An early 17th-century 'half-carvel' construction in the North Frisian Wadden Sea: The Japsand wreckage near Hallig Hooge, Germany

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Abstract: This paper outlines the research results of a recent discovery of two early 17th century wreck fragments of a mixed clinker and carvel construction – a so-called 'half carvel' – at the Japsand, an outer shoal of the island of Hooge in the North Frisian Wadden Sea, Germany. The description is followed by a discussion on how this find could be contextualised in terms of a northern European shipbuilding tradition and ship-type. This paper advocates that 'half-carvels' ought to be seen as part of a broader phenomenon of carvel-analogous shell-first lapstrake constructions prevalent in the Baltic Sea and beyond.

Key words: half-carvel, clinker, carvel, shipbuilding, North Sea, 17th century

1. Introduction

In February 2017, an articulated slab of mixed clinker and carvel planking was discovered by a group of mudflat hikers at low tide to the east of the Japsand, an outer shoal ca. 2 km to the west of the island of Hooge in the federal state of Schleswig-Holstein, Germany (Fig. 1). A few days after this find was reported to the State Archaeology Department of Schleswig-Holstein (ALSH), the ALSH sent a team to the island, as it was feared that this wreck fragment might be relocated by tidal currents. With the assistance of local volunteers, the hike across the mudflats was carefully planned, which involved wading through several tidal creeks. A very short time window of about an hour was planned for the documentation of the wreck, involving GPS localisation, a photographic documentation suitable for a Structure-from-Motion (SfM) photogrammetry, individual sketches, and sampling for a dendrochronological analysis (Fig. 2). The remaining time was required to transport the equipment and samples off site. The team left well before the incoming tide. Although the mudflats could still be traversed for some hours after the lowest ebb, the rising water level in the tidal creeks could have cut off the line of retreat. In May of the same year, another slab of planking was discovered at a distance of ca. 400 m to the northwest of the former. This fragment was discovered on the Japsand itself and needed to be partially excavated (Fig. 3). It had the very same features as the first slab and both wreck fragments would fit together like pieces of a puzzle. There can be little doubt that both fragments originated from the same vessel, which is also corroborated by their identical dating (*cf.* Zwick *et al.* 2018).

Due to the short time window in which the survey had to take place, the wreck fragments could not be studied in greater detail and the exposed location of wreck fragment 1 (WF1) led to its loss shortly after the investigation. WF2 remained *in situ* and was gradually covered by sands again. It was detected through a multi-coil FD-EMI survey three years later, in which WF2 was used as test case to optimise this technology (*cf.* Wilken *et al.* 2022).

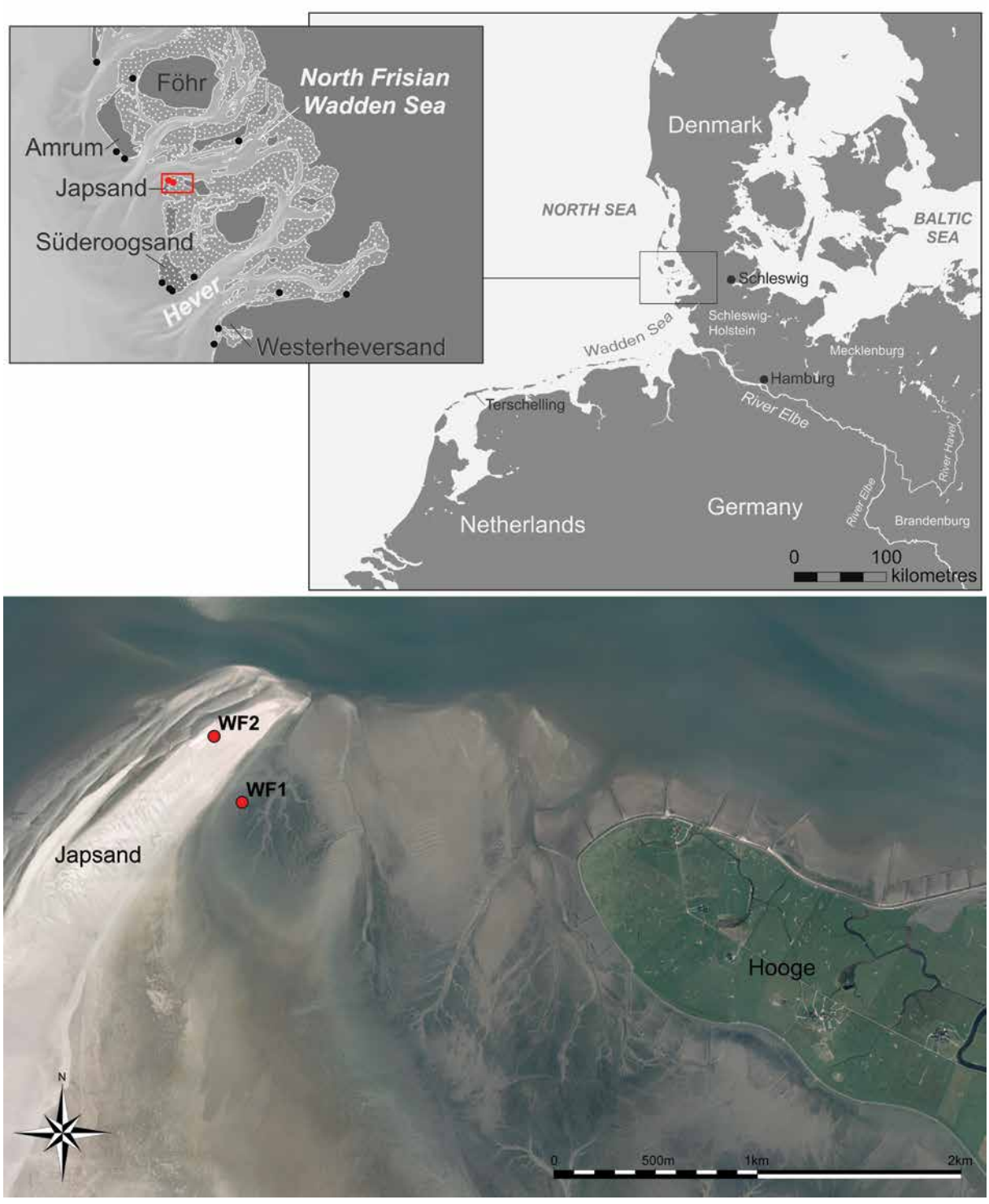

Fig. 1 The location of both wreck fragments WF 1 and WF 2 in a satellite image of the Japsand and the island of Hooge. The map excerpts indicate the location of the Japsand wreckage (red) in the general geographical context, the tidal mudflats (white dotted areas) of the North Frisian Wadden Sea, and other archaeologically investigated wrecks (black dots) (graph: D. Zwick; satellite image: GeoBasis-DE/LVermGeo SH/CC BY 4.0).

Fig. 2 The documentation of the first wreck fragment (WF1) in February 2017 (photo: ALSH)

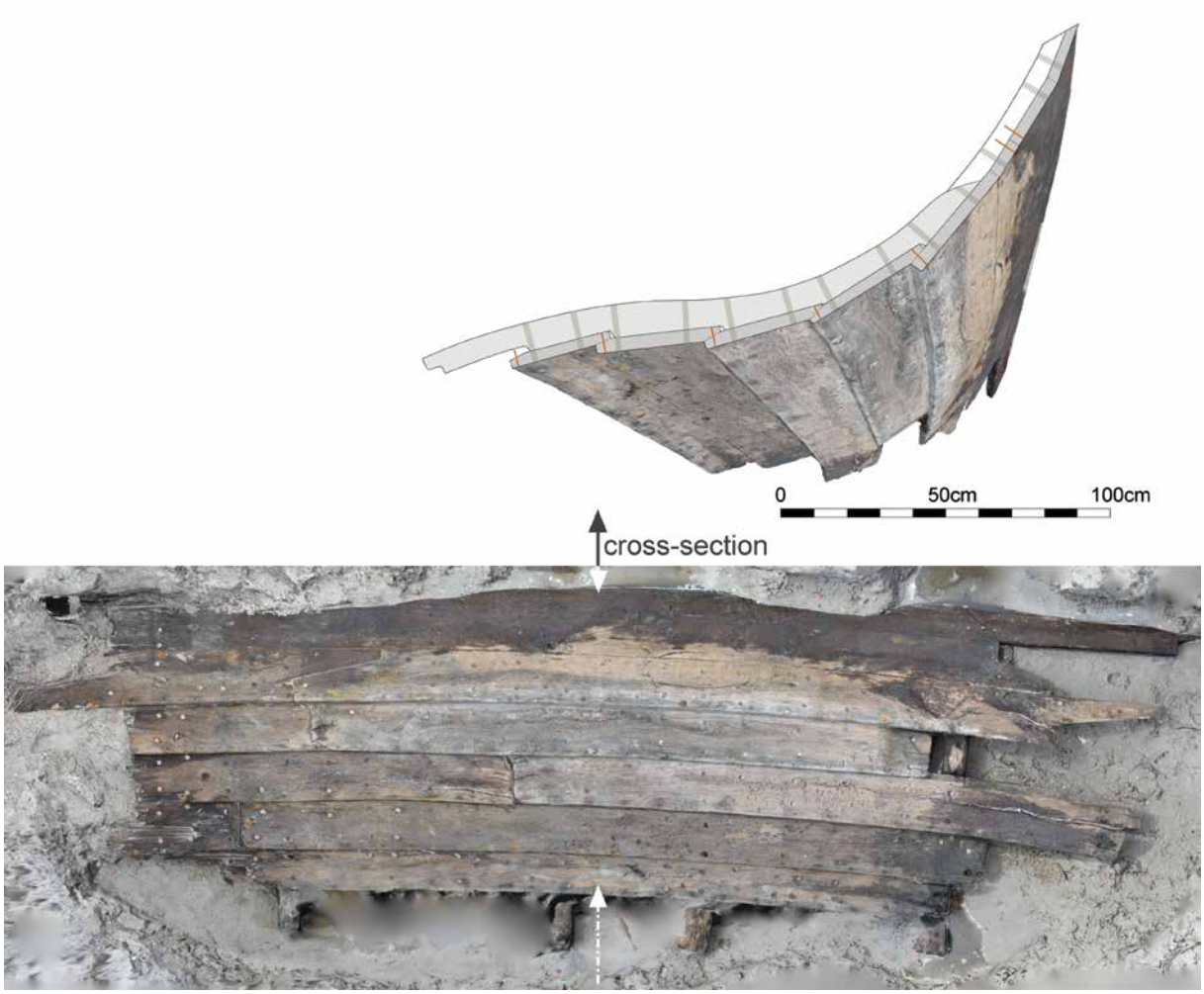

Fig. 3 The second wreck fragment (WF2) as recorded in May 2017. The orthogonal projection and cross-section view was generated as SfM-model with Agisoft Metashape on the basis of over 200 photos. The framing and fasteners were schematically added (graph: D. Zwick).

2. Description of the construction

In terms of general dimensions, the first wreck fragment is ca. 4.5 m in length and the second ca. 9 m. If fitted together (Fig. 4), the combined slab would measure roughly 12 m in length.

Of the first fragment, five strakes (two clinker, three flush-laid) and of the second fragment seven strakes (four clinker, three flush-laid) are remaining. A strake sheer is discernible and in WF1 a slight increase of plank widths could be observed towards the ship's midship area, i.e. strake 1 from 35 to 38 cm, strake 2 from 33 to 34 cm, strake 3 from 34 to 35 cm, strake 4 from 32 to 35.5 cm, strake 5 from 34.5 to 36 cm.

The plank widths vary between 32–38 cm and the plank thicknesses seem to be fairly consistent at ca. 4.5 cm. The tree-ring structure observed in the sampled planks' cross-sections indicate that they were tangentially extracted from the trunk and most probably sawn, as indicated by the regular thickness and the absence of adze marks on the even surface. While the flush-laid planks[1] are fastened to each frame normally with three treenails, sometimes less, most clinker planks[2] were fastened with two treenails as well as iron fasteners on the upper and lower landing at a fairly regular distance of 22 cm +/- 2 cm in the centre of the landing, measuring ca. 6.5 cm. The iron fasteners were subject to an advanced state of corrosion, leaving only some rectangular rivet plate impressions measuring ca. 2.5 × 2 cm. The nail shafts are ca. 0.9–1.0 cm in thickness.

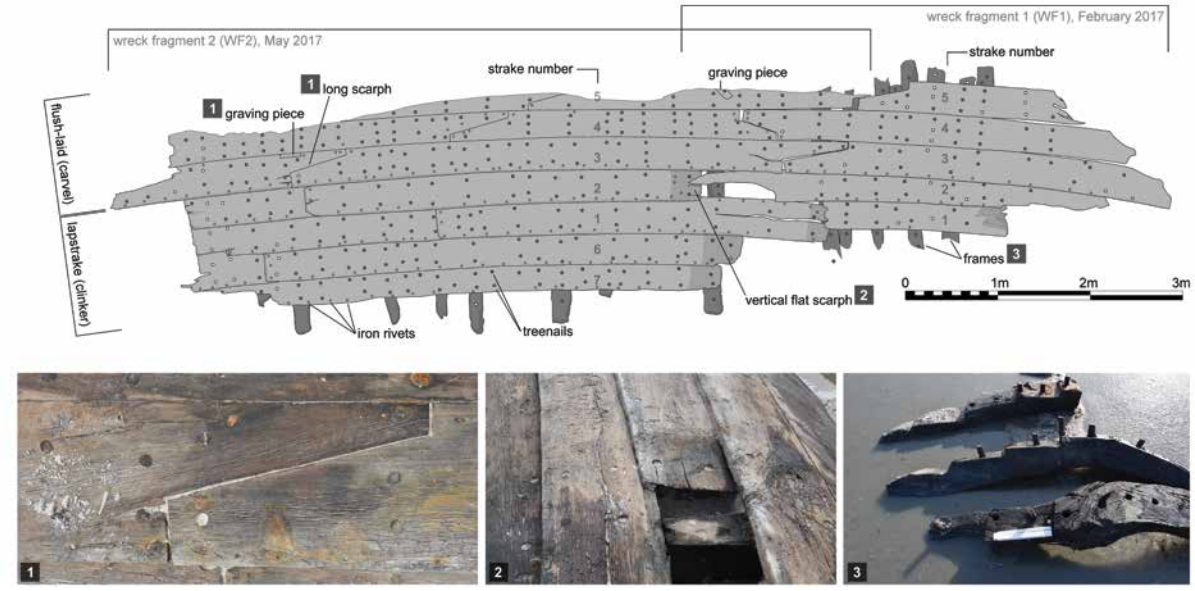

Fig. 4 Plan of both wreck fragments hypothetically fitted together (graph: D. Zwick, photos: ALSH)

Nails were also used to reinforce the long scarphs (ca. 60 cm, Fig. 4.1) of the flush-laid planks, as well as the flat scarphs (ca. 30–40 cm, Fig. 4.2) of the clinker planks. In the case of the flush-laid planks' scarphs, the tapered ends were secured with 1-2 iron fasteners onto a frame. Thus, the frame has to be in alignment with both tapered ends. Based on the observation of the frames protruding from beneath the slab of planking, this indeed seems to be the case. Naturally warped timber – i.e. compass timber – was used to ensure that two closely spaced frames were inserted at the beginning and the end of the flat scarph. The framing seems highly irregular both in terms of dimensions and bend (Fig. 4.3). A general pattern, however, is the greater curvature of framing timber at the joggled outer side – that is the side to receive the clinker planks – and thus it could be inferred that this must be the turn of the bilge (Fig. 3). Just above the turn of the bilge, the planks were laid flush, thus the clinker-built portion of the hull must have been below the waterline. As a consequence, the vessel must have appeared as a carvel-construction to the outside observer. Some top-timbers

[1] The term 'flush-laid' essentially describes the appearance of carvel-planks, forming a smooth outer surface. As the skeleton-first principle is often implied when speaking of carvel constructions, it makes sense to use the term 'flush-laid' in a context in which a shell-first or alternating building sequence was applied. Nonetheless, the term 'carvel' has become commonplace even for those constructions and in most languages the distinction between 'carvel' and 'flush-laid' is not expressed through terminology, so the term 'carvel' in the original and restrictive sense cannot be upheld in this article throughout, as terms like 'half-carvels' have become proper nouns despite their inadequacy.

[2] The term 'lapstrake' is used as umbrella term for vertically overlapping planks, which prominently includes clinker (implying the use of rivets). Since the distinction of 'lapstrake' and 'clinker' is not made in other languages (e.g. in German or Swedish), 'clinker' is often synonymously used for lapstrake.

ended just slightly above the turn of the bilge, arranged in between the floor-timbers and not interconnected. Some of the framing timber at the turn of the bilge turned backward at the lower end, forming a slight S-shape, indicating its proximity to the keel.

Two oblong graving pieces in the carvel planking of the second fragment were observed, which are not necessarily later repairs, but could have been inserted over a knot for watertightness.

3. Date and provenance

WF1 was extensively sampled, whereas only few samples were taken from WF2. All samples are of oak. The sample code 'P' indicates plank and 'S' indicates frame. Based on the dendrochronological analysis, the timber was cut between 1603 and 1609, or possibly later. The latest date with sapwood inclusion is provided by sample 'S8' with a felling date of 1609, providing a *terminus post quem* and thus indicating that the vessel could have not been built before that year. Sample 'S12' did not contain sapwood or wane and if a standard margin of 20 years is added, the hypothetical felling date would be 1617.

Sample	Start	End	felling year
Wreck fragment 1 (WF1)			
P 1	1473	1575	Around/after 1595
P 2	?		No result
P 3	1459	1515	Around/after 1536
P 4	1467	1553	Around/after 1573
S 7	1473	1603	1603
S 8	1498	1609	1609
S 9	1515	1607	1607
S 11	1418	1586	Around/after 1606
S 12	1517	1597	Around/after 1617
Wreck fragment 2 (WF2)			
S1			1608
P2			Around/after 1584

Table 1 Dendrochronological results provided by Dr. Karl Uwe Heußner March 24, 2017 and July 20, 2017

Therefore, the building of the vessel will probably have occurred during the second or third decade of the 17th century. The highest correlation of the first fragment is with regional curves of the Swedish island of Öland with a t-value of 7.1. There is also a relatively high correlation with northern Germany, i.e. Schleswig-Holstein, western Mecklenburg, and Hamburg. The second fragment also has high correlations to northern Germany, particularly western Mecklenburg and the Havel region (Ostprignitz-Ruppin) in Brandenburg. In summary, there is no clear provenance but it is safe to assume that the vessel's timber originated from the south-western Baltic Sea region. Since there are no strikingly different locations, the differences could be attributed to the blurred nature of the inconclusive dendrological analysis, and therefore it seems fair to suggest that there is an absence of regional variation in the sourced timber. This is also highlighted by the fact that oak was used for all elements of the preserved hull. This is an indicator for:

- an abundant availability of oak timber near the shipbuilding site. The cost-benefit assessment on the use of oak in sections of the hull that could be built with a less expensive wood species was likely offset by transport costs (in that it was less costly to use more expensive timber than to import other wood species to the shipbuilding site).
- a rural setting, in which the building timber for the vessel was sourced locally – probably from a singular forest – rather than from different groups of imported timber, as was common in an urban setting at that time.

This impression is also corroborated by the graving pieces at the plank edges. If they were inserted during the vessel's construction (e.g. necessary to patch over knots to insure water-tightness), this would be an indicator for the absence of a specialised access to import timber suitable for planks, and an indicator that the craftsmen were obliged to make best use of the locally available timber.

4. Inferences on wreck site formation

The Japsand is the northernmost of the three North Frisian barrier islands, i.e. an outer shoal with an elevation of ca. 1 m above the mean high water, which can be entirely flooded at astronomical peak tides or storms. These shoals are subject to a long-term coastal erosion process affecting the entire western shoreline, which also led to the discovery of the Hörnum Odde wreck (ca. 1690) the year before at the southern tip of Sylt (Zwick 2021). Sedimentation takes place to the east, thus the shoals are effectively 'relocating' up to 20 m eastwards per annum[3]. The find location of WF1 is peculiar, as it was discovered in a mudflat area normally not affected by erosion. It can be presumed that it was also formerly situated at the Japsand and broke off from WF2 recently. This is corroborated by the fact that WF1 lay totally exposed and with no scour, which is an indicator that the relocation must have occurred shortly before its discovery.

Fig. 5 The destruction caused by the Burchadi Flood of 1634 in a contemporary engraving entitled "Die erschreckliche Wasser-Fluth" (after Henssberg aus Happel, Historische Kernchronik 1682)

WF2 was almost entirely covered by sand, but must have migrated as well, as the Japsand formed in the late 19th century. On a map of 1864 its emergence is indicated by the sandbank 'Junge Jap' (young Jap) further south, whereas the find location of the Japsand wreckage corresponds to a mudflat area with the name Knudshörn (*cf.* Handtke 1864). Therefore, it can be ruled out that the wreckage was deposited in the Japsand for more than a century, which must have eroded from a deeper channel or migrated with the sand mass to its current position. The absence of marine borers indicates that it must have been covered by sediments for most of the time. This is contrasted by another wreck fragment

[3] Wattenmeerstrategie 2100 (government paper), pages 21–22: https://www.schleswig-holstein.de/DE/Fachinhalte/K/kuestenschutz/strategieWattenmeer2100.html (accessed on January 18, 2021).

from the Japsand, an 18th-century sternpost with plank fragments (hood-ends and stealers), rudder-pintles and copper sheathing, which was heavily degraded by *teredo navalis* (Kühn 1999: 35f.).

Due to the absence of associated finds or dateable evidence for later repairs, a lifespan for the vessel could not be inferred from the find itself. In view of the construction date in the 1610's or thereafter, the Burchadi Flood of 1634 seems a relevant date, which devastated the entire coastline of the Wadden Sea (Fig. 5). The storm flood had such a force that even large seagoing ships were swept across dykes into the streets (*cf.* Riecken 1991: 12). The fact that sizeable slabs of articulated planking have disintegrated reflects the forceful impact on a hull's structural integrity, suggesting a major meteorological event as cause for the loss of the vessel.

5. Conceptual similarities and contextualisation

The most striking feature is the mixed planking, with clinker planks on the lower portion of the hull and flush-laid planks on the upper part. This type of construction has been commonly viewed within a Scandinavian context, dubbed 'half-carvel'. A notable case was documented in Bohuslän in 1938, western Sweden (Hasslöff 1970: 58f.) (Fig. 6). The vessel under construction was not referred to as 'half-carvel', but as a galeas, and when asked why this mixed construction was preferred, the shipbuilder Anders Mattson attached not much meaning to the carvel-planking, but emphasized instead his preference for building the difficult part of the hull – i.e. the bottom part up to the turn of the bilge – in clinker, for the hull to "take shape under his hands". Once completed, the futtocks and top-timbers would be raised, to which carvel planks would be attached (Hasslöff 1970: 59).

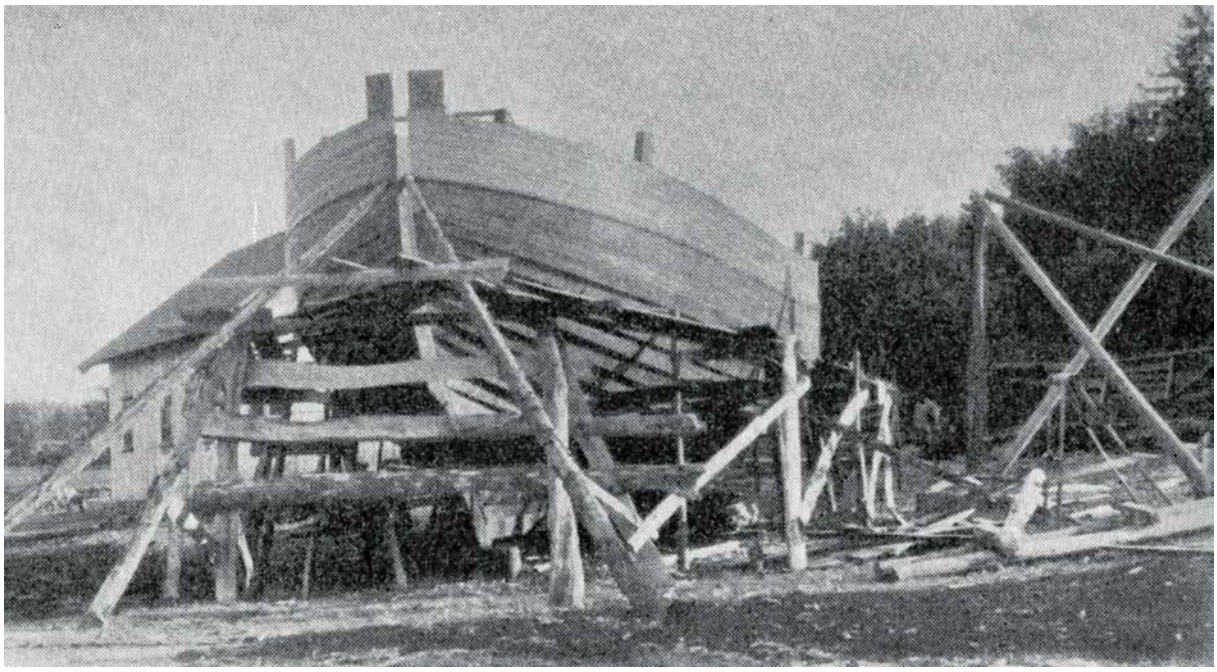

Fig. 6 Anders Mattson's galley under construction in 1938 in Bohuslän, Sweden. The lower portion of the hull is clinker-built and the upper strakes are finished with carvel planks (after Hasslöff 1970: Fig. 19).

Based on this description, the term 'half-carvel' has to be regarded as misleading, as this is first and foremost a shell-first clinker construction, which appears as a carvel only by analogy above the waterline (the carvel part being a secondary feature). Nonetheless, for the lack of a better term, the original term is kept in this article. These half-carvel constructions can be traced from the mid-16th century to the early 20th century and are most common in Sweden (*cf.* Eriksson 2010). Variants occur also in other parts of the Baltic Sea, in the North Sea, along the Norwegian coast, and in the White Sea.

It is notable that the Japsand wreckage is one of the oldest specimens for a half-carvel, predated only by the Åkroken wreck from Sundsvall (Sweden), which timber was sourced from the Swedish province of Jämtland or Finland in 1577 (Eriksson 2008: 5; 2010: 80), and the Terschelling Paal 9/10 wreck of 1546 from the Netherlands (Overmeer 2023: 171). Half-carvels are typically linked to the Baltic Sea, but the recent discovery of the wrecks from Japsand and

Terschelling, as well as Westerheversand at a distance of only some 25 km to the Japsand, raises the question whether half-carvel constructions were a more widespread phenomenon in the North Sea. Although the Westerheversand wreck of 1687 is not a half-carvel, but a construction with alternating lapstrake planks in the upper part (*cf.* Cattryssee 2013: 30ff.), comparable to *sandskuders* in Denmark (*cf.* Gøthche 1991: 85), such constructions were conceptually comparable to half-carvels, as pointed out by Niklas Eriksson (2010, 81f.). Interestingly, all of these North Sea variants were built entirely of oak that was sourced in the general region where the wrecks were discovered, thus forming a contrast to the Swedish half-carvel counterparts, which were mostly built of pine. Another distinguishing feature in the case of the Terschelling wreck is the presence of *spijkerpennen* (Overmeer 2023: 171), a feature linked to the Dutch flush-technology (*cf.* Maarleveld 2013), thus indicating that there were regionally independent developments and not a singular evolutionary branch that lead to the establishment of a specific 'half-carvel' type *per se*.

Arguably, half-carvel constructions like the one encountered at the Japsand have to be regarded as a broader phenomenon in shipbuilding, where minor aspects of carvel shipbuilding influenced traditional clinker or lapstrake constructions either during the construction phase or in a later rebuild. This influence could also be asserted for converted clinker/lapstrake constructions generally, of which several were rebuilt as 'carvels' by the addition of a secondary layer of flush-laid planks (*cf.* Auer, Ditta 2016; Belasus 2017; Grundvad 2010; Mäss 1994; Ossowski 2006).

It must be stressed that the aforementioned half-carvels and variants were not classified by contemporaries on the basis of their peculiar hull construction, but as ship-types based on region, size or rigging, such as (1) 'galeas' (Bohuslän, Sweden), (2) 'skuta' (Roslagen, Sweden), (3) 'sandskuder' (Denmark), (4) 'Nordlandsjekte' (Norway), and (5) 'schooner' (Finland and Sweden).[4] The main connecting factors of all these vessels are their rural character and the coastal shipping routes they were operating on, as well as their reliance on clinker/lapstrake technology or shell-first building methods as guiding principle.

6. Conclusion

Despite superficial similarities to Swedish half-carvels, the decisive question remains whether the Japsand wreckage has to be seen as part of a more widespread phenomenon in carvel-analogous constructions, possibly stemming from an independent development in the North Sea area, or whether it could be specifically linked to a Swedish influence? It dates from the time of the Thirty Years' War, in which Sweden gained territorial possessions in Mecklenburg and Pomerania, but not in the area of the North Frisian Wadden Sea, which was part of the Duchy of Schleswig-Holstein-Gottorp and the Kingdom of Denmark, Sweden's main rival for maritime hegemony. If the provenance for the timber is an indicator, the location where the timber was sourced could have been under Swedish control.

Despite the overwhelming evidence for a similar type of construction from Sweden and other Swedish influenced areas, there is also a case to be made for a local North Sea origin. Both the Westerhever and Terschelling find from the North Sea indicate that these carvel-analogous variants were most likely local, which cannot be ruled out for the Japsand wreckage either.

The 'Dutch flush' technology (*cf.* Maarleveld 2013) can also be regarded as carvel-analogous construction variant in the sense that it is essentially a shell-first construction too, and thus not a proper carvel-construction in the skeleton-first sense. In contrast to the 'Dutch flush' technology, which was used in large merchant ships of the Dutch East Company for instance, the carvel-analogous lapstrake constructions are all small to mid-sized vessels of a vernacular character used in small-scale coastal seafaring. Such vessels are less prominent in historical sources and therefore their archaeological and ethnographic study is of preeminent importance. The Japsand wreckage is – literally – two pieces in this puzzle to address the topic of analogous or partial adaptation of carvel technology in rural coastal communities and its wider cultural-historical implications.

[4] (1) Hasslöff 1970, 58, (2) Berg 1984, pp.131, 188ff., (3) Gøtchche 1991, 85, (4) Thorsvik 1965, 27, (5) Eriksson 2010,79f.; Auer, Ditta 2016.

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