipping associations, the new Scandinavian states spent a lot of money installing navigation marks, like beacons and small lighthouses (Barfod 1995, 156-157). The nighttime beacons cost a lot in manpower and fuel, and therefore money. The old Hanseatic port towns on the southern shores tried to follow this development, as we can see in our example of Wismar, where fire beacons and horns and bells to make a noise during fog were established (evidently since 1542) (Fig. 4). A construction manual for the important beacon of Skagen from 1560 gives us a better imagination of reconstructions in those times (Fig. 5).[3]

The erection of *Winkbaaken* or *Kapen*, sort of moveable beacons like that established at Pillau in 1497, is also documented (Schiller, Lübben 1875, 143; Forstreuter 1940, 58-123). Coastal beacons were built on

[3] '*Den skal være jern, 1,5 alen dyb og så vid sam en tønde. Tømmerværket, som lampen skal hænge i, skal være af egetømmer og bygget som en papegoje, så lampen kann nedlades og tænden og igen opsættes, saledes som dyndige viderer dan vis ham. Den skal hange 20 alen hojt, sa søfolkene kann se den langt ude is søen, og den skal sættes alleryderst på strandbakken, lige hvor revet skyder'.* Kanc. Brevboger vom 16/12/1560, cited after Barfod 1995, 155.

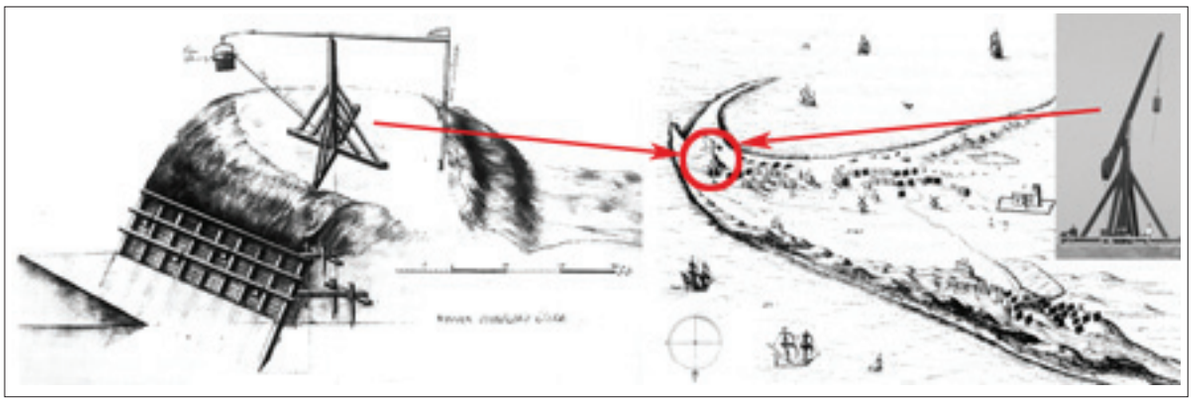

Fig. 5. Mobile and immobile beacons like those at Skagen (right, reconstructed) in line navigation with the high towers of churches guided ships to safe anchorage and to waterways marked as the entrances to harbours (after Benedicht 1573; photograph by Springmann).

the tops of hills, and needed trained staff with a basic knowledge of navigation, so that they would be able to communicate with the ship's steersman and show the way into the entrance of the port. Employing such staff meant additional costs. Living near the coast was always hard. The soil was not at all fertile. Plunder from wrecks was a welcome contribution towards the cost of living. It is no surprise that misguidance is quite often recorded.[4] In rough seas, where pilots could not be taken on board, these moveable beacons were often the only way to lead a ship in the direction of the harbour.

The new process also meant changing the infrastructure and the topography of the buildings of port towns already from the 15th century. As small Romanesque churches turned into high Gothic cathedrals, extra-large towers were erected to be used as landmarks. From 1549, the tower of St Marien in Stralsund rose 151 metres, and until its destruction in 1647, the church was the highest building in Europe (Clasen 1947). St Petri in Rostock, with a height of at least 126 metres, was also one of the highest stair-less towers in Europe, along with the 122-metre tower of Notre Dame. Rostock's St Petri is a good example of the practice, as it is clearly stated in the church's chronicles that the tower had a mainly navigational purpose.[5] Like other large buildings, or other churches with high towers, they offered the chance of line navigation, as Medieval illustrations show (Fig. 6).

Beside this varied use of churches, special coastal towers were built, some of them very strong, which were also used as defensive structures, like those at the entrance of Rostock harbour in Warnemünde, mentioned in a source from 1487 (Draggendorff 1902, 71), and also shown in the well-known Vicke-Schorler-Rolle, produced between 1578 and 1586 (Witt 1989). The largest ones were erected at the mouth of the Wisla, directing the way to Danzig. Some of them were lit with *teertunnen* (Schiller, Lübben 1875, 143), as is evident in *Cosmographia Universalis* by Sebastian Münster from 1554. Some were lit by candles, as is evident in the illustration (Springmann 2014, 855) (Fig. 7). Less prosperous towns like Memel used fire pots hanging from simple wooden constructions, as is illustrated by Hartknoch in 1684. His illustration shows that this simple construction survived until the 17th century. A friend and colleague of mine, the Lithuanian ship historian and shipbuilder Simas Knapkis, has made a reconstruction of Hartknoch's fire pot, and tested it on the seashore near the little village of Vinda (formerly Windenburg). The fire was even seen from Pervalken, more than ten kilometres away. On a stormy night, the 0.5-cubic-metre pot would take up to five cubic metres of oak logs (Springmann 2014, 852).

In stormy weather, and during rain, lighting such fire pots was problematic, as is mentioned in old sources.[6] This navigational system, with characteristic buildings and special high structures, was recorded in the *Vertonungen*. Two-dimensional drawings depicting the port town from the sea at a certain distance. Besides the 'sea books' and the first sea charts, they became essential documents aboard those pan-European sea traders. Hanseatic ports were contiguous, and their characteristic skyline combined with sailing courses were sometimes the only means of avoiding confusion (Fig. 8).

If a ship came close to the aforementioned sandbanks, it was essential to mark the way with buoys. In the early days of seafaring, seafating were used simple wood-

[4] *'Niemand soll aus oder ein leuchten, mit einigen Schiffen, er sei dann Unser Mit=Bürger.'* From the Danziger Willkür of 1597.

[5] *'Er bauwinge einer Spitzen allhier in der Stadt Rostock so dem gemeinen sehefahren Manne eine besondere Kunde und Nachrichten zur Sehefahrt geben wirt'.* (Springmann 1995, 84).

[6] *'... baaken und teertunnen de men im valle der nodt ansticken konde…starke wacht holden moten.'* Often the storms were too heavy to light these signals: *'... also dat de baken edder teertunnen hen unde wedder angesteken worden, ock de klocken allenthalven tho storme geschlagen'* (Schiller, Lübben 1875, 143).

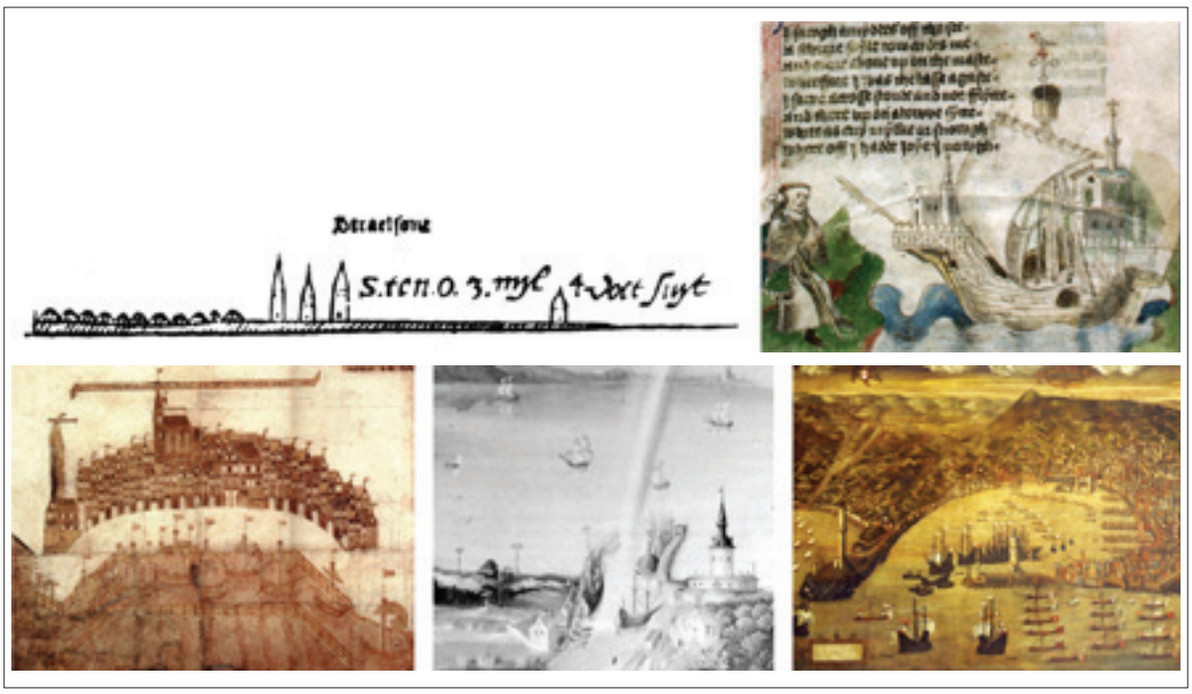

Fig. 6-6a. Sketches of the coastline with harbour towns (left): *Vertonungen* with characteristic features, mainly high buildings, were used for line and cross navigation. Sometimes this *Vertonungen* received position marks, as the example from Stralsund shows. The illustration (right) from the record of a pilgrimage (1439–1450) could demonstrate the importance of churches for line navigation as well (Stralsund Archive).

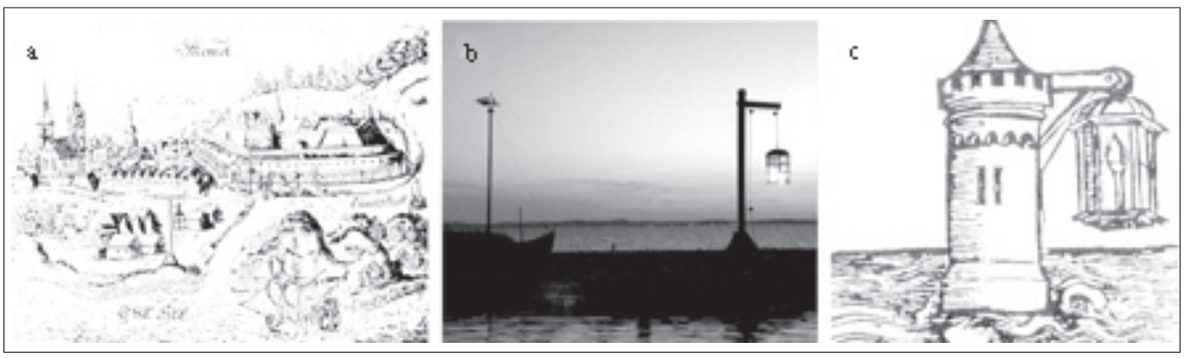

Fig 7.a-c. Even in 1684, a barrel of tar was hung on a simple wooden construction, as is evident in Memel from Hartknoch's townscape; b a reconstruction of it by Simas Knapkis, Rusnė; c wealthier port towns built a tower and used a flame to show ships the right direction.

en barrels. They were not green and red, but black and white, as can be seen in Figure 9, marking the seaway to the Vistula Lagoon in the 16th century. On some of them, a bell was attached.[7] In winter, they were taken to the town, otherwise the ice would destroy them. Special buoy tenders were used, paid for from the city's treasury (Deggim 2000, 65ff.). At Hamburg, buoys are mentioned as early as 1461. It took six weeks to install them all along the waterway.

In the Baltic, the systematisation of these navigational marks went together with the restructuring of the Scandinavian kingdoms in the 16th century. To make international shipping safe, in 1560 the shoals of Trindelen and Falsterbo, the reef at Anholt, and the stream at Dragør, were marked with buoys by order of King Frederik II of Denmark and Norway. Most of the funding for this came from the *sundtoll*; in addition Frederik ordered the towns to mark their own harbour entrances.[8] It was the Hanseatic tradition to ask for *tunnengeld*, which incoming ships had to finance in order to pay for the port town's navigation services, although the Scandinavian kingdoms still tried to circumvent these payments in the 16th century.[9] The laws

[7] *'... stor tønde med en klokke.'* Kanc. Brevboger vom 8/6/1560 (after Barfod 1995, 155).

[8] *,... to stærke og velbeslåede tønder og lade dem udlægge på de nævnte steder.'* Kanc. Brevboger vom 22/4/1560 (after Barfod 1995, 155).

[9] *'Zu der Wismar, den witten, von der tonnen neu ufgesetzet, seindt die Denischen zu geben nicht schuldig'* (1552). Traktat of 25 July 1560, mellem Kong Frederik II af Danmark-Norge og Hasestæderne angaaende Stædernes Handel i Danmakr og Norge og de Danskes og Norskes Handel i Hansestæderne, med Biakt og Tillæg (Laursen 1907, 640).

Fig. 8. Olaus Magnus' *Carta Marina* from 1539 shows that more or less every port town kept such lighted sea towers.

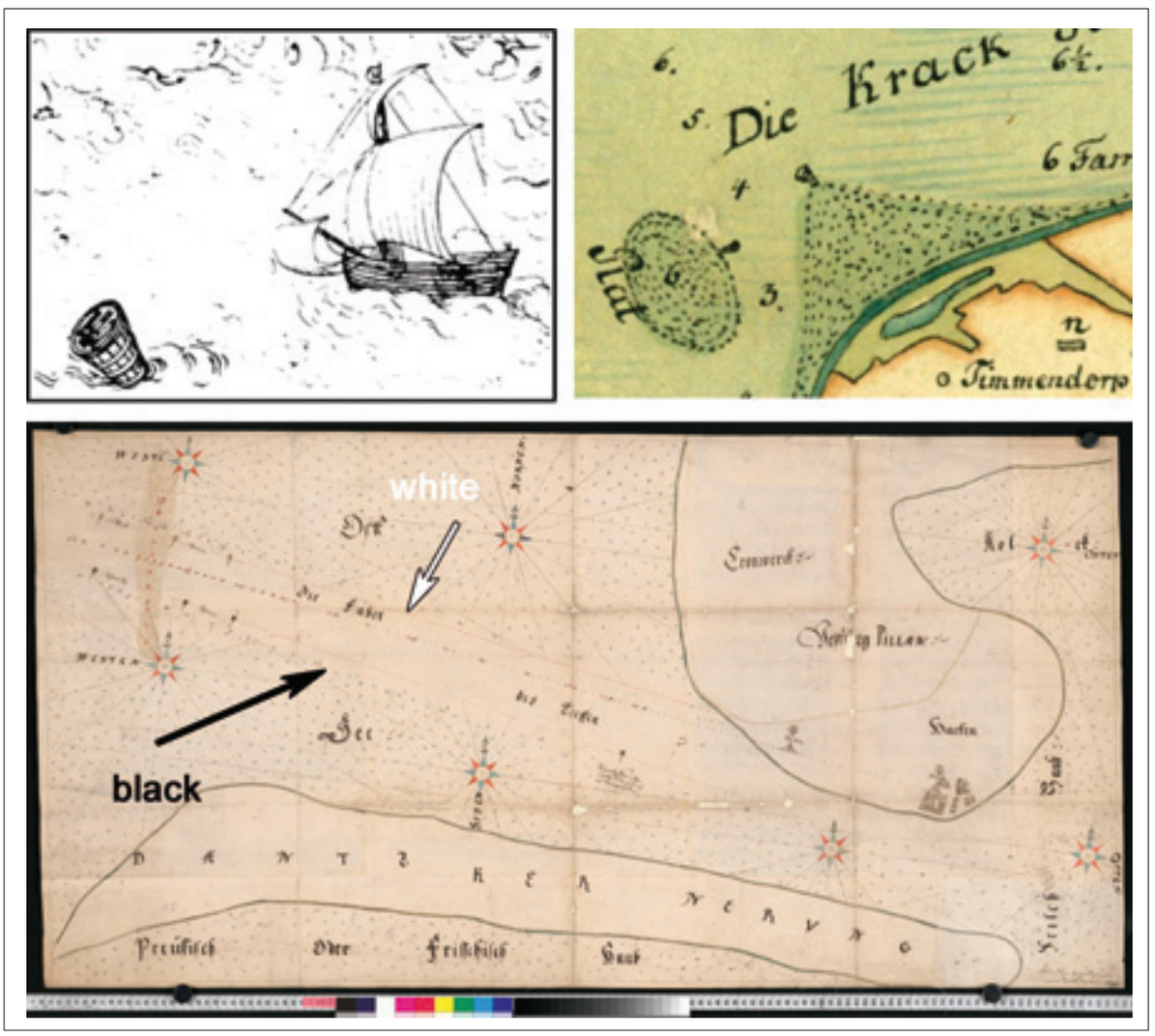

Fig. 9. Buoys in those times were simple wooden barrels, made waterproof with tar (detail from a chart of the River Elbe by Melchior Lorichs, dated 1568, left). They were black and white, and not red and green, as the sea chart by Lucas Schwartz (1650) marking the Pillau depths shows (middle). Buoys were also used to mark sandbanks (detail from a sea chart from the 17th century showing the entrance to Wismar harbour, right).

Fig. 10. It was generally forbidden to unfurl sails inside the inner harbour. Often big ships used tenders, or *Espinge*, to tow ships, as is evident in a picture from the 16th century showing the mouth of the River Weichsel, left. This tradition was even used until the end of sailing, as is seen in a picture from Wismar from the beginning of the 19th century.

of those times also reflected the nuisance of mooring ships at the buoys.[10] Where the water was very shallow, simple wooden piles were rammed into the sea bed, as we know from at Wismar (Techen 1929, 267-283). Some of these piles contained information about the usual depth of the seaways (Hagen 1881, 418). Despite the implementation of a system of navigation marks, it was still a challenge to reach the mouth of the harbour safely. Therefore, *Espinge*, large tenders which were tied to the front of larger ships, were used to tow sailing ships inside the harbours (Fig. 10). They were also used to bring out anchors.

They were strongly manned, not only to tug but also to reduce the speed, because sailing ships obviously have no brakes. To unfurl sails in the inner harbour was usually forbidden by harbour rules at the time (Springmann 2016, forthcoming). Written sources concerning the well-known ship *Peter von Danzig*, the former *Pierre de la Rochelle*, which entered the service of Danzig in 1470, show that the *Espinge* of the ship had 36 sweeps.[11] But this alone did not help. Often the sailors would use wooden sticks to measure the water's depth, and push the ship in the right direction.[12]

Reaching the inner harbour

On the southern shore, the main problem in reaching the entrance safely was the frequently changing situation at the harbour entrance, especially at river outfalls. This was caused by three main factors:

1. The movement of sand by the river from inland to the mouth, and its displacement there through the current in front of the harbour entrance.
2. The isostatic levelling of most of the coast along the southern sandy shore of the Baltic.
3. The rotation of the earth, which changed the location of the river's mouth from time to time from east to west.

Of course, this knowledge is the result of modern natural science. In the 15th and 16th centuries, people were only able to deal with the consequences of these developments by empirical investigations. Town councils fought for the stabilisation of shallow entrances and waterways to the harbour in two ways. One was restrictive, the other more active.

A restrictive law tried to stop people throwing their waste into the waters of the harbour. Pilots were punished with death if they wrecked a ship on purpose: they were hanged near the place where they wrecked the ship.[13] Generally, it was forbidden to block waterways with any kind of vessel, as the waterways were the veins of any seafaring town. In the town law of Wismar, the *Bursprake*, inhabitants were obliged to assist the dredging of the inner harbour (Techen 1929, 373). In some towns, the digging was done by special mud prams, as is illustrated in Figure 11.

But despite of all these efforts, harbours gradually became shallower, and the draught of vessels went the opposite way. Towns were forced to react. In some

[10] *'Niemand soll Schiff oder Bording an Tonnen, ausserhalb den Bollwercken, auf die rechte Tiefe weisende, bevestigen oder anbinden, bei Verlust des Schiffes oder Bordings; damit die gemelten Tonnen, zum Schaden des gemeinen Seefahrenden Mannes nicht verschickt noch verrückt werden mögen'* (Pardessus 1831, 476).

[11] Lienau (1943, 7).

[12] *'... stukket lange bjælker du på den side, at de ikke skulle komme ham for nær.'* Kanc. Brevboger, vom 8/9/1563 (after Barfod, 1995, 171).

[13] *'Daß der Cörper auf eine Mast oder Pfahl an den Ort, da die That verübet und das Schiff geblieben, gehängt werden soll'* (The *Hansisches Schipphrecht* following the Roles d'Oleron, § 25).

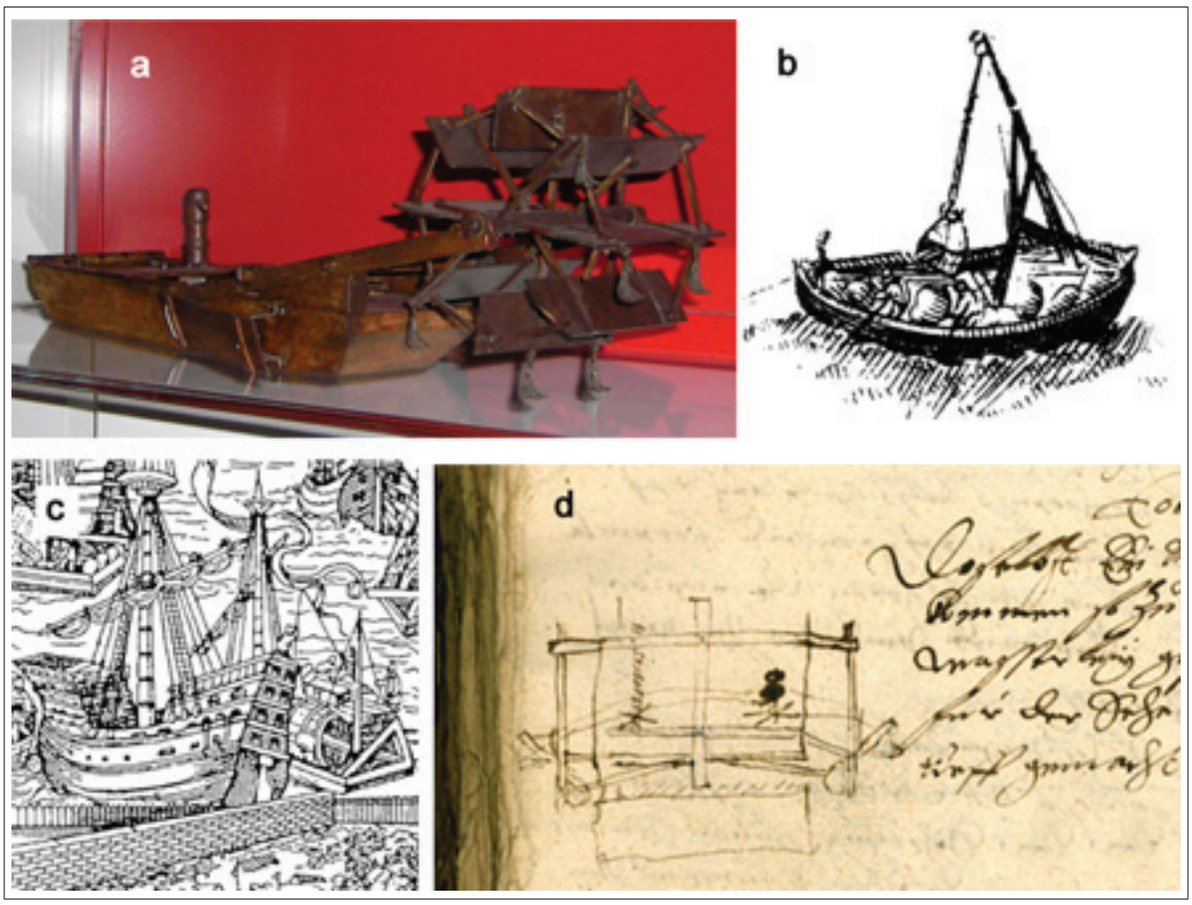

Fig. 11. A simple method to clean the entrance to a harbour was to plug the ground (a). Inside harbours, without current, mud prams were used to dig the ground of the inner harbour (b). The 16th century was a time of great innovation. Mud mills, as seen in a woodcut of Lübeck harbour by E. Diebel from 1552, were introduced in the Baltic (c). With these new techniques also came some curious developments, as a drawing in a Rostock protocol book from 25 August 1582 demonstrates (d).

ways, the extension of the system to lighten vessels before entering the harbour brought a relaxation, but this was dangerous, and not always the preferred solution, because:

1. the goods could get wet during unloading
2. the unloaders cost extra
3. good weather was essential
4. it was difficult to control the unloaders outside the harbour.

Most port towns were situated more than five miles inland. Therefore, town councils had to decide either to fight against the shallow harbour waters, or to pursue their maritime trade on a smaller scale. That would have meant a massive decrease in profits. International shipping needed deeper waterways, and most towns wanted to participate. So they spent money on deepening the entrances and for new ultrastructures of the harbours. Therefore, sea towns reacted in four different ways:

1. As an alternative to deepening the waterways, towns built harbours at the mouths of rivers.
2. They built water constructions to channel the river, and moles for ships inside harbours (Fig. 12).
3. They hired dredgers to dredge the waterways (Fig. 11.c-d).
4. They hired specialists, mostly from the Netherlands or from Italy.

Thanks to their shallow waters, Dutch engineers had a lot of experience in deepening waterways. The towns welcomed these engineers, and tried to bind them contractually. A lot of innovations reached the Baltic with them, so that we can mark the 16th century as a century of great water constructions (Fig. 11.c-d). Already in 1464, the town council of Lübeck was searching for two specialists to erect a water construction to protect the entrance to the harbour. In 1510, 11 ‘cog bridges’ were built in Danzig. According to Paner, this was motivated by the dispatch of ships of a new shape with deeper draught came to Danzig in those times, to replace the cog-shaped vessels (Paner 1999, 45-53). After the crevasse of the Curonian Spit in 1479, with the extension in 1510, the sea harbour of Königsberg in Pillau was erected (Forstreuter 1940, 113). In 1497, the Pillau depth was dug out. In 1520 and 1550, a wooden

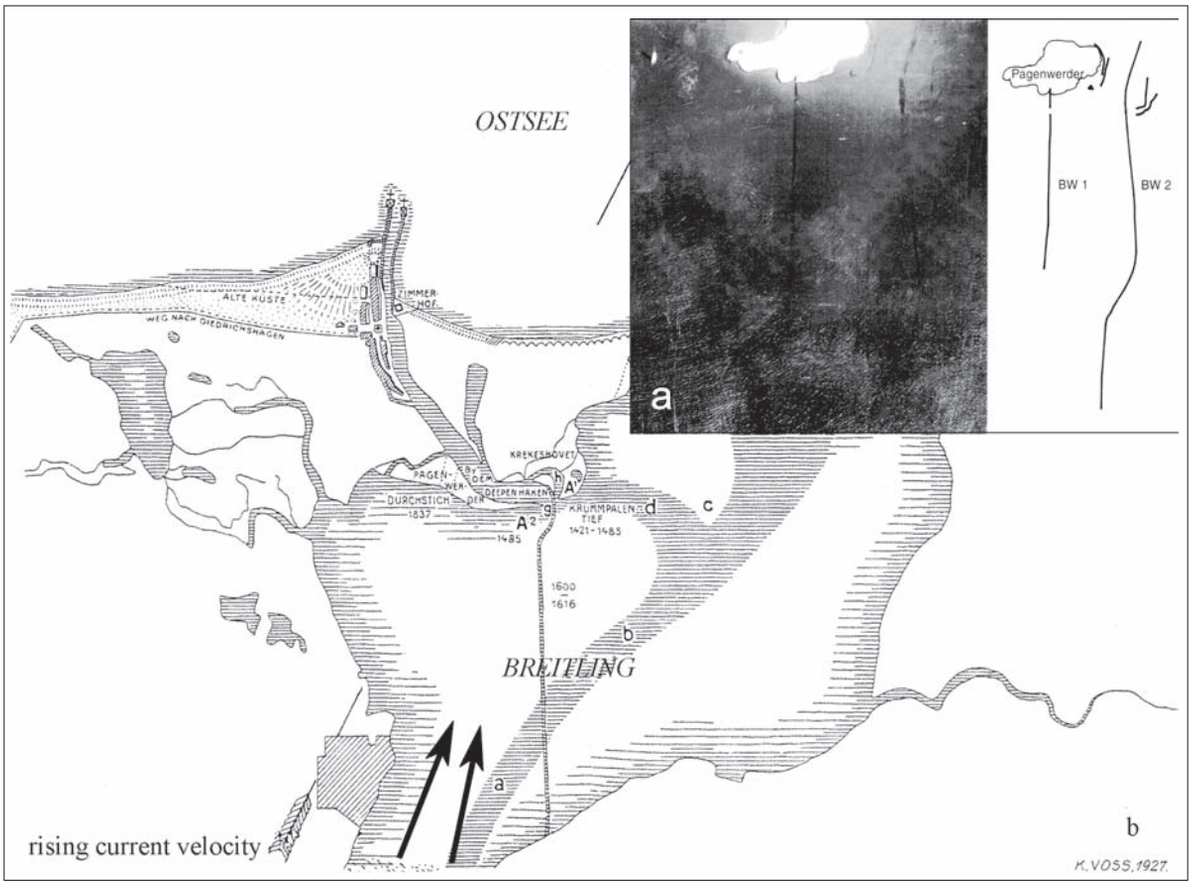

Fig. 12.a-b. Wooden moles were built to channel and speed up the current of the river, as is seen from archaeological investigations conducted by the author.

Fig. 13. Wooden constructions were also installed to protect the entrances to harbours, as is seen in an example from Pillau in the 16th century (chart collection of the GSTA Berlin No. 10.803).

construction consolidated the side of the waterway into Königsberg (Fig. 13) Special authorities looked after the ways to harbours. In most Hanseatic towns, they were called *Barsenmeister* (Deggim 2000, 67). From 1584 to 1588, a *Wandkiker* worked in the castle of Kronborg, to control the waterways (Deggim 2000, 114). In Danzig, a *Wasserbaliu* is mentioned in written sources (Hirsch, Vossberg 1858, 214). In Königsberg, they called him the *Karwansherr* (Meckelburg 1865, 9).

This stabilisation of the sides of a waterway was especially important at the entrances to the Curonian Lagoon and the Vistula Lagoon, where sand from moving sand dunes was brought by the wind and blown into the waterways (Fig. 13).

With respect to point three and four, the harbour constructions at the outfall of the River Warnow show how much effort and ideas water engineers applied at the end of the 15th and the beginning of the 16th century. Engineering science expertise from the Dutch led to the channelling of the river, and therefore the use of the natural strength of the river for ‘self-cleaning’, as Figure 12 demonstrates (Springmann 1995, 71-85).

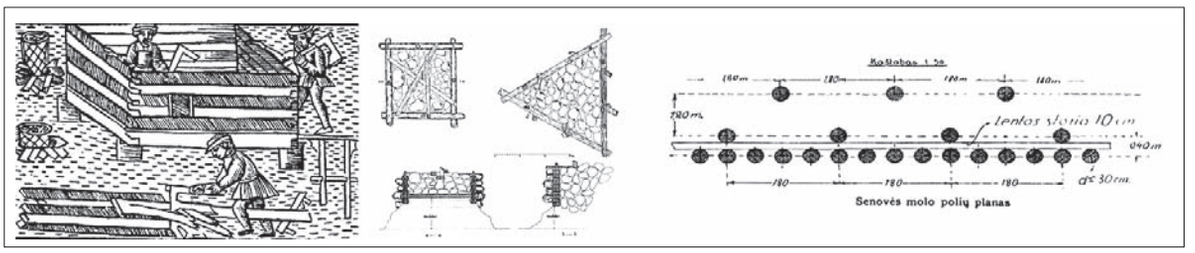

Fig. 14. Former moles were not rammed, as the extract from Olaus Magnus' *Carta Marina* from 1532 (left), and the archaeological investigations by Harald Åkerlund in 1951, demonstrate (middle). The archaeological investigations made by Vladas Žulkus in Sventoji/Heilgenau/Heligenaa make rammed piles inside mole constructions evident (right).

These constructions came with a general improvement in woodworking handicrafts in those times (Fig. 14). Even smaller harbours, like the one at Sventoji, which were used as an alternative to larger ones, needed such water constructions in order to offer their services (Žulkus, Springmann 2001, 167-181).

Although the channelling process brought some improvement to the situation, it was still necessary to move the beds of the waterways by plugging (Fig. 11.b). This moles used like a pipe, which caused an increase in the velocity of the current, and took the sand out of the mouth of the river. But this alone was not enough to deepen shallow waterways. The 16th century was also a century of great and spectacular developments in dredging machines, developed by so-called artist engineers. Venice and Geneva were melting pots for these inventions. Educated people with a technical background from Dutch and German regions went there, and were inspired by the developments. Not only the town councils of the Hanseatic towns, but also the dukes of northern regions were led to adapt the Italians' ideas. Money was collected to implement the developments. In the Rostock archive, I found a drawing of a dredger sold as a new idea for digging the sandbanks in front of Rostock harbour in 1582 (Fig. 11.d).

Topography and harbour management in the inner harbour

In the 15th century, territorial lords cared little about controlling the outfalls or the entrances to rivers. This included controlling the shipping activities of the Hanseatic League (Techen 1929, 270). In Medieval times, the lords were generally not very involved in maritime trade, and therefore they were not experienced in water construction and navigation services. From their point of view, it would only have cost money and people, and in the end would have led to rivalry with the strong Hanseatic towns. This attitude changed completely in the 16th century, when the lords gained and the Hanseatic League lost power. Gradually, the dukes became aware of the sea trade as the key to participating in the international developments of those 'revolutionary times'. They used two main methods to achieve a shift of power in their favour:

1. Fighting for control over river outfalls and entrances to harbours by legal and military means (Draggendorf 1917, 123ff.).
2. Extending the *Klipphäfen*, small beach harbours used only by the dukes (Koppmann 1885, 101-160).

Concerning the first, and the inner waterways in Medieval times, it was not always clear how far the influence of regional power reached. Hanseatic towns put a lot of effort into defining the inner harbour area, often with a wooden pier that also protected the town during military action. The gates into the inner part were constructed differently, as Figure 15 shows.

Apart from their interaction with the pilots, foreign seamen mostly came in touch with the bureaucracy of the port town for the first time at the tree house, which was situated directly by the gate (Fig. 15). This was the place of the *Bomherren* or *Brückenkieker*, also described as a *Baumschließer* (tree closer) (Fritze 1998, 109; Söderlund 1999, 505-511). They kept the register and worked together with the other authorities, namely the harbour clerk, who assessed and collected harbour dues (Deggim 2000, 114). After passing Helsingborg and the sound toll, ships and loading were controlled at the gates again. Only if the sea was rough could ships pass the tree house without inspection.[14] At the tree house, information was given to the captain where to moor the ship inside the harbour. In Danzig, one of the biggest Hanseatic ports, a *Pfahlknecht* was responsible for allocating the ships to special moorings, depending on their draught and their size (Hirsch, Vossberg 1858, 213). Therefore, vessels gradually fixed draught marks

[14] *'… konde averst dat Schip/Storms und Unwedders halven/ thom Tollen=Spicker nicht anleggen/so schall de Schipper den Tollner toropen/dat he jemand schicke/so de im Schip verhandene Guder unde Waren besichtige'* (Lüning 1710-1722, Vol. IV, 1033).

Fig. 15. The gates to the inner harbour were made of two simple constructions: a a simple wooden tree, as seen in this detail of a picture of Stockholm by Olaus Petri, 1535; b, c iron chains were also used, serviced by the 'tree closer' sitting in the tree house, as is visible in a detail from the Merians Wismar illustration from 1653, and the Koinhusens Rostock illustration from the 17th century (Wismar Archive).

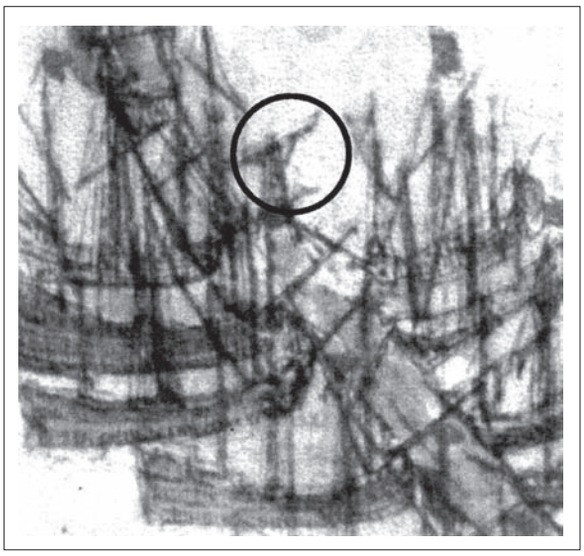

Fig. 16. Jetties at the end of the wooden piers in Stralsund (detail from *Stralsunder Staudeplan* from 1647).

on their hull.[15] Sometimes, ships with a high draught were moored at piers led from the quay to the middle of a river, as is visible in the illustration of Rostock and Stralsund. At the head of these constructions, jacks were attached to pull the ships along landing bridges (Fig. 16). The quays in these times did not change much in comparison with those from Medieval times, such as those in London.

At the tree house, it was also checked if ships needed cranes or simple jacks, which were situated along the quayside, as we can see in the illustrations of Stralsund and Bergen (Matheus 1988, 82-88; Ellmers 1996, 145-165; Springmann 2007, 154-162) (Fig.17). Sometimes, shipyards were used to unload the goods. Often the weighing stations were situated right beside the cranes, as is evident in Hamburg (Fig. 17 a). Sometimes they were far away, as in Rostock (Fig. 17b).

[15] *Unde islik schip schal ghetekent sind* (Witthöft 1978, 41-51).

The close vicinity of both were advantageous, as nobody could take away loads without paying taxes. Clerks at the cranes, the *Kranmeister*, and the weighing units, in Hanseatic towns called *Wrager* or *Wracker*, monitored the correct calculation of weights and the quality and quantity of the goods (Deggim 2000, 155) (Fig. 17a).[16] Sea trade suffered from the application of different taxes, the *Ungeld*.[17] In Medieval times, different units made the sea trade complex and problematic. In the 15th and 16th centuries, efforts were made to standardise and simplify weights and currencies, as we can see in the Rostocker Band, as a standardisation of containers, and written as a regular currency in the Baltic region (Held 1918, 127-167).

The harbour was an important place to ensure the efficient functioning of ships. On the *Bragebänke* ships were keeled over and could be caulked. This was rather simple on ships build in a carvel construction, which was the main technique of planking, compared to clinker-built ships like cogs. Shipbuilding sites were located near the *Bargebänke* oder *Brabank* (Pardessus 1833, 470). Due to the fact that this place was turning more and more into an area where ships were tarred with naked flames, the town council decided to relocate the *Bargebänke* outside the inner harbour, as happened in Copenhagen in 1547 (Fig. 18).[18] However, the streets were rebuilt to take the heavy weight of larger vehicles. New streets would lead directly from the harbour to the city centre. This meant a tremendous change in the infrastructure of many Baltic port towns, but not of all. Illustration shows that the infrastructure

[16] Sometimes special clerks were submitted for special goods. They were called *Korn-, Hopfen-* or *Salzmesse*r (see Techen 1906a, 202).

[17] *Pfahl-, Prim-, Prahmmoney* but also *Buoymoney* and *Werk-* and *Pfundzoll* are mentioned in written sources (Wolf 1991, 46ff.).

[18] *Niemand soll sein Schiff bragen oder stürzen anderswo*, Danziger law from 1597 (Deggim 2000, 155).

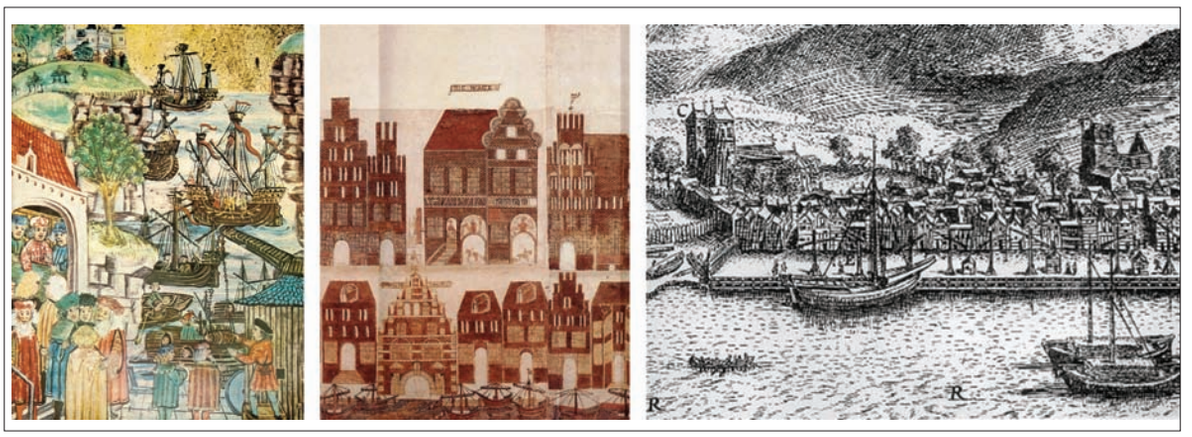

Fig. 17. Cranes and weighing houses were often situated close to each other, as is seen in Hamburg harbour (a). Sometimes goods had to be transported to weighing houses far from the harbour, as is seen at Vicke-Schorler-Role, a Rostock illustration from 1586 (b).

Fig. 18. *Bargebänke* were set up inside harbours to caulk ships built in the new carvel planking technique, as is visible in the inner harbour of Copenhagen 1547 (left), in comparison with the situation in Venedig; an impression by Vittore Carpaccio from the beginning of the 16th century.

Fig. 19.a-e. On the eve of the Early Modern Age, the naval harbour was the main innovation in maritime topography. The first renovation took place in the middle of the 16th century in Copenhagen: a before reconstruction: b after reconstruction In comparison with the Danish capital, the situation at Stockholm harbour in the 15th (c), 16th (d) and 17th (e) century showg no great changes.

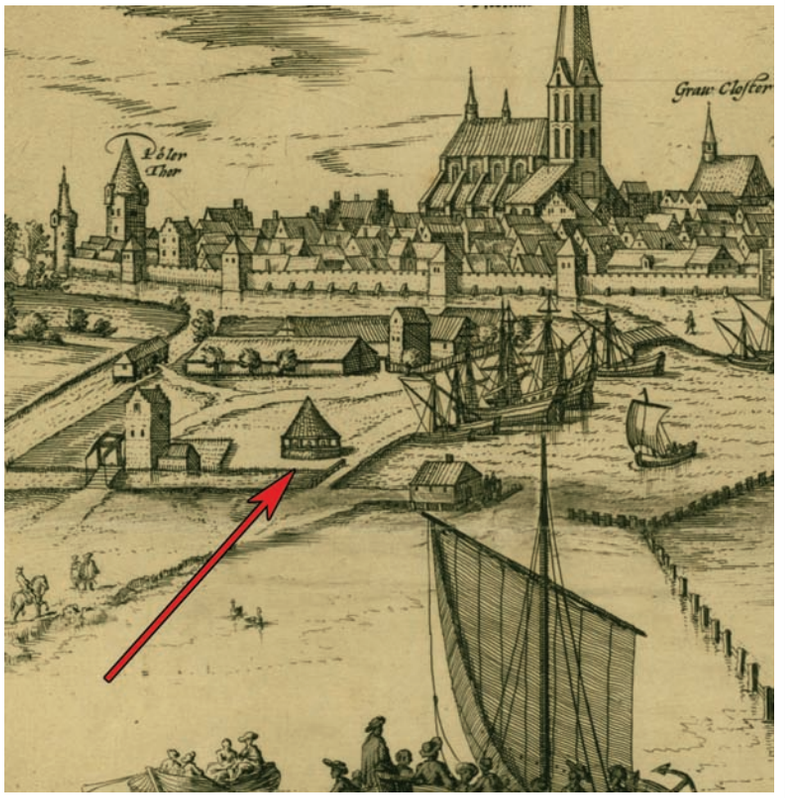

Fig. 20. A rounded cooking house in a Merians Wismar illustration shows the situation in 1653; cooking was allowed only here, in order to avoid fires.

of Stockholm only slightly changed over the centuries, (Fig. 19.a-c) whereas the infrastructure situation in port towns such as Copenhagen was the opposite, as newly founded naval fleets were based there (Fig. 19.d-e) (Priebs 1997: 126-150). Military ports were established with features characteristic of the particular needs of warships. In comparison with Copenhagen's development, important harbours like those in Stockholm did not change so much (Fig. 19e).

The social aspect

On the eve of the Early Modern Age, voyages became longer and longer. Sometimes weeks would elapse before ships reached a harbour. Although bigger vessels contained cooking chambers, cooking on moored ships in the inner harbour was strictly prohibited (Techen 1906b, 101ff., Deggim 2000, 43).[19] Therefore, seamen used special rounded cooking houses, as Figure 20 from Wismar illustrates.

The larger Baltic ports turned more and more into intercultural melting pots. This increased the risks of epidemics entering regions, through interaction between inhabitants and seamen in the port; however, I could not find anything like the board of health in the Mediterranean port town of Ragusa from the year 1377 (Zorn 1986, 51ff.). Such Baltic authorities appeared in the late 17th and early 18th century (Wehrmann 2011, 95-109). In this context, we should not forget harbourage, in which seamen could forget their exertions maybe in the arms of a woman who did not give pleasure for free (Kachel 1927). How beautiful these girls were also depended on the strength of the beer and the price of a tankard of it.

[19] Danziger Willkür from 1597 § 22 (see Pardessus 1834, Vol. 2, 477).

Closing words

This short article illuminates only part of the complex situation of changes in harbour construction, infrastructure and topography on the eve of the Early Modern Age in the Baltic. It is still a great pity that research does not currently seem to be interested in this aspect of maritime history very much. It seems to stand somewhat in the shadow of the systematic study of ships. In addition to my hope that this contribution arouses some interest in this fascinating aspect of harbour development, the article is also a souvenir of my collaboration with Vladas Žulkus in the Sventoji/Heiligenaa/Heiligenau harbour project, which generated two articles and a lot of good memories (Žulkus, Springmann 2001, 167-181; 2002, 160-176).

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UOSTŲ KONSTRUKCIJŲ, INFRASTRUKTŪROS IR TOPOGRAFIJOS RAIDA BALTIJOS JŪROS AREALE ANKSTYVŲJŲ NAUJŲJŲ LAIKŲ IŠVAKARĖSE (1450–1600 M.)

MAIK-JENS SPRINGMANN

Santrauka

Laivai nėra „Skrajojantys olandai“ – juos pakrauti ir iškrauti bei aprūpinti reikia uostų. XV ir XVI a. Baltijos jūroje plaukiojo vis didesni laivai, ir tai lėmė didelius jūros uostų konstrukcijos ir topografijos pokyčius. Didžiųjų laivų, tokių kaip holkai, kapitonai turėjo būti daug atidesni plaukiodami arčiau krantų nei mažų laivų su mažesne grimzle, tokių kaip kogas, epochos kapitonai. Dėl besikeičiančių smėlio seklumų priešais uostus ypač pavojingos laivybai buvo pietinės Baltijos pakrantės. Siekiant saugumo uostų prieigose buvo įrengiami nauji papildomi navigaciniai ženklai. Dabar teisingą kelią jūreiviams rodo mobilūs ir stacionarūs bakenai, kai kurie iš jų šviečiantys, kai kurie su garsiniais signalais. Praeityje jūros keliai ženklinti bujomis. Tai buvo baltai ir juodai nudažytos paprastos dervuotos medinės statinės. Kaip navigaciniai ženklai buvo naudojami ir aukšti gotikinių katedrų bokštai. Be to, pakrantėse buvo statomi specialūs bokštai, kartais labai masyvūs, kurie tiko ir kaip gynybiniai statiniai. Stiprūs įtvirtinimai buvo Varnemiundėje, įplaukiant į Rostoko uostą, bet didžiausi stovėjo Vyslos žiotyse. Navigacinės sistemos su charakteringais pastatais ir specialiais aukštais statiniais būdavo pavaizduotos dvimačiuose brėžiniuose, vadinamuose „Vertonungen“. Juose buvo nupiešti šalia uostų buvę įvairūs bokštai, matomi iš jūros atitinkamais atstumais. Nepaisant įdiegtos navigacinių ženklų sistemos, saugiai pasiekti uosto įplauką buvo sudėtinga. Todėl kartais burinius laivus į uostus virve įtempdavo irkliniai vilkikai, vadinami „Espinge“, kartais būdavo įsitempiama ir inkarais. Laivus įtempti į uostą buvo galima ir iš molų. Upėse laivus prieš srovę dažnai traukdavo arkliais.

Olandai paskleidė patirtį statyti medinius molus srovės greičiui padidinti ir išnaudoti natūralią srovės jėgą, kad išsivalytų upės farvateris (12 pav.). Esant seklioms pakrantėms olandų inžinieriai anksti įgijo farvaterių gilinimo patirties. Daugelis tų naujovių XVI a. pasiekė ir Baltijos jūros uostus. Kai kuriuose uostuose gilinant akvatorijas buvo naudojami specialūs plokščiadugniai laivai, vėliau ir inovatyvios žemkasės („dumblo malūnai“) (11 pav.). Baltijos pakrantėse, kaip alternatyva didžiausiems uostams, buvo statomi maži uosteliai, tokie kaip Šventoji (*Heiligenaa*) Lietuvoje.

Hanzos miestuose buvo stengiamasi aptverti vidinius uostus, kurių mediniai pirsai, kaip užtvaros, saugodavo miestą ir karinių veiksmų metu. Didesnių uostų įplaukose stovėdavo įvairių konstrukcijų mediniai statiniai su vartais (15 pav.). Iš tų statinių prie uosto vartų specialūs žmonės (vok. *Baumkieker*) klausdavo, ar laivo iškrovimui reikės krano, ar pakaks paprastų skryščių. Ir vieni, ir kiti įrenginiai būdavo išdėstyti išilgai krantinių, kaip buvo Štralsunde ir Bergene. Laivams iškrauti buvo naudojamos ir laivų statybų vietos. Svarstyklių stotys kartais būdavo visai šalia kranų, kaip Hamburge (17a pav.), kartais – toliau, kaip Rostoke (17b pav.). Dideli uostai darėsi vis labiau daugiakultūriai. Socialinėms reikmėms tenkinti uostuose būdavo specialūs virtuvių namai (virti uoste stovinčiuose laivuose buvo griežtai draudžiama), smuklės, prieglaudos.