

SHIPBUILDING TECHNIQUES FROM THE MEDIEVAL AGE ONWARDS

INTRODUCTION

Although the origin of Baltic navigation goes back far in history, all documentary evidence confirms the beginning of real shipping around the 4th-5th century AD. It was then that a number of nations with a typical early-medieval culture established their first permanent settlements on the Baltic coasts. Succeeding centuries saw the growth of these communities and the evolution of centres of political and economic power. Both commerce and hostilities required the use of ships, and these were built along the Baltic coast.

From the 9th to the 12th centuries the Baltic Sea was most readily accessible to the Scandinavians, the Western Slavs, then known as Wends, the Balts, subdivided into Prussians and Ests. Some contemporary sources also use the name Ests for the Prussians. The north-eastern shores of the Baltic were inhabited by the Lapps and the Finns. However, the Scandinavians living along the northern coasts of the Baltic were in possession of the longest shoreline. At this time the lands of the Slavs stretched from as far west as the area around the present-day city of Kiel to the mouth of the river Vistula in the east. Beyond, towards the east and north, lay the territories of the Prussians and Ests.

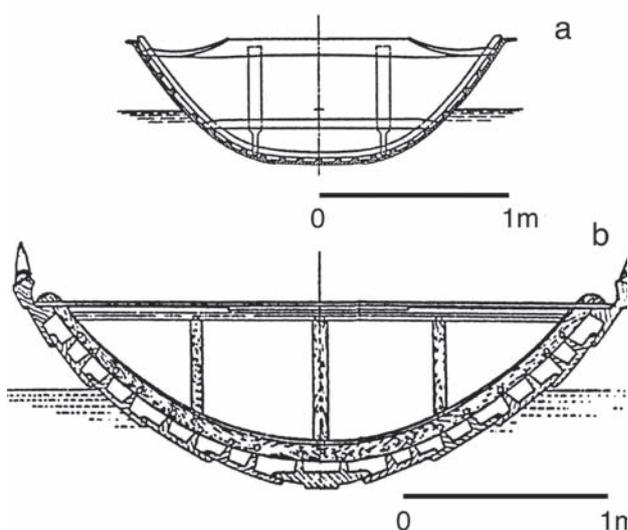
THE EARLIEST BALTIC BOATS

The most interesting boatbuilding region on the Baltic appears to be the area of Denmark. The numerous islands and the Jutland peninsula separating the North Sea from the Baltic, were a convenient site for the growth of settlement and a maritime economy. Long before the early Middle Ages this area had been a crossroads where the civilizations of northern and southern Europe met those of the eastern and western Europeans. It thus comes as no surprise then to learn of the scientifically valuable finds of boatbuilding remains in Denmark. Some of these are of exceptional importance, e.g. the Hjortspring and the Nydam boats. Further wrecks, from the Viking era, as well as ships from the post-Viking period, have made an invaluable contribution to our knowledge of boatbuilding in northern Europe.

Methodical studies of the history of boatbuilding began in the late 19th century, when a number of boat-wrecks were excavated. Since that time remains of ancient boats continue to be found, and they are



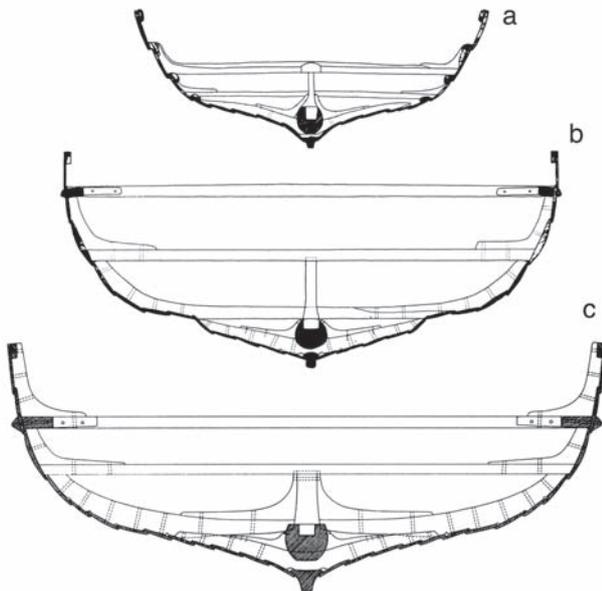
The settlements of nations in the 10th-11th centuries around the Baltic coast: a-a) Danes, b-b) Swedes, c-c) Finns, d-d) Russians, e-e) Ests, f-f) Prussians, g-g) Slavs.



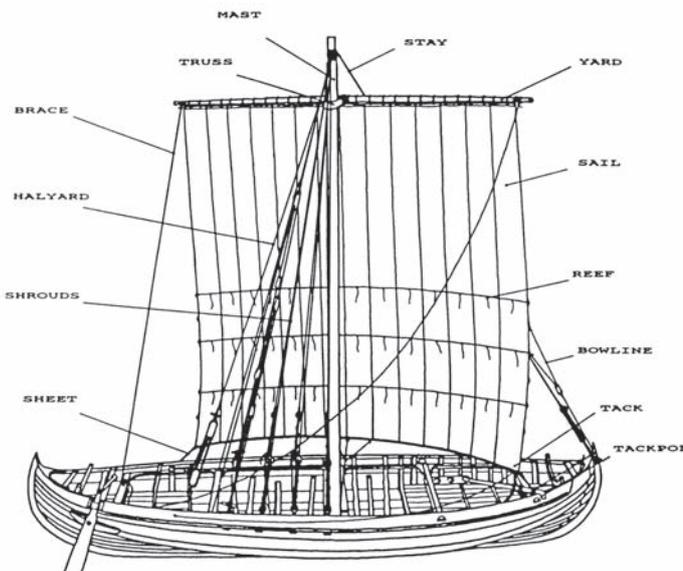
Cross-sections of the early wooden Baltic boats: a) the Hjortspring boat – 4th-3th BC, b) the Nydam boat – 3rd cent. AD.



The Nydam boat on exhibition at the Landesmuseum für Vor- und Frühgeschichte at Schleswig.



Cross-sections of the Scandinavian cargo boats: a) the Skuldelev 3 (the small cargo Baltic boat), b) the Skuldelev 1, c) the Hedeby 3 (both the ocean-going knarr type craft).



The rigging of the Skuldelev 1 replica boat "Saga Siglar".

enriching our knowledge of local shipbuilding. The upshot of these studies was a fairly early attempt at defining the line of development of Scandinavian watercraft, derived from boats made from hides, and regarded as one of the four prototypes of present-day boats and ships. A key role in this theory is played by the oldest known Nordic plank boat, the 4th-3rd century BC Hjortspring boat, whose form resembles that of skin boats, but which was made from five broad planks of lime wood sewn together with bast cord. Moreover, the method of forming the ends of the hull is reminiscent of the skin boats depicted in the numerous rock engravings found in northern Scandinavia and dating from a much earlier period. The wrecks of the boats from Bjöke (1st-2nd century AD) and Nydam (3rd century AD) are representative of a later stage in the technical evolution of Scandinavian boats. The traditional sewing of planks had been replaced by riveting.

As far as the historical development of boats from the Baltic coasts of Scandinavia is concerned, the view is that they could have evolved from either rafts or dug-outs. In the low-lying areas of today's Denmark and in the forest-covered regions of southern Sweden, there was no lack of materials for building boats. Their construction enlarged the range of Nordic boatbuilding techniques, as a result of which a series of boat types emerged during the Viking period. Many of these have been excavated, e.g. the boats from Kvalsund, Oseberg, Gokstad, Tune, Ladby, Skuldelev, Hedeby and Galtaback, to mention but a few. Scientific analysis of this rich material has enabled the typical features of Scandinavian boats from the 8th to the 12th century to be established.

STRUCTURAL FEATURES OF 9TH-11TH CENTURY SCANDINAVIAN BOATS

Typical features of early-medieval Scandinavian boats were the rounded stem and sternpost fixed to the beam keel, the central part of which was roughly T-shaped in cross-section. The keel, stem and sternpost were made from oak. Applied from the stern to the bows in clinker fashion, the strakes were fastened together with iron rivets and were caulked with plaited strips of animal hair. The ends of the strakes were usually rabbeted into the sides of the stem and sternpost.

Up to around the 9th century every strake of a Nordic boat had characteristic elongated projections with openings through which ropes could be threaded in order to fix the transverse reinforcement elements to the planking. By the end of the 9th century this type of joint had been replaced in Scandinavia by pegging: the strengthening elements were joined together by means of wooden pegs 20-30 mm in diameter. The state of the boatbuilding art of the day required the boat to be built by the shell technique, and as work progressed, the floor timbers and keelson were fitted into the interior of the hull, followed by the thwarts, knees and stringers. The construction was completed

with the addition of rowlocks. The rudder was fixed to the starboard side of the hull near the stern.

An important aspect of technical progress in the construction and use of Baltic boats was the introduction of sail propulsion; on the Baltic this took place during the 8th or 9th centuries. Therefore, boats that were to be moved by wind had a mast step in the keelson and a mast yoke in the thwart above. The rigging consisted of one set of ropes for supporting the mast and another for controlling the sail.

The Scandinavian sagas have handed down a lot of information about the names of the types of vessels sailing in those times. The snekar and drakar were combat craft. Vessels also came to be known by the number of oars on each side used to propel them. Usually these were 'fifteeners', 'twentiers' or 'thirtiers', which were classed as 'longships' (langskip), although gigantic craft with 60 oars on each side were constructed from time to time.

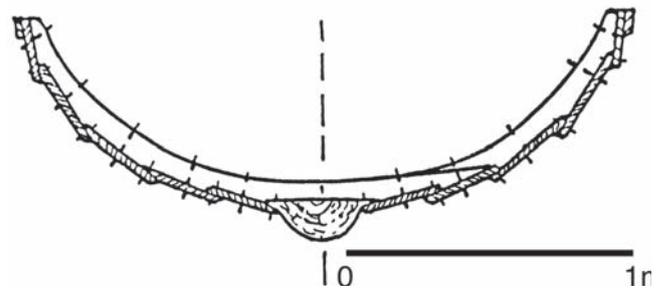
The largest merchant vessel was the 'knarr', and smaller ones included the 'feria' 'byrdingr', and 'skuta'. Though they were all sailing ships, they could also be rowed.

EARLY MEDIEVAL SLAVIC BOATS

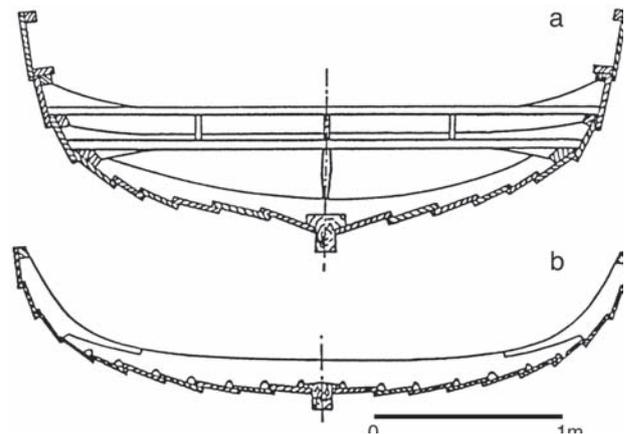
The oldest written sources telling of the riparian settlements and navigation of the Slavic peoples date back to the 6th century AD. The West Slavs first ventured out into the open sea in the 9th century. To meet their needs for fishery and transportation, they produced rafts and dugouts from the trunks of oak, pine, willow and poplar. To sail in safety at sea, however, appropriately constructed craft were required. Though better than a raft for this purpose, even a dugout had to undergo modification: this involved raising its sides by attaching overlapping planks to them. In the larger boats, the dugout part of the bottom was of no great significance and, in time, came to be left as a semicircular beam – the keel. This development is well illustrated by the keel of the wreck of a 9th century fishing boat found at Szczecin.

By the end of the 9th century keels had become T-shaped in cross-section. Dugout keels in small local boats persisted on the southern Baltic until the beginning of the 20th century. Ancient Slavic boatbuilding reached the peak of its development in the 11th-12th centuries, when large plank-built boats undertook long commercial voyages and naval campaigns, against the Vikings amongst others. Many parts of Slavic vessels from this period have been discovered along the south-western shores of the Baltic.

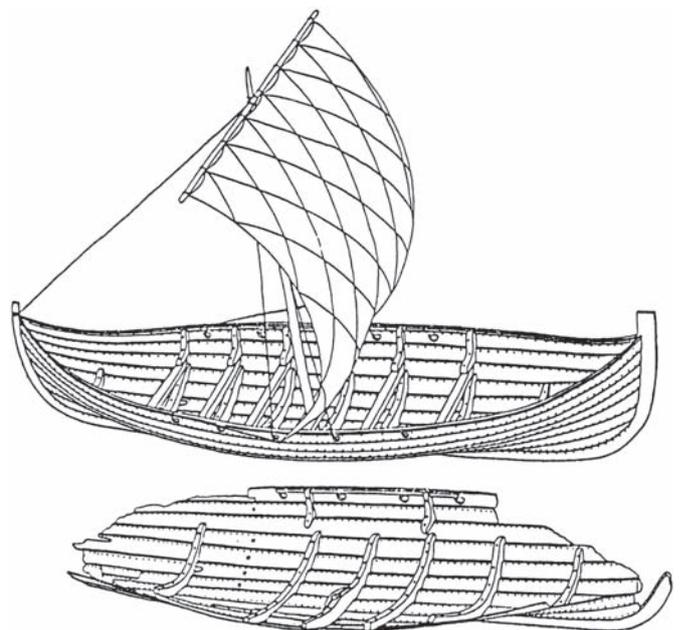
Slavic boats of the 9th-12th centuries had a number of characteristic structural features: they were made of oak; in silhouette, they resembled Viking ships, but their bottoms were flat. They were built by the shell technique, and overlapping planks were caulked with moss. The use of 9-15 mm diameter pegs, to fix the planking together, became the characteristic solution in the Slavonic boatbuilding technique.



The Szczecin boat's cross-section.



Cross-sections of the Scandinavian and Slavonic type of boats represent the typical form of the bottom: a) the Skuldelev 3, b) the Czarnowosko I.

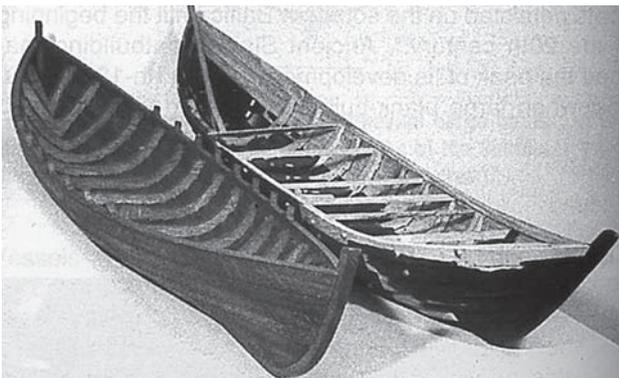


The Ralswiek 2 boat and its reconstruction by Peter Herfert.

Originally propelled by oars, these boats were additionally fitted with a rectangular sail from around the 10th century onwards. As in the Scandinavian boats of the period, the rudder was attached to the stern end of the starboard side. The surviving sources make no mention of the names of these boat types; however, like the Nordic boats, they did have names.

EARLY MEDIEVAL PRUSSIAN BOATS

The eastern neighbours of the Slavs on the Baltic were the Prussians, up to their demise in the 13th century, when they were conquered by the Teutonic Order. Their boatbuilding traditions were clearly influenced by the Scandinavians if one accepts that the wrecks excavated here were built locally. Their hull shapes were reminiscent of typical Baltic boats, but some constructional details were clearly derived from local traditions. Archaeological excavations on the presumed site of Truso have brought new material to light, e.g. traces of boats whose sides had been fastened with iron rivets.



Two reconstruction models of similar medieval boats from Prussian area – on the left the Frauenburg (Frombork) boat from the Viking period – according to investigations from the year of the discovery in 1895; on the right the Tolkmicko I boat, from the end of the 15th cent. Photo Ewa Meksiak

BOATS OF THE PEOPLE OF THE NORTH-EASTERN BALTIC

Archaeological remains indicate that the boats built on the Gulfs of Bothnia, Finland and the northern part of Sweden in the early Middle Ages were no different in external appearance to their Scandinavian prototypes. However, the remoteness of these boatbuilding sites from the main trading centres precluded frequent contact with them and contributed to the survival of ancient boatbuilding techniques into the 19th century. These included the mechanical splaying (by steaming) of a dugout's edges, which were subsequently raised by planks aligned in the clinker fashion and sewn on to them. The capacity of the hull was thus increased. The dugouts and the planks used to raise their sides often had projections to which the frames could be lashed.



The oldest known illustration of the sewn boat from Finland – the part of the title page of the French translation (1674) of the J. Schefferus book Lapponia.

13TH-15TH CENTURY BALTIC SHIPS

Urban growth in Western Europe created a great demand for raw materials and agricultural produce. The holds of the very much larger ships built since the 12th century now carried not luxury items but bulk cargoes, and in the 13th century vessels of this kind became an ever more frequent sight on the Baltic. These ships, including types such as the cog and holk, had come originally from ports on the North Sea. The increase in trade stimulated Baltic boatbuilders to construct new types of ships, not only similar to those arriving from elsewhere, but also evolving from traditional sea-going craft; this activity gave rise to ships like the kreier and bording (byrdinger). However, the most common class of ship on the Baltic in the 13th and 14th century was the cog. It is generally thought that the cog came into existence at the mouth of the Rhine, and that the Frisians using them had spread its design in northern Europe. It is known from written sources that cogs were arriving at Gdańsk already in the first half of the 13th century and that they were the largest vessels to sail even up the Vistula. By the end of that century they were certainly being built in Baltic shipyards.



The seal of Elbląg (Elbing) from 1242 represents the early type of cog.

As a result of the numerous discoveries of wrecks identified as cogs, our knowledge of this particular ship is now extensive. Particularly significant was the discovery, excavation and scientific examination of the cog discovered at Bremen in 1960.

The earliest design of a Baltic cog is depicted on a seal of the town of Elbląg (Elbing) from 1242. This image is regarded as one of the earliest showing a single-masted ship with a hinged rudder. The straight, beam stem and sternpost are also an innovation. A late-13th century seal from Gdańsk depicts a cog with platforms



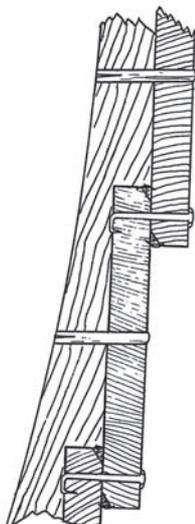
The seal of Gdańsk from 1299 depicts a cog with platforms above the bow and stern.



The seal of Gdańsk from 1400 represents the typical holk from the first half of the 15th century.

above the bow and stern. Further modifications to the cog's design are reflected in the 14th-century seals from Baltic towns, *e.g.* Stralsund and Elbląg, and these versions are very similar to the Bremen cog. These ships still have the characteristic straight, sloping stems and the castle above the stern.

Cogs had a flat bottom, and sides clinker-built by the shell technique. They had fairly short, low beam-keels extended at either end by naturally grown crooks, and these in turn were raised by the stem and sternpost. Characteristic of all wrecks identified as cogs, are the methods of joining the planks and caulking the hull. The planks were nailed together, with the end of the nails being bent inwards on the inside. The gaps between the planks were usually caulked with strips of moss held in place with wooden slats stapled to the planks.



Typical overlapping sides planks observed in wrecks of the cog ships – clenches nails and the caulking compressed by battens stapled to the planks.

Important elements in the cog's construction were the transverse reinforcement beams. These were attached to the planking during the hull's construction.

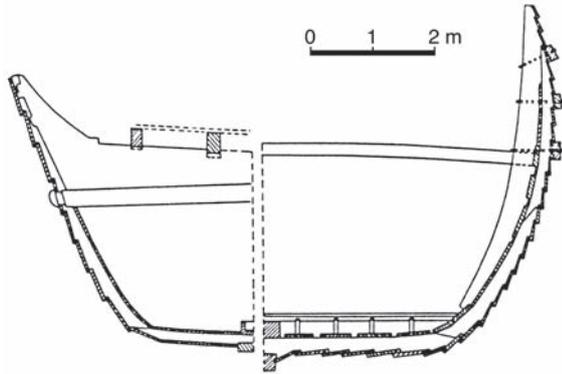
The discovery of the Bremen cog also made it possible for the method of deck construction on a medieval ship to be examined. Since the hull was built by the shell technique, and the transverse reinforcement constituted not a frame but merely a set of crooks abutting on to one another in various ways, the transversally aligned deck planks were supported on longitudinal beams.

In all probability, the earliest holks were built on the North Sea around the 10th century; however, they did not become common in the Baltic until 400 years later. In the opinion of some researchers, they were technically the successor to the boat derived from raising the sides of a dugout. Other researchers, however, consider the holk to have evolved from the early medieval plank boat, such as the knarr for instance. Though it resembled the cog from the technical standpoint, the hull of a holk was clinker-built in its entirety, and the stem was rounded. The hull was built by the shell technique, and the planks were riveted, but before this were caulked with strips of animal hair. The deck is laid out transversally as on the cog.

The remains of the vessel known as the 'Copper Ship', raised in 1975 by the Polish Maritime Museum, are presumed to be the structural elements of a holk. Even so, the appearance of the 'Copper Ship' cannot be described with any certainty. The stern planking makes a sharp angle with the sternpost; this aspect of the design is similar to that of the ship on the 1424 Elbląg seal, which is recognized as a holk.

In the 15th century, holks had two and then three masts. An innovation was the use of a triangular sail on the mizzenmast, borrowed from Mediterranean ships.

Besides cogs and holks, smaller types of Baltic craft were built. For instance, the ferry used in coastal shipping as a lighter was flat-bottomed, as the wrecks at Falsterbo have shown. Other types, like the 'krejer', 'smack', 'ligurna' and 'bording' were large, clinker-built vessels. The wrecks excavated at Kalmar are the remains of such craft.



Two cross-sections of the most popular medieval ships: a) the Bremer cog, b) the "U 34" ship from Holland represents the holk.

"BALTIC CARAVELS"

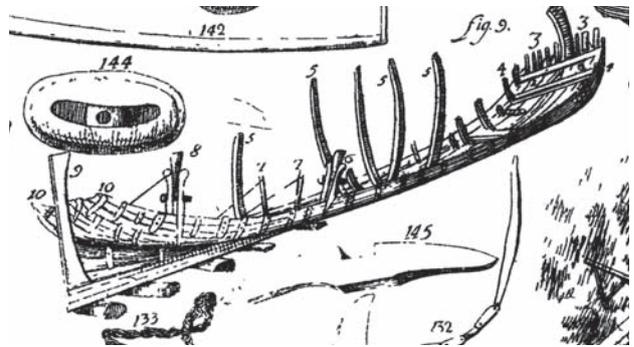
By the turn of the 15th century the first three-masted merchantmen from south-west Europe, made their appearance in Baltic countries. They had been set in motion by the carracks that sailed here from the west coast of France. Because of their characteristic flush planking, they became known as caravels, although they were quite different from the true caravels of Spain and Portugal.

The techniques of carrack construction were unknown to Baltic shipbuilders. Those of Gdańsk had to wait until 1470, when they were able to examine one of those carvel-built hulls in detail. This happened after the 'Peter van Rosseel', a carrack of large proportions, caught fire and was abandoned by her French owner in the port. The ship was taken over by the city authorities and put back into service around 1470. Now named 'Peter von Danzig', it functioned as a privateer, and was the contribution of Gdańsk to the Hanseatic League in its war against England.



The O. Lienau's reconstruction of the "Peter von Danzig" – the model from the Polish Maritime Museum collection. Photo Ewa Meksiak.

Some researchers believe that the refit of this carrack in Gdańsk was crucial to the acquisition of this new technique by the local shipbuilders. However, this fact should not be overestimated. It seems unlikely that even a close examination of a finished hull could ensure the successful application of the new technique without technical knowledge. This would have required many years of practical experiments which, so far as one can judge, were undertaken. Shipbuilding records do not make it clear whether early 16th-century Baltic ships were carvel-built. Conservative attitudes probably prevailed and most vessels were built with clinker hulls. Other shipyards in northern Europe also attempted to build the new type of hull. Nevertheless, the pictorial evidence shows that even as late as the 17th century many north European shipyards were still using the shell technique to construct carvel hulls.



Fragment of a shipyard view of the illustration in A.C. Raalamb's book "Skeps Byggerij" of 1693 presenting the shell first method of a carvel ship hull construction.

The conversion of vessels into fighting ships is quite clear from images of cogs and holks. They had crenellated fore- and sterncastles, and protected platforms on the masts. As the standard sea-battle strategy at that time involved boarding, this was facilitated by special anchors at the end of chains cast from raised bowsprits on to the enemy vessel, and the hooked ends of the mainsail yard-arms. When in the 15th century firearms were first used on ships, the first cannon were placed at the sides of the castles. It was not possible to accommodate heavy guns on the decks as they were made at that time. Deck structures had to be strengthened and this was something that was accomplished during the Renaissance.

INTO 16TH TO 19TH CENTURY

In the second half of the 16th century in Denmark, Sweden and Poland there appeared a new kind of ship, the South European galleon. They were brought from western Europe, or built on site, as happened in Poland in 1570-1572, where such ships were constructed under the supervision of the Venetian shipbuilders.

These galleons had flush planking, developed castles, and three masts on two of which the two square-rigged sails were put. They were also equipped



A model of the “Smok” – one of the earliest galleon type ships on the Baltic constructed in years 1570-1572 by two Venetians in Elblag (Elbing) for the order of the Polish king Zygmunt August. Photo Ewa Meksiak.



Swedish and Polish galleons during the battle at Oliwa (1627) a picture by Adolf Boy – very good example of similarities in the Baltic warship construction.

with artillery placed under the deck and in the quarterdecks. Along with the building of these vessels the types became unified and the construction got more and more alike.

The development of the Dutch trade in the 17th and 18th century resulted in the appearance of the new kinds of vessels on the Baltic Sea. Those were the fluits, pinnace, galiots, smacks, hokers, and many others. In the 18th century these ships were often built in the Baltic shipyards under the supervision of the Dutch masters or the shipwrights, who were settling down there. The Baltic builders were also looking for the most favorable hull forms. For example Peter the Great, the founder of the Russian navy, used Dutch solutions, whereas the Mediterranean styles, mainly rowing-sailing ships – chebecks, inspired Frederic Chapman to build the vessels used in the fights in the Swedish and Finnish skerries. The situation was similar at the end of the 18th century and in the 19th century in terms of building big cargo ships such as barks, brigs and frigates used for sailing across the Baltic Sea. In fact these ships, although built in different shipyards, did not differ much.

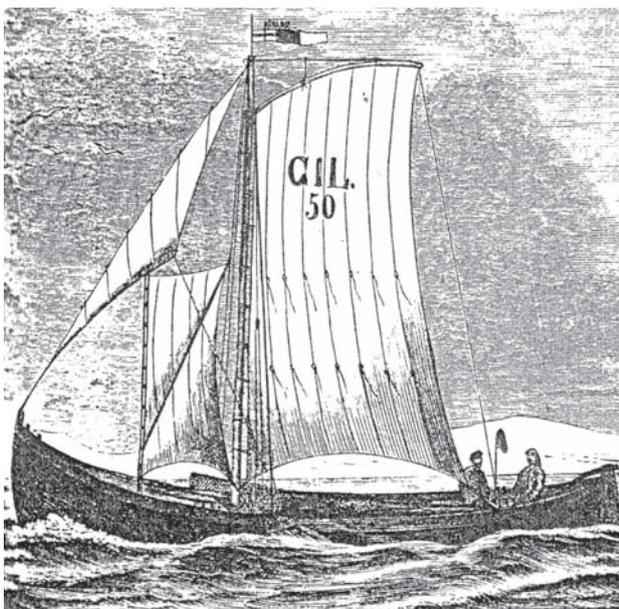
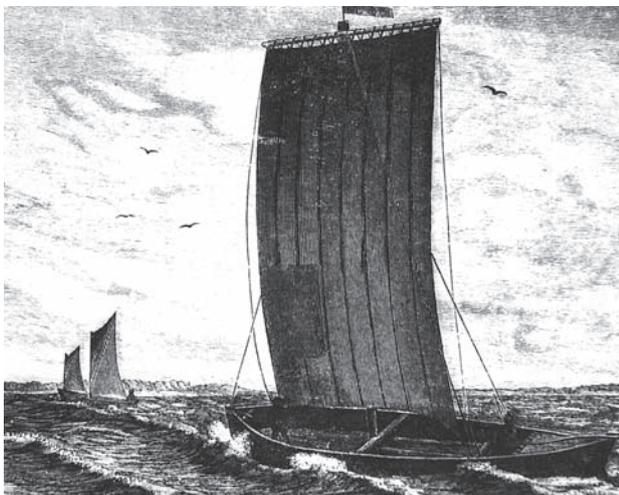
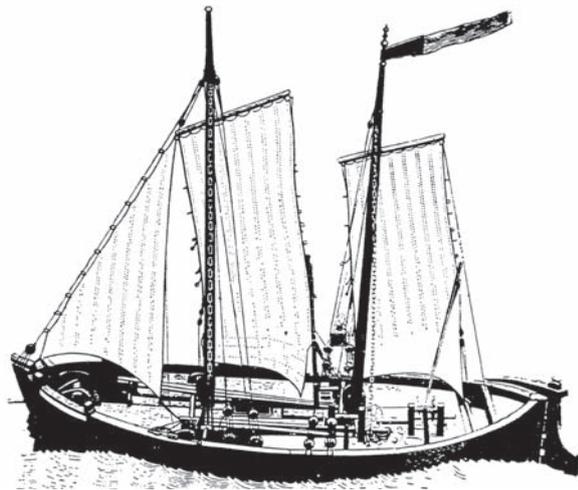
The situation in the building of local small ships and fishing vessels was however, very different. Small cargo ships were built for the same aim – coastal transport. They were built in the workshops in all the Baltic countries and had similar forms of sails – fore and-main masts with rectangular sails and mizzen with a gaff sail or ship’s had a complete gaff rig. They differed locally in shapes and names of types. Very often they did not have the equivalent, like the lomme from Tolkemit (Prussia), *Klaine* and *Grossereisekahne* built in the ports of Curland, German *Galeas*, or Nordic yachts. As the pilots’ books say, such ships were the first to begin and the last to end the sailing season in the Baltic ports.



The “Stadt Elbing” galleon from the end of the 18th cent. A typical trade ship constructed in many Baltic shipyards.



The ship “Balder” from Marstal (Denmark) represents the galeas type of small trade vessel.



Typical fishing boat used on the Baltic lagoons – a Taglerpolten from the Oder Lagoon, Angelkbane from Vistula Lagoon and Kurrenkahn from Kurland Lagoon representing various forms of a local type of watercraft.

Compared to the cargo ships (even the smaller ones with local differences in hull forms, names, and form of sails) there are major constructional differences in fishing vessel hull forms. The age of the regional tradition, and limited sailing areas; along with the most favorable forms for the hulls and sails; had a great influence on maintaining their uniqueness until contemporary times. Unfortunately, the traditional boatbuilding of the Baltic Sea is dying out, whereas in other places it has survived in the forms similar to the ones of the early Middle Ages. In such a way the regional differences have survived. It is strange though, for example, in the 19th century and at the beginning of the 20th century that on the three lagoons: Oder River, Vistula River and Curland *i.e.* Nieman River, which are similar to each other in terms of hydrographical conditions, fish species, and governed by the same national fishing organization, and in spite of the unification of the fishing gear up to World War II; the fishing boats were very different from each other. For example the Taglerpolte from Oder estuary, Aagelkahne from the Vistula lagoon, and the Kurrenkahne from Curland. Similarly, the boats used on the open sea, such as the zees boats from the Kashubian district had very different shapes than the similar eeke – boats from the Blekinge province in Sweden. In the way the small boats were built we can also see many options, which are examples of “borrowings”. Such are the designs of the Scandinavian (Swedish) drift cutters and the Danish and west Pomeranian cutters used by the fishermen as the first sea-worthy Baltic ships.

When it comes to the traditional shipbuilding of the Baltic countries we can observe the courses of the necessary, common investigation. All our countries have already got the scientific materials and listed our domestic boats. However, we are still lacking the synthesis, although the first trials for this have already taken place. In 1998 Statens Sjöhistoriska Museum in Stockholm organized an exhibition and issued a catalogue about the folk boats from the North of Europe. In the catalogue many specialists presented peculiar types of watercraft. This material, and other important publications, are a perfect source for the beginning of the synthesis and describing the common features and the differences in the folk boats. I think that such a study could be done with the cooperation of a few scientists from the Baltic countries.

FINAL REMARKS

Finishing my speech I would like to stress that the aim of my presentation was not the description of all the common features in shipbuilding over past ages, but to stress the most important problems and suggest ways for further investigation. That is why I skipped the part about building steel boats with mechanical power, which, especially when compared to contemporary times, can have many interesting aspects. In my last sentence I would like to claim that the common features of the vessels increase with their size, which seems to be an issue that is obvious, and does not demand further investigation.

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