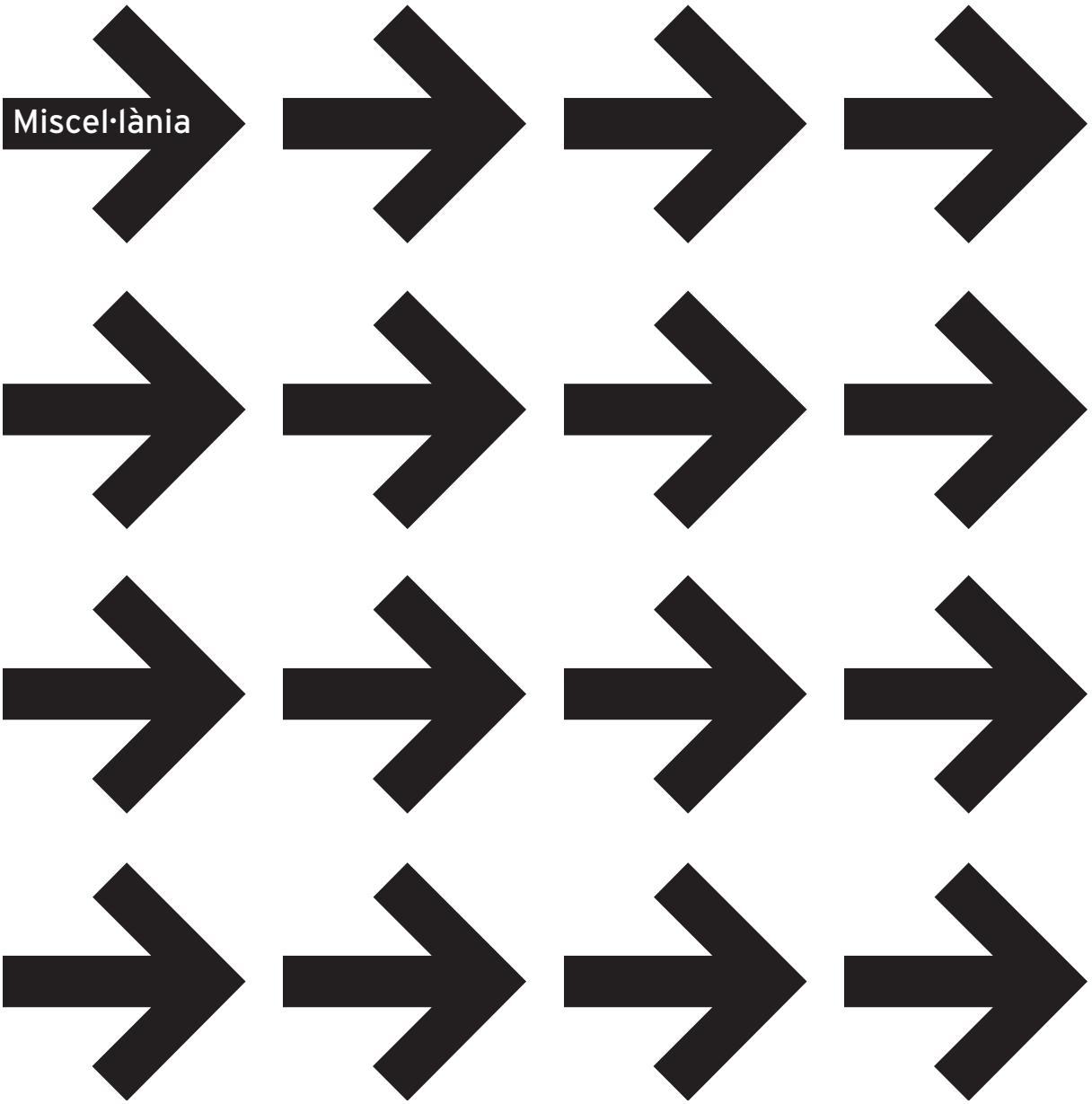
Miscel·lània

The Hanseatic Cog of Bremen AD 1380

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A great moment is rare in archaeology, but when it suddenly happens to come, it needs people who are up to it; they don't have any chance to prepare themselves. The man who at low tide in the river Weser some two kilometres downstream of the medieval city of Bremen in October 1962 was confronted with the wreck of a 23 m long wooden hull (see fig. 1) and made it a great moment in archaeology, was Dr. Siegfried Fliedner, custos of the medieval and maritime departments of the Museum for the History of Bremen. He not even was an archaeologist, he was an art historian and returned from the wreck with the suspicion that it might be that of a Hanseatic cog. So far no living person had ever seen a cog, but only six years before the historian Paul Heinsius had established a definition of that type from the pictorial and written evidence of the Hanseatic period. His book (Heinsius, 1956) had been printed at Weimar in the Deutsche Demokratische Republik, but when Heinsius in the same year 1956 became a naval officer in the navy of the Bundesrepublik Deutschland, this book was pulped as an act of the Cold War. Fortunately enough the Bremen museum had got one of the few volumes, which had been delivered in time, and Fliedner could compare the shape and the clinker construction of his wreck with the statements of Heinsius and found the first support for his suspicion.

For the Germans the Hanseatic period (1159-1669) is one of the few highlights of their history and the cog is well known as the outstanding ship type of the Hanseatic League even though nobody really knew how she looked like. That's why the mere possibility to excavate a real cog electrified Fliedner and made him successful in raising money, engaging divers to salvage timber by timber of the wreck, finding rooms to store at least 45 t of waterlogged timber, and caring for methods to prevent them from drying up (Löbe, 1969), looking for a draftsman to draw the lines of the shipfind and for a model builder to make a model of it. Finally he ordered a special ship with a diving-bell to exploit the muddy riverbed and found interesting constructional details and shipwrights' tools (fig. 2) but not any piece of cargo or ballast (Fliedner, 1964; Pohl-Weber, 1969). It took him three years until he won his struggle for the cog and he enjoyed the

Fig. 1. The damaged portside of the Bremen cog wreck as it appeared for the first time in the river Weser downstream of Bremen at low tide of October 9th 1962. (Photo: Deutsches Schiffahrtsmuseum)

Fig. 2. The shipwrights' tools and shoe found in the Bremen cog (1380). (Photo: E. Laska/ Deutsches Schiffahrtsmuseum)

Fig. 3. A cog depicted on the town seal of Stralsund (1329). (Impression: Deutsches Schiffahrtsmuseum)

fact that the hull had sunk on her starbord side, which in the mud of the river remained in a very good state of preservation and nearly complete from the keel up to the highest rail of the aft castle including stem- and sternposts.

Simultaneously with all his tasks of management he started research to prove that his wreck in fact was that of a cog, and was lucky enough to reach firm ground due to the complete preservation of one side of the hull. Just like several other Hanseatic seaports in the Baltic, the town of Stalsund showed a very specific type of ship in its town seal, the last edition of which had been cut in 1329 and used down to the 19th century. Fliedner found heads protruding through the planking of the Bremen hull. He found this very construction feature in other cogs of the Stralsund shape depicted on seals of other Hanseatic towns, such as Damme and Harderwijk (Fliedner, 1964: 5). Thus Fliedner confirmed his first suspicion beyond any doubt: the Bremen wreck is indeed that of a 14th-century cog!

This result was a breakthrough in maritime archaeology. For the first time an excavated ship of the Middle Ages had been identified with the term of her type, which is handed down to us in written sources only. Fliedner had succeeded in translating archaeological facts into the language of history, which not only historians but

out that Stralsunders themselves called the seal «the cog» ('*unser Stad Siegel ghenomed den* kogghen') in 1483 and also later, the name coming from the type of ship depicted on it (fig. 3). The seal shows the *cog* above the waterline with a high, box-like hull, clinker-built with straight and steep stem- and sternposts, a centreline rudder with tiller, fore and aft castles, one mast and one square sail. In a second step, Fliedner compared the ship on the seal with the complete starbord side of the wreck he was excavating (see fig. 4) and, with the exception of the rigging and the forecastle, which were missing, found all those details exactly as depicted on the seal. In addition to that, Fliedner saw five crossbeams with their everyone could easily understand. Both archaeology and history profited from this step into a new dimension. Though the Bremen wreck in those days was the only one of its kind, it was nevertheless an isolated item; on the contrary it became the visible representative of a type of ship very well known in history. All data from the written sources could be applied to the wreck. And wherever a cog is mentioned in documents, this wreck gives information on her construction, size, cargo-capacity, sailing qualities and so on. In contrast to older famous shipfinds, such as the Nydam ship or the Gokstad ship, the new find from the start was introduced to the public as the Bremen cog. Fliedners example changed the world

Fig. 4. The reconstructed Bremen cog in the cog hall of the Deutsches Schiffahrtsmuseum at Bremerhaven. (Photo: E. Laska/Deutsches Schiffahrtsmuseum)

of nautical archaeology. Since then excavators of medieval ships have a new aim: they want to determine the type of their hulls, and many of them were successful in corresponding research (Crumlin-Pedersen, 1966; Ellmers, 1972; Crumlin-Pedersen-Olsen, 2002; Brand & Kühn, 2004).

Having reached this remarkable result Fliedner successfully endeavored to get expert witnesses for an adequate way of conservation of the masses of waterlogged timber (Noack, 1969) and the iron components of the find (Ladeburg, 1969), for the reassemblage of the broken pieces of timber and for the way to present the complete ship to the public in a house especially adjusted for it (Hoheisel, 1969). Simultaneously he carried out further research into the vessel (Fliedner, 1969) and among others found the two upper gudgeons missing; only the two underneath the waterline had been nailed to the sternpost. Obviously the sternruder could not have been hung in its position: the cog had not been finished off when she sunk with a barrel of tar and the shipwrights' tools on board but without any cargo. A sudden flood must have torn her off from the shipyard and as no ballast was inside she very soon capsized. Without doubt she had been built at Bremen (Fliedner, 1964), and the tools and the toolmarks, which are to be seen in her very well preserved timber, reveal hitherto unknown insight into the working procedures of the Bremen shipyard. Fliedner further cared for dendro dating and got remarkable results (Bauch, 1969): the oaktrees for the long straight structure members, such as keel and keelson, stem- and sternposts, crossbeams and others, had been cut down far away in the forests of the Weserbergland in 1378 and floated along the river Weser to Bremen, whereas the naturally grown curved timbers for the ribs and so on had been cut in the environs of Bremen. The rafts from the upper Weser reached Bremen late in 1378 or early in 1379 and the shipwrights there immediately began to build the cog and launched her late in 1379 or early in 1380. In that year a flood disaster tore her from the shipyard until she capsized in a whirlpool her lower parts soon being covered by mud and sand so that the shipwrights were not able to take her back (Genieser, 1969).

In 1971 the Deutsches Schiffahrtsmuseum was founded at Bremerhaven as the national maritime museum of Germany and the federal state of Bremen handed over the Bremen cog as an inaugural gift. As Fliedner did not move to Bremerhaven, new persons became responsible for the cog and they all followed the conceptions Fliedner had developed with the double strategy of scientific research in the archaeology and history of the type and management for the hull in the three steps: reconstruction, conservation and exhibition. The reconstruction had to be done before the conservation as the thick planks could not be bent after conservation. Even the house, which after Fliedners stipulations had been designed for these three steps, became the «cog hall» as part of the new building for the Deutsches Schiffahrtsmuseum. The central idea of this hall was to suspend the hull from the ceiling so as to avoid any supporting construction, which might mar the view to the ship. The naval architect Wolf-Dieter Hoheisel had developed the technical details (Hoheisel, 1969) and had been engaged by Fliedner to realize them. At the new museum he became the technical director with the responsibility for all technology surrounding the cog (Hoheisel, 1985).

Fig. 5. A replica of the Bremen cog under sail. (From: Hoffmann & Schnall, 2003)

As a first step inside the cog hall a huge tent was erected to store, sort and reassemble the timbers of the cog –the drying up of them being prevented by an artificial mist, which in the tent was produced by a sprinkler system. Fliedner had already engaged the master shipwright Werner Lahn, who ten years after the discovery of the cog, in October 1972, started to lay her keel a second time. Working in a relative atmospheric humidity of not less than 96% he and his crew reassembled the cog in a three-dimensional jigsaw puzzle of more than thousand black pieces of timber. The many broken pieces were glued in a special treatment without loosing their moisture and planks and ribs were fastened to each other by new wooden dovels driven into the old drilled holes. From a gallery through windows in the tent the public could watch the reconstruction process, which after six laborious years resulted in the only medieval cog standing in a museum (fig. 4) protected from drying up by the artificial mist (Lahn, 1985). Photographs of it found their way into German schoolbooks and all necessary measurements could be taken from the reconstructed hull with the aim to work out an exact plan drawing of a cog for the first time in the world, as in the Middle Ages cogs were built without any drawing. Finally in 1992 a detailed description of every structural member and the construction process was published in German and in English with not less than 36 plan- and detail-drawings (Lahn, 1992). This thorough documentation until now is the base for all the models subsequently made for many museums at former Hanseatic towns and other places as well as for the replicas in original size, which from Bremen, Bremerhaven, Kampen and Kiel sail the Hanseatic routes in the North Sea and the Baltic (see fig. 5).

As a second step the conservation process started with the erection of an enormous steel tank custom-built around the cog with a volume of 800 m^3 and with windows of thick glass to allow the public to watch the conservation process from a gallery (Hoheisel, 1985). Waterlogged archaeological timber is a unique and fragile material. If it is allowed to dry up, it shrinks and wastes away, tears and warps. During many centuries, being under water bacteria has consumed the very substance of woodcell walls. Cavities have been formed and are now filled with water, which supports the destroyed cells and their perforated walls. The weakness of the wood is not immediately apparent. The aim of conservation is to convert the waterlogged cog into a dry vessel without damaging the fabric during the process. The principle to get that aim is easily said, but the realization is difficult enough. The water in the cells has to be replaced by another substance, which does not evaporate like water and supports the week cells (Hoffmann & Schnall 2005). Fortunately enough, a suitable substance had been found in the 1960s: polyethyleneglycol (PEG). It is soluble in water and is available in different molecular weights as to meet the different stages of deterioration of the wood: small molecules for solid wood and bigger ones for week wood. But as a sufficient soaking with PEG takes many years depending on the thicknes and deterioration of the wood nobody had experience regarding the best way of treatment. Following the expert's advice to Fliedner (Noack, 1969) the tank around the cog was filled with water and PEG 1000, the concentration of which had to be gradualy increased in correspondance to the penetration. When the cog was submerged in her new bath the tent and sprinkling-system were taken down.

But as there were no methods known how to control the stage of penetration, in 1979 Dr. Per Hoffmann, who was an expert on the chemistry and biology of wood, was engaged as conservation officer for scientific research in

the conservation of waterlogged wood firstly for the cog, secondly for other shipfinds to come. Having installed his own laboratory he succeeded in developing a method, by which PEG is to make visible in wood, and he saw in all samples taken from the cog that the molecules of PEG 1000 were too big for penetrating the solid wood and too small for stabilizing the decayed zones. His further research resulted in a two-step method with a first bath consisting of PEG 200 to penetrate the cell walls and less deteriorated wood tissues and a second bath of PEG 3000 to fill and support the cavities of the badly deteriorated wood cells from inside, thus replacing the water as it evaporated. But as PEG 3000 is solid at room temperature the second immersion bath needed to be heated at 40°C for four years while its concentration was gradually raised to a final 70% (Hoffmann, 1985; Hoffmann & Schnall, 2005). During two decades the visitors could see the ship submerged in a pale green bath, the visibility of which was kept by pumping the liquid continually through huge filters. Towards the end of the process the high concentration of PEG allowed only the timbers close to the windows to be seen. When the wood at last stopped taking more PEG the second soaking was terminated and the liquid pumped off leaving the hull totally encrusted in white solified PEG. Yard workers disassembled the tank and when the cog had been cleaned until the timbers appeared dry and in their natural warm dark-brown colour, the third step of treatment was reached.

In May 2000 the cog finally stood free and dry in her hall, ready for permanent exhibition (fig. 4). More than 37 years after her discovery and 620 years after her sinking she was formally presented to the public! No other original cog of the Hanseatic period is to be seen anywhere else in the world. The design of the cog hall allows the visitors to walk around the ship in the level of her keel and look up at her complete starboard side and perceive its specific shape and its dimensions. A mere layer of gravel prevents the visitors from walking so near to the ship that they might grasp at the planks. As the upper part of the portside is missing the visitors from the first gallery have a full view into the hold and see the construction of the hull from the inside. They can imagine where the cargo was piled up in Hansatic times and see the long keelson with the rectangular hole for the only mast. The upper gallery allows to look from above onto the deck and the aftcastle with a windlass in its middle and a capstan on its top.

When the visitors look through the glassfront of the cog hall unto the dock of the Deutsches Schiffahrtsmuseum they are able to compare the cog with another wooden sailing-vessel, the threemasted barque «Seute Deern» (='Sweet Girl'). More than 500 years younger than the cog, she is the biggest wooder cargo-carrier under sails that has survived anywhere, and the last one under German flag. The cog was the first type of a big cargo carrying sailing-vessel flying the flag of a German seaport. With both original ships, the onset and the end of long tour trade with wooden German sailing-ships are to be seen at one glance. Some figures may illustrate the long development from one to the other. Compared with the «Seute Deern» the Bremen cog appears tiny, though she in her days was one of the biggest ships of her homeport. Her overall length is 23.23 m and the maximum breadth 7.62 m. The resulting length to breadth ratio of ca. 3:1 makes her a rather sturdy ship, while the «Seute Deern» with her overall length of 75.7 m, her breadth of 11 m and the length to breadth ratio of her hull of ca. 5.6:1 is a slender ship, which could carry a cargo of 955 t at a draught of ca. 5 m. The cog is midships from keel to wash-strake 4.26 m high and weights about 60 t. Fully loaden she could carry 44 herring lasts (= 84 t) at a draught of ca. 2.25 m and a remaining freebord of 2 m (Kiedel & Schnall, 1985: 81). As usual with medieval ships even the cog could carry only little more than her own weight! Though both ships are square riggers they very much differ in their rigging. While the cog had not more than one mast and one square sail of ca. 200 m^2, the «Seute Deern» has three masts with up to 23 sails (ten of them square) covering in total 1418 m^2. As all these sails could be handled one after the other for such a big ship with eleven times more cargo than the cog, a crew of only 28 men was enough.

For the cog the number of crew cannot be derived from shape and size of the hull, but has to be found in

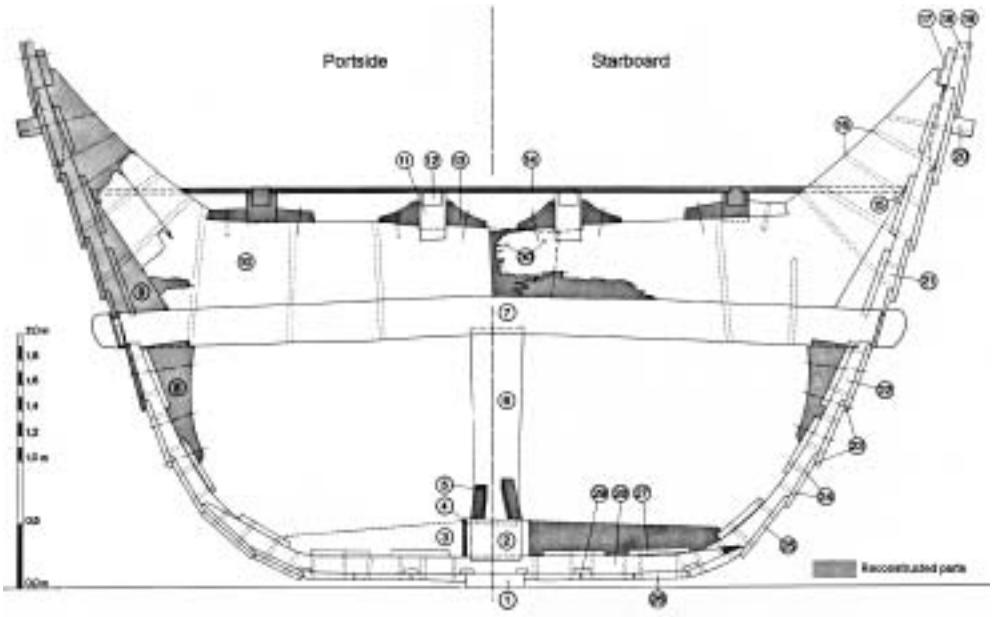
written sources. So far only two documents from AD 1403 and 1404 are known and they fit with the Bremen cog: an Elbing ship of 50 herring lasts and another Bremen ship of 44 herring lasts both are told to be sailed by crews of eleven men including the skipper (captain); but nothing is said on the structure of the crew. We just know that cogs normally sailed day and night, which made two watches necessary, that of the skipper with four sailors and that of the helmsman with four other sailors, resulting in ten men for the handling of the ship. The eleventh man was the cook, who had to serve both watches. But as Hanseatic merchants or their agents for their trade used to sail in cogs, which carried their goods, often some more people were on board and lived together with skipper and helmsman in the cabin underneath the aftcastle, where they were protected from rain and storm. The oldest evidence for this cabin is the Stralsund seal of 1329 (fig. 3). From then on, the men «behind the mast» were better off than the rest of the crew, who lived «before the mast», where cogs had no cabins or other shelters. These sailors just had to sleep on the open deck or underneath, on top of the cargo, in their own sleeping bags made from animal skins with the hairs to the inside (Ellmers, 2003). The cabin of the Bemen cog was furnished with a long bench to sit down or to sleep and as the most modern luxury for the first time on board it was a ship with a real toilet! Thus the visitors get an unforgettable impression of the beginning of the distance which determined the relationship between officers and crew during all the following centuries of seafaring.

All these new insights into the daily life of the sailors are the result of scientific research, which parallel to the work on the remnants of the hull was carried out under the leadership of the author of this article. Due to the importance of the cog and having been a nautical archaeologist from 1971 for the new museum, he had been elected as the first director in charge. Sailing the replicas of the Bremen cog as part of the research programme (fig. 5) led to surprising results. As the flat keel (see fig. 6) did not sufficiently couterbalance the drift off, the cog made so little good when sailing against the wind that Hanseatic skippers depended on winds from behind or from the sides for their long tours and very often had to wait for these winds, especially when they wanted to sail westward. Today we can hardly imagine how long medieval ships sometimes had to wait. One accidentally reported example is a fleet, which in early spring in 1417 had sailed from Lübeck to Novgorod to buy the new furs from the winter-season 1416/17, but even at the end of September they were not yet back «as there was no eastern wind»! In the Baltic the compass was introduced only in the fourth quarter of the 14th century. Previously cogs had to sail in sight of the coastline. Before a strong wind blowing towards the land could press a cog against the shore or when a storm was coming, the skipper, with his cog, tried to get to an anchorage in lee of an island or promontory as quickly as possible and waited there until the storm calmed down. Good knowledge of such sheltered places against any direction of the winds for every skipper was the prerequirement for secure transport of goods in cogs. On the other hand cogs under favourable conditions could sail rather quickly. At the shore of the island of Ösel in the 13th century some cogs waited three weeks for good conditions and then in one night covered the 127 sm strait across the Baltic to Visby in one night using the polar star as guidemark (Ellmers, 2003).

The installation of the first cabins underneath the aftcastle in the 14th century caused a momentous change in the way how the skipper guided his ship. Before that, he could guide the ship along its course, control its position and could regularly inspect its condition while steering it from the aft part of the deck with the tiller in his hand. But when the man at the tiller had to stand underneath the castle-deck in between the long cabins at both sides and behind the heavy windlass, he could no longer look around the sea nor could he even see his own sail. From this postion the skiper could not guide his ship any longer. For the first time he had to delegate some aspects of his responsibilities. He found his new position on the deck of the aftcastle, from where he could watch all he had to watch. But for the handling of the tiller he had to appoint another member of his crew, who had to move it after the continual advice of the skipper standing

Fig. 6a. Midship section of the Bremen cog (1380). (Reconstruction: W. Lahn; Drawing: R. Schultze/ Deutsches Schiffahrtsmuseum)

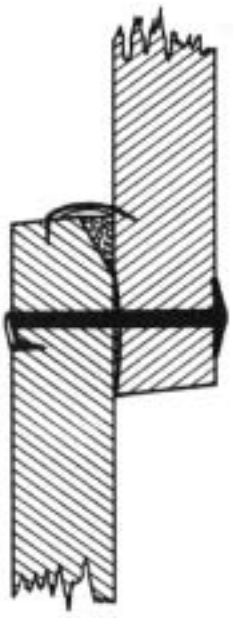
1 Keel
2 Inner keel with mast step
3 Pillar of the mast step
4 Strengthening of the mast step
5 Oblique pillar
6 Pillar of the crossbeam
7 Crossbeam
8 Beam knee
9 Wedge
10 Bevel knee
11 Longitudinal beam
12 Beam scarph
13 Cam
14 Deck board
15 Deck ceiling
16 Dowels
17 Washboard stringer
18 Bulwark stanchion
19 Washboard
20 Channel wale
21 Top timber
22 Futtock
23 Frame dowel
24 Nails
25 Clinkered plank
26 Carvel plank
27 Inner plank
28 Floor timber
29 Limbers
30 Scarph dowel



above his head. This job sharing proved its success and since then it became custom on board of ships up till today (Sauer, 2002). The visitors are able to see the above installation, which produced that far-reaching change in the guidance of ships.

Another branch of the research programme was field-archaeology for new shipfinds in Germany. The Deutsches Schiffahrtsmuseum cared for some of the medieval ones and started their conservation after the method developed for the cog, with the aim to exhibit a medieval fleet with the cog as flagship (Hoffmann, 1992). Two riverboats are already accompanying the cog in the exhibition. The first one represents the Rhenish type of an «oberländisches Schiff» in a small version built around AD 1000 and excavated near Krefeld. To construct this vessel a logboat was split lengthwise in two halfparts, in between which two bottom-strakes were inserted and both ends were closed by transoms to form a cargo-vessel much wider than the mere logboat. In Hanseatic times bigger versions of this type were the predominating cargo-ships of the Rhine upstream of Köln (that is why they were called 'oberländisch') and made this town the Hanseatic market for all the goods of the rich countries along the upper and middle Rhine, in the first place for wine (Ellmers, 2004: 55-59). The other exhibited shipfind is a long riverboat with a flat bottom and narrow clinker-built sides, built in 808 or a few years later, and excavated in Bremen at the bank of the river Weser. Its type is not yet known. In the boat some Frisian potsherd (with grinded shells in the fabric) were found. This type of pottery was transported upstream the Weser in the first half of the 9th century as far as the famous Karolingian monastery of Corvey, all of which indicates the reach of Frisian inland trade (Ellmers, 1985: 44-46). The third shipfind is not yet ready for exhibition but it is extremely interesting for the development of the cog type. It was excavated at the bank of the Weser inside the medieval city of Bremen as well and it is the undermost portion of

Fig. 6b. Clinker seam of the Bremen cog (1380). (From: Kiedel & Schnall, 1985; Drawing: W. Lahn/Deutsches Schiffahrtsmuseum)



the aft end of a cog built about AD 1170 (Rech, 2001: 52) on top of a logboat with a protruding end carved out of the solid in shape of a sternpost with an iron gudgeon for a centreline rudder nailed onto it (Wesemann & von Fick, 1993). This is in fact the oldest evidence of this type of rudder (fig. 7).

How could this rather small fragment of the underwater part of a ship be identified as that of a cog? It could never be compared with the cog above waterline on the Stralsund seal (fig. 3) as Fliedner could happily do with «his» nearly complete wreck. But as this was proved to be a cog by its shape, the museum staff analysed its specific construction with the aim to find those criteria which might enable other archaeologists to identify even small and decayed fragments as cogs. As starting point for the following archaeological definition of a cog, the Bremen cog served as the key which opened a new door for the correct historic interpretation of a hitherto unknown shipbuilding tradition. Though the Bremen cog is clinker-built it differs so much from the clinker construction of Viking ships that they cannot have been developed from the same root as historians thought before. Whereas the Viking ships have elegantly curved lines with a deep reaching keel out of which the stem- and stern- posts rise in elegant bows, the Bremen cog has box-like contours with a keel exceeding the flush laid planks of the flat bottom by not more than 5 cm (fig. 6). Heavy strait stem- and sternposts meet the keel in sharp angles (fig. 4). Whereas the planks of Viking ships are split and normaly up to 3 cm thick and up to 30 cm broad those of the Bremen cog are sawn, 5-6 cm thick and up to 65 cm broad. Viking planks are joined by iron rivets, the points of which are hammered flat over lozenge-shaped roves; the planks of the clinker-built sides of the Bremen cog are kept together by iron nails, the points of which are bent again into the inside of the planks and the caulking is covered by narrow laths kept in position by flat iron caulking clamps, which in Hanseatic times were known as «sintel». Several of these constructional details prove that the Bremen wreck, built in ca 1170 (fig 6), was the fragment of a cog.

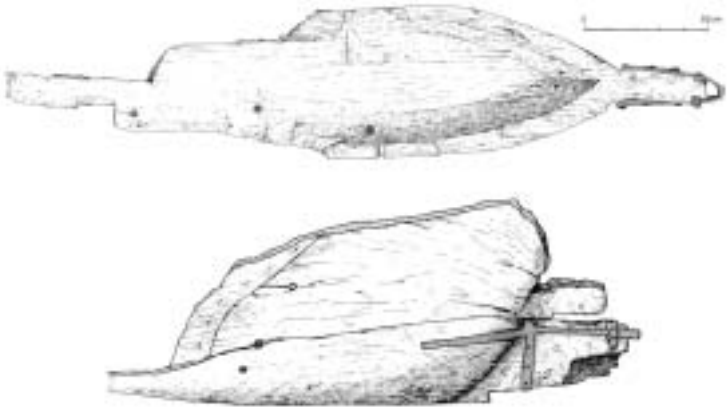
As a result of this research archaeologists are now able to differentiate the remains of Viking ships from those of cogs even when no timber has been preserved at all, just by the different iron fastenings in the clinker seams. Using the hooked cog nails and the caulking clamps as guides, some very interesting facts emerge. The Bremen cog was not the first cog to be excavated; she was only the first one to be identified as a cog. For example, Wreck V of Kalmar in Sweden, excavated in 1933-34, was also a cog (Åkerlund, 1951: 78f). Meanwhile more than two dozen cog wrecks in different stages of decay are recovered (Crumlin-Pedersen, 2003; Hoffmann & Schnall, 2005: 19), all with rather few objects on board, as most of them were stranded or sank in harbours and obviously the crew or inhabitants of nearby villages had used their chance to get as much as possible from the cargo and equipment. Nevertheless in some of them one found tools for eventually necessary repairs, in some others the left over of ship food and kitchenware, in others some weapons. In short, they open deep insight into hitherto unknown details of the everyday life on board of cogs (for the following: Ellmers, 1995). For example there is information on what sailors did in their spare time: in one cog-wreck a complete set of wooden nine-men's moris pieces was found, all hand-carved obvi-

Fig. 7. Part of a logboat as a structural member of a cog built ca. 1170, excavated at Bremen, with the oldest evidence for a cetreline rudder. (From: Wesemann & von Fick, 1993)

ously by a sailor himself. Every cog seemed to have had a stove consisting of a narrow wooden chest filled with clay, the horizontal surface of which in some cases was covered with a layer of bricks as a support for the open fire into which the clay or metal pots were put for cooking the food.

The spiral featherings of crossbow-arrows found in one of the cogs gave these arrows the same spin, which in the 18th century made the bullets of rifles so unerring. Obviously crossbow-men on board of cogs were sharpshooters, who from their high positions on top of the fore and aft castles could make very effective use of the armour-piercing steelheads of their arrows. In this way even the small crew could defend a cog against pirates, since sailors were well trained in crossbows. In case of war cogs could easily be converted into warships by manning them with as many armed soldiers as possible. A Hamburg cog for example in 1368 had 60 soldiers and 20 sailors on board (Ellmers, 2003: 172). Though the Hanseatic League did not go to war to make conquests, it was very effective in defending its favoured position in trade against kings as well as against pirates (Fritze & Krause, 1989).

Since the decks of cogs were not waterproof and every rain and spray and waves in stormy weather penetrated through the deck into the bilge, sailors of cogs must have been very uncomfortably off as the North Sea and the Baltic, where the cogs sailed, are a zone of rain and storms. No wonder that these sailors are very often depicted in hooded coats (fig. 3) made from loden. As they had no sheltered room these coats were their only protection against rain and spray. But in continuous rain the sailors were wet to the skin after a while and nevertheless had to pump the water out of the bilge more often than on board of any later ship with a waterproof deck. The outlets for the pumped out bilge water are to be seen at both sides underneath the castle-deck of the Bremen cog.



In cog wrecks only very few fragments of cargo have been found; what cogs transported is much better known from written sources. The main imports were fur and wax from Nowgorod, iron, tar and butter from Sweden, herring from Scania, stockfish from Norway, wool from England and cloth from Flandres. The most important exports were wine from the Rhinevalley via Köln, beer from Bremen and Hamburg, salt from Lüneburg via Lübeck into the Baltic, grain and grainproducts from the seaports along the southern shore of the Baltic, timber from Danzig and flax and hemp from the eastern Baltic. Archaeology just gives insight into some special objects of transport and into the nearer circumstances of cargo

Fig. 8. The tar-barrel of the Bremen cog and its lid with the engraved trademark of a merchant (1380). (Photo: E. Laska/ Deutsches Schiffahrtsmuseum)

handling. For example the evidence from the leaky deck in cogs tells us why not only beer, wine and oil or salted herring had to be transported in barrels but also that every good had to be protected from water, for example books. Thus the barrel was the mostly used container in trade by cogs and the business of coopers was flourishing. Every barrel in Hanseatic trade was signed with the personal trademark of a Hanseatic merchant, an arrangement of some strait lines, which among the analphabetic sailors and dockers had the same function as the later consignment note. Each barrel with a trademark was precisely delivered to the house of the merchant whose mark was engraved into its lid (Ellmers, 1995: 211f). When this merchant sold the barrel with its contents, he crossed out his mark. So did the Bremen merchant, from whom the shipwright of the Bremen cog bought the barrel full of Baltic tar found in that ship (fig. 8).

One has found wrecks with the constructional details of the Bremen cog and in seaports even the characteristic nails and calking clamps and other minor fragments of cogs along the Hanseatic trade-routes in the Baltic as well as in the North Sea from Belgium and London in the west (Goodburn, 1997) to Bergen/ Norway in the North. As long as the keel is at least completely preserved, even badly decayed wrecks allow to compare their seizes and cargo-capacities with that of the Bremen cog, with her 15.6 m long keel (Crumlin-Pedersen, 2003: 246). Among the cogs of the 14th century only that one found at Skanör/Sweden with her 18.7 m long keel was much bigger and could carry much more cargo than the Bremen cog. Several cogs are of roughly similar or smaller size. Definitely much smaller is a group of cogs excavated in the Ijsselmeer-polders with keels from 8.5 to 12.6 m long. That with the 12.6 m long keel had much lower sides than the Bremen cog, sank with a load of ca. 20 t bricks and was obviously engaged in regional shuttle traffic between the coast and the inland. From an earlier trip, lying between the ribs there were still several seashells, transported from coast to inland for the extraction of lime (Ellmers, 1995: 209f.). Of special interest it is finally a nearly 6 m long and 1.3 m wide boat, built in 1269 and excavated at Rotterdam in 1991 (van Holk, 2001). With a flat bottom of three flush laid strakes, steep straight stem- and sternposts, clinker-built sides with hooked nails and moss caulking under narrow laths, kept in position by iron spikes, it has all the characteristics of the bigger cogs and therefore it has to be considered as a product of the same shipbulding tradition as the cog. When the first big Viking ship was excavated at Gokstad, Norway, in 1880 three minor boats of different sizes were found, too, being constructed after the same principles as the big ship. Thus from the start it was known that the shipbuilding tradition of Viking ships included big ships as well as small boats. In the same way the shipbuilding tradition of the cog comprises big cogs of different sizes for what were long tours in those days, small cogs for regional purposes and small boats for different uses in local waters or as dinghies of big cogs.

At Novgorod, where Hanseatic merchants had one of their trading centres, in layers of the 12th-13th centuries has been found the 1.22 m long end of a logboat, which in the same way as the logboat in the Bremen cog fragment of AD 1170 (fig. 7) had been part of a smaller boat, probably the dinghy of a cog (Dubrovin, 1995). In early Hanseatic times this part of a logboat under the term

«kanenblok» was a very well defined constructional element within the shipbuilding tradition of the cog. It was object of trade to such an extent that a special custom tariff was fixed for it, for example at Hamburg in 1260. As we learn from that term the small boat of the cog tradition was known as «kahn». Even mere cog shaped logboats in Schleswig-Holstein were called «kahn» and used in coastal fishing. Of the four excavated ones only one could be dated; it had been carved in the 15th– 16th centuries (Ellmers, 2004: 60-62; Crumlin-Pedersen, 1966).

Within this manifold shipbuilding tradition the Bremen cog of 1380, with her fore and aft castles, represents the most developed version of the big cog for long tours. At the same time in smaller Hanseatic towns such as Kiel or Wismar the biggest cogs for long tours did not have any castles as it is seen from their respective town seals, which always depict their greatest ship. Before the late 13th century no cog had castles and in the 12th century cogs were less wide and less high than the Bremen one, so that they, in spite of keels up to a length of 18.6 m, could carry much less than the Bremen cog (Crumlin-Pedersen, 2003: 264). Among these only the cog wreck found at Kollerup in Jutland with a building date of 1150 is older than the Hanseatic league, which started in 1159 when the seaport Lübeck was founded in the south-west corner of the Baltic as a bridgehead of the German trade across the Baltic as far as the east coast of Sweden and Novgorod in present Russia.

For the older history of this shipbuilding tradition up till today shipfinds are missing. There are just some 60 hooked nails from reused cog planking at the trading centre in the island of Birka near Stockholm, dated to the 10th century, several hooked nails and caulking clamps of 8th/9th centuries at the Frisan trading centre of Dorestad, Netherlands, and a dozen small 9th century coins struck at Hedeby in Schleswig-Holstein and Ribe in southern Jutland with cogs depicted on them. Finally cogs are mentioned in a few 9th and 10th century documents in the Netherlands. All this evidence is found along the main Frisian trade route from Dorestad via Hedeby to Birka. As we learn from those coins, these Frisian cogs in the 9th century had one mast with one square sail, a flat bottom and strait and steep stem and stern posts, which met the bottom nearly in a right angle. The sides are clinker-built from four strakes and therefore cannot be higher than 1.8 m. These relatively low and small cogs were steered by a special type of side rudder, which clearly differs from the side rudder of Viking ships, and survived until now in the lake of Steinhude near Hannover, where it is known as «Firrer» and its specific mode of operation can be studied. When Hansatic merchants in 1159 started to sail across the Baltic from Lübeck for the first time, they made use of this Frisian cog type, which then still had the side rudder of type «Firrer», as is to be seen on the town seals of Lübeck. But as Hanseatic trade flourished, bigger cogs soon were needed, which no longer could be steered by the «Firrer». Thus at the latest ca. 1170 the centreline rudder (fig. 7) was used instead for the first time (Ellmers, 1994) and proved to be so successful, that after a short while no other steering gear was used any longer with big ships up till today.

Towards the end of the 14th century the development of big cogs for long tour trade reached its peak. The youngest cog of this category found so far is that of Skanör, built in 1396. With her 18.7 m long keel she is at the same time the biggest excavated one (Crumlin-Pedersen, 2003: 264). A new ship type, the «hulk», which along both sides of the Channel had developed into a bigger ship than the cog, pushed her out of traffic. In 1400 a new Danzig (Gdansk) townseal already showed the hulk and in 1453 a cog was mentioned for the last time in a Hanseatic document. In contrast to the big cogs for long tours the smaller versions within the same shipbuilding tradition remained much longer in use. Small cogs served for regional transport in the Netherlands for further centuries to come. Such a cog with a 12.7 m long keel and 1.93 m high sides sunk ca. 1430 in the Zuiderzee. It was excavated in 1986 (Hocker & Vliermann, 1996), leading over to coastal vessels of cog shape as depicted 1627 in Dutch coppers, where they were known as «kaghes» or «kochs» with cargo capacities between 12 and 22 t (Stettner, 1996; Crumlin-

Pedersen, 1966), which fits very well with the excavated smal cogs of the 14th century. Just the sail had been changed meanwhile from square sail to sprit sail, which could be operated by a smaller crew. The «kahn», the small boat within the shipbuilding tradition of the cog, even survived in different versions in Northern Germany as far as the late 20th century, when the construction of wooden boats came to its definite end (Ellmers, 1994).The boat hall of the Deutsches Schiffahrtsmuseum presents several original ones to the visitors. They are shown how that very chapter of nautical history, which the discovery of the Bremen cog opened up, was closed towards the end of the last century.

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