Bayonese cogs, Genoese carracks, English dromons and Iberian carvels: Tracing technology transfer in medieval Atlantic shipbuilding

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Resumen
En esta síntesis se combinan diferentes hilos de investigación para ofrecer una perspectiva integral del grado en el que los constructores navales y navegantes de la costa atlántica se vieron influidos por tendencias del norte y sur de Europa y las diversas formas en las que se manifestó la implementación de las innovaciones en la construcción naval, sobre todo en aquellos casos en los que las innovaciones fueron apropiadas y adoptadas de forma parcial, combinándose con soluciones técnicas propias. En este estudio destaca la cooperación marítima anglo-vasca y el papel que desempeñaron los constructores navales vascos en la transición técnica que iba de comenzar a construir la embarcación por el casco a iniciarla por el esqueleto.

Palabras clave: cogs, carracas, carabelas, Atlántico, construcción naval, tecnología medieval.

Abstract
In this synthesis archaeological and historical research strands are combined in order to gain a more holistic understanding on the different influences shipbuilders along the Atlantic coast where subject to and the different ways innovations were implemented, appropriated and combined with native shipbuilding traditions. A major emphasis of this study is the English-Basque maritime cooperation and the role of Basque shipbuilders in facilitating a gradual transition from a shell-first to a skeleton-first principle.

Keywords: cogs, carracks, clinker, carvel, Atlantic, shipbuilding, medieval technology.
1. INTRODUCTION

For the last decades the study of maritime affairs in medieval times remained largely the domain of historians, with an emphasis on written, iconographic and ethnological sources. As a maritime archaeologist, this author is struck with the impression that many historians have not given up their “claim” on having a monopoly on the narrative of how ship-types evolved over time, despite historical sources are mute on technical details and only indicate static type-labels, origin, sailing routes, and in rare cases details on cargo-bearing capacities and inventories. Shipwrecks, in contrast, are the tangible remnants of the maritime past, not restricted to the information contemporaries felt worth recording for legal or economic transactions. Admittedly, the corpus of shipwrecks studied in its pioneering phase was—until recently—considered not representative enough to infer general trends in technological development, and maritime archaeology therefore remained stuck in descriptive analysis. Mundane constructional features were not likely to add any deeper insights to the ‘big picture’ historians aspire to draw.

In recent times, however, maritime archaeology has entered a second phase, in which general patterns in construction have become more apparent, with a whole swathe of other information illuminating medieval shipbuilding practises that paint a rich picture of the past, indicating mundane aspects such as the availability and management of resources, particularly in terms of timber-supply, culturally inherited preferences in technical solutions and foreign influences, which were implemented with varying degrees of success. Realising this potential, this synthesis presents an effort to bridge several gaps of scholarship that have divided a field of common interest. Most importantly, this study aims to combine a historical and archaeological approach in a meaningful sense, in that historical type-labels are not merely projected onto archaeological ship-remains, but the different source categories assessed on their true and restrictive informative value. As this study will show, type-labels are a floating concept and cannot be exclusively associated with ship-types in the constructional sense, although differences on a constructional level may indeed be implied. Another gap to be bridged is the linguistic gap between the Germanic and Romanic speaking world, which has artificially divided the discourse into a northern and a southern European narrative. It is striking how the academic discourse on cogs in particular has taken place in almost total isolation to southern European sources, and presented as exclusively northern European, Hanseatic or even Frisian ship-type. Although this can be attributed in part to the fact that shipwrecks associated with the cog-type were exclusively discovered in northern waters so far, there is rich iconographic and written evidence that cogs were also built and crewed on the Iberian Peninsula and the north-western Mediterranean Sea region.

Thus, an attempt is made in this paper to re-evaluate the mutual influences in medieval and early modern shipbuilding techniques between northern and southern Europeans and the underlying dynamics affecting change, while not getting “hung up” on ambivalent historical type-labels. Especially from an archaeological point of view shipbuilding traditions are surprisingly static in many respects, but whenever change occurred, it is sudden and linked to major societal changes, which are often explicitly echoed in historical sources. Although primarily concerned with the technicalities involved in ship construction of large seagoing ships that were at one point in time regarded as the cutting edge of technology—like cogs and carracks—more general aspects of medieval society are illuminated in the process: What were the driving forces behind technical innovation? How do aspirations to emulate a superior foreign technology become manifest? And, quite generally, what is the human capacity for innovation by adaptation? An emphasis is put on a period in which northern European shipbuilding technology was lagging behind to that of their southern European counterparts in many respects, emphasising the transience of the ‘powerhouses of innovation’.

2. NORTHERN CRUSADER COGS IN THE MEDITERRANEAN SEA

The earliest references to cogs in the Mediterranean are connected to the crusades to the Holy Land predominantly of German, Frisian and Flemish origin. Although efforts have been made to trace the ‘cog’ etymologically in early medieval times, it has to be dismissed before the 12th century as being too ambivalent a term. For instance, the 9th-century term cogscult has been often interpreted as cog-tax, but may rather point to a koke, i.e. a judicial person in a regional Frisian dialect. Possibly the earliest

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2 FLEDNER 1969, 44; HEINSIUS 1986, 70.
definite reference to a cog as ship-type can be found in the chronicles of the Flemish town of Nieuwpoort in 1163, mentioning coggas, alongside other vessels such as a clincaboit, losboit, buza and scuta. Other early references are found in Wolfram von Eschenbach's poetry, one of the most widely read works of the Middle Ages and thus a great source for the colloquial use of terms. Within the context of the crusades he mentions an extraordinarily large army being transported in kieilen (keels), treimunden, urssieren and in kocken (cogs). In another excerpt he mentions, amongst other types of vessels, kocken, üssiere, seytiez and snecken used to ferry a crusader army on horseback and on foot across the river. Naturally, the largely legendary character of Eschenbach's poems does not permit any conclusions on factual grounds, but he will have undoubtedly used terms familiar to his contemporaries. By listing a number of different vessels equivocally used to ferry an army across a river, it is safe to foreclose, that the reference did not touch on the vessels' actual suitability to operate in a fluvial environment, but used instead to highlight the heterogeneity of the crusader contingents. Each vessel appears to be a stereotypical mode of transport for Europeans of different origin. For instance, the snekke appears to be a typical Scandinavian type. The Danish King Canute VI ordered in 1187 explicitly snekker for the impending crusade. Cogs on the other hand were initially associated with Germans, Flemings or Frisians—all people from the southern North Sea coast. The saga of Olav Tryggvason—written after 1200 retrospectively—referred to a fleet of kuggar sent by German Emperor Otto I to Christianise Norway; kugger being the generic term for a Hanseatic ship at the time when the saga was written. In 1210, the King of England used five Frisian cogs for warfare and in 1217/18 German and Frisian crusaders are said to have sailed in cogs to capture Damiette in Egypt. It is perhaps no coincidence that cogs are typically ascribed to people from the German Empire in the same way as snekker are ascribed to the Danes, given that the earliest written sources on cogs are in Old and Middle High German. The first reference to cogs in the Baltic Sea can be found for the year 1206 in Henry of Livonia's chronicles, written from the perspective of an eye-witness not long after the events occurred. The notion that the first genuine references to 'cogs' date all around the same time, yet in vastly different geographical regions, is striking.

However, the Low German "monopoly" on cogs in the late 12th and early 13th century became swiftly obsolete: While a reference to four Danish cogs travelling to Tallinn in 1221 may be due to the chronicler’s Low German linguistic bias regarding the classification of ship-types, the earliest Danish source on cogs dates only few years later, when in 1224 King Valdemar II of Denmark pledges to join the crusades with snekker and kogger. Albeit there is no evidence to suggest that the ships called cogs by Germans were similarly built to cogs called by the Danes thus, the sudden advent of the term 'cog' in written sources does not necessarily imply the development of an entirely novel type of ship in the mid-12th century. The connotation of the term cog may have been an identifier on the origin—as we have just seen—or may have been used with the operational capabilities of the vessel in mind, more in terms of a function rather than construction. In late 12th-century sources cogs were generically characterised in the sources as large vessels, as opposed to small vessels:

![Image](image-url)

This remains also the case a century later, in which a Pomeranian document from 1281 refers to majoribus navibus liburnis, id est
It is not inconceivable that the fleet of 36 ‘large ships’ from Frisia and Bremen, anchoring off Lisbon in 1189 during the Third Crusade, would have been similarly built as ships later identified as cogs, but not yet commonly called so by contemporaries. Ships for the Third Crusade were built in different regions and towns and four left Cologne in 1189 with victuals for three years and with 115 armed men. Armed ships with sufficient victuals — «navibus bellatoribus armis et cibaris sufficienter» — also left Bremen in the same year to join the crusade. Most references to ships remain generic. Is the term “cog” only a linguistic alteration for such large seagoing ships?

Although Wolfram von Eschenbach’s use of ship-types is mostly generic, he specifically ascribes to cogs the capability of carrying provisions for long voyages and the transport of horses. This premise is correct, cogs would have been the ideal long-distance vessels for armies, especially in waters foreign or hostile, in which there were but few suitable harbours. The two excerpts above stress that sufficient provisions for long voyages were taken onboard by the crusaders, which must have been a difficult task in terms of food preservation. One possible aspect of this high degree of seaborne self-sufficiency is the practice of keeping livestock on board of ships as source of fresh meat. Ships large and sturdy enough to transport horses could also transport livestock, and interestingly, archaeological evidence suggests that this practice was already known at this early time. The investigation of the mid-12th century Kollerup wreck, which may have been called a cog, revealed that cattle was slaughtered on board the vessel. Not unlike the crusader ships, which departed from Cologne, the Kollerup Ship is also likely to have departed from the Lower Rhine as indicated by pottery from the Low Countries and Rhenish slates. It foundered during the failed attempt of circumnavigating Cape Skagen, a dangerous area with no natural harbours and thus no protection whenever onshore winds turned the coast into a dangerous lee shore. Ships travelling on routes with no possibility to make save landfalls over a long period of time would have most likely kept a supply for fresh meat on board. Aside from meat, fresh water supply made landfalls necessary. Emo von Friesland recorded an eye-witness account of a Frisian crusader fleet entering 1217 the Ebro River near Tortosa in Spain — dividing Christian from Muslim lands — in order to replenish its water supplies after exertions and thirst. This reflects the difficulty of replenishing supplies when sailing off hostile shores, in this case Granada, which was then under Saracen rule. In the later course of events some of the Frisian ships became unseaworthy, so Count William and parts of his contingent followed the common practice of returning overland, leaving the ships behind. Although the long-distance voyages with only few landfalls would have facilitated little direct contact, the prospect of crusaders choosing the land route back home would have nevertheless provided Mediterranean shipwrights ample opportunities to study the clinker-built wrecks of the northerners in more detail. However, there is no evidence to suggest that northern European shipbuilding has left any traces in local shipyards at all.

19 Hansisches Urkundenbuch I, 884, ed. Höhlbaum 1878, 303.
20 KURTH 1911, 183.
22 quindeceim centum homines has been previously translated as 1500 men in Heinsius 1986, 94f. and Vogel 1915, 127, which would have been perhaps rather expressed as mille quingenti. 1500 men divided on four vessels would have meant a crew of 375 per vessel, which — in addition to large enough provisions — would have been quite unlikely for that time. Either the chronicler exaggerated or the writer’s native tongue prevailed by translating ‘fifteen-hundred’ literally, and not by the correct Classical Latin ‘hundred fifteen’, i.e. centum quidecem.
23 Narratio Itineris Navalis ad Terram Sanctam, ed. Chroust 1928, 179.
24 WOLFRAM VON ESCHENBACH, Parzival, I, 58, 1-16.
25 WOLFRAM VON ESCHENBACH, Parzival, X, 546, 1-30 (24).
26 The Kollerup wreck is tentatively associated with this new cog-type and there is much to be said for it, given the novelty of hull construction coinciding spatiotemporally to historical cog-references since the mid-12th century (cf. HOCKER 2004, 72ff.). However, it would be precipitant to refer to the Kollerup-type as ‘cog-type’, as historical ship-types were not necessarily synonymous to types in a constructional sense.
27 KHORTZ ANDERSEN 1983, 16. However, the evidence for on-board slaughtering could be also connected to the salvaging operations after the ship ran aground.
28 KHORTZ ANDERSEN 1983, 16.
29 (…) tertio die Tortosam civitatem accessimus, ubi Errora fluvis, limes gentium et terminus fidelium, dulcibus aquis influens amaritudinem temperat et reddit potabili. Ibi tandem Sarracens a tergo relictis, libertatem consecutui et aquas potabiles, veteres veritate probata proverbii, quod libertatem estimat et precium ponit aque potabili, laudavimus inventorem. cf. Röhricht 1879, 66.
30 UNGER 2006, 268.
that time. Even at the destination of most crusader fleets, i.e. the Levantine ports, it were the
Mediterranean-built crusader ships that left a visual impact, judging from ship graffiti in Acre from the
second half of the 13th century. In fact, many central European—including German— crusaders
boarding Levantine-bound vessels in Venice must have become more familiar with Mediterranean-
built vessels than with northern European cogs. The ships in Venice were very distinctive in both
construction and rigging. Most German crusaders travelling via Venice to the Holy Land would have
originated from the inland, and thus were not acquainted to the shipbuilding techniques of their
countrymen on the distant northern shores. The German Emperor Frederick II himself appears to have
used locally-built Mediterranean ships in the 1220’s of the chelandre and taride type. This may well
be due to the fact that the personal ties to the Mediterranean of the Staufer emperor were much
stronger than to the northern fringe of his empire, due to his Sicilian roots.

One feature in particular, however, became synonymous with northern ships at that time: Rather
than the clinker or lapstrake construction technique and hull design, it was first and foremost the single-
masted square rig that was perceived as the most distinguishing characteristic for northern European
vessels, forming a sharp contrast to the Mediterranean lateen riggers. This allowed Christian prisoners
in Beirut 1197 to identify an approaching fleet with square-sails –vela quadranguia– as their own. The
shape of the sail must have been perceived as the most distinctive criterion in this period, as in
1232, when a Genoese referred to the seal of La Rochelle (Fig.1) thus: “In alio vero sigilo erat imago
cujusdam ligni ad similitudinem Cochae cum arbo et vello quadrature expenso”. This excerpt has
been often mistoken as a reference to a cog depiction. But in verity, the description merely likens the
single square rig –cum arbo et vello quadrature– to that of a cog. Thus, the cog was evidently
perceived by the referrer as the most prominent or largest vessel to carry such a sail. An anonymous
Teutonic Order chronicler described in 1245 retrospectively the siege of Acre of 1191, in which
crusaders from Bremen and Lübeck are said to have used the sail of a ship called cog as canopy for a
hospital. This reference might stress the perceived exceptionalism of the northern cog in this region,
especially because its square-sail would have been much better suited to be used as canopy than a
lateen sail.

While 13th-century documents from the time of the crusades referred to them as cucas or coggones
that were brought in by northerners they had evidently no perceivable influence on Mediterranean
shipbuilding at that time, despite claims to the contrary. A lasting “northern” influence occurred not
before the early 14th century, however, and it seems important to stress that “northern” has to be
redefined when it comes to shipbuilding, as will be elaborated in the following section.

3. THE SOUTHERN BORDER OF THE NORTHERN SHIPBUILDING TRADITION

From the mid 9th century onwards Norman pirate raids have depopulated the Asturian, Galician,
Cantabrian and Basque coastline. But when the raids ebbed away and maritime trade took its place,
coastal urban settlements emerged, as testified by archaeological excavations with habitation horizons in San Salvador for the 10th/11th-century and San Sebastián for the 11th/12th-century. Shipyards in Bayonne are attested since 1131 after it was conquered by Alfonso I, King of Navarre. It has been presupposed, however, that Bayonese shipbuilding became most influenced by Norman and English traders, especially when Aquitaine became an English fief in 1154 and when the English king granted fishing and whaling rights to the people of Bayonne in 1170. Early on, Basque ships appear to have played an important mediating role in the coastal trade between England and its French possessions. In 1223, for instance, four nefs from Bayonne and one coca transported wine from Aunis near La Rochelle to Portsmouth. The English influence is well reflected in historical sources regarding the close commercial links of the Cantabrian and Basque cities of Santander, Bilbao and San Sebastián to England since the early reign of Henry III (1216-1272). This is also reflected by ship depictions on northern Iberian seals, resembling the ships of the Cinque Port seals in striking detail (Fig. 2).

These iconographic representations are often associated with keels or nefs, which Scandinavian ancestry is ostensive. Thus it is not surprising, that the northern Iberian Peninsula belonged to northern Europe in terms of shipbuilding and other aspects of culture. Ethnographic studies have revealed that the division line between the northern clinker tradition and the southern carvel tradition is marked by the Duoro River –Portugal’s largest river: Boats in the northern rivers of Minho, Lima, Duoro are clinker-built, whereas those in the southern rivers of Nabao and Tejo are not.

4. PAN-IBERIAN VOYAGES OF BASQUE AND CANTABRIAN CLINKER-BUILT COGS

The year 1304 is often perceived as key date, when Mediterranean shipbuilding became subject to an Atlantic influence, or as noted by the Florentine chronicler Giovanni Villani: «At this time people from Bayonne in Gascony came with their ships, which they called Bayonese cogs, through the Strait of Gibraltar into the Mediterranean to privateer, and they caused a lot of damage. Since then, Genoese, Venetians, and Catalans started to use cogs and gave up shipping with their own large ships, because of the greater seaworthiness and lesser expenses of cogs. Through this, our ships have greatly changed, especially the hulls.» This was not a random event. It has to be seen as a punitive expedition in response to the alliance of France’s King Philip IV with the Genoese, of which the latter disrupted English trade in Flanders with a galley fleet. The Bayonese privateers can be perhaps understood as the long arm of English influence, seeking to disrupt the Genoese adversaries in their home waters.

As a matter of fact, pan-Iberian cog voyages from the Basque and Cantabrian region occurred already in preceding decades. The earliest Catalan reference dates to 1230, where a coca from Bayonne was hired for a voyage to Mallorca. In 1277-78 Castilians are known to have hired Basque-owned and

40 ALBERDI LONBIDE & ARAGÓN RUANO 1998, 16.
41 GOYHENECHE 1990, 368.
43 GOYHENECHE 1990, 368.
44 HUTCHINSON 1994, 80.
45 FILGUEIRAS 1979, 45.
46 Own translation from a German translation in EWE 1981, 24 from an Italian manuscript: Giovanni Villani, Historia Fiorentine seu cronica (Muratori Rerum Italiarum scriptores XIII, 412 D, E) VIII, cap, 77: «In questo medesimo tempo certi di Bajona in Guascogna con loro navi, le quali si chiamavano cocche Baonesi, passaro per lo stretto die Sibilia e vennero in questo nostro mare corseggiando, e fecero danno assai; e d’alli hora inanzi i Genovesi e Viniliani e Catalani usarono di navigare con le cocche, e lasciarono il navigare delle navi grosse per più sicuro navigare, e perché sono di meno spesa. E questo fue in questa nostre marine grande mutazione di navilio.»
47 ORTEGA VILLOSLADA 2008, 443.
48 EBERENZ 1975, 104.
crewed vessels for service in the Mediterranean to secure the Guadalquivir River in the wake of the capture of Seville in 1248 and Sanlúcar in 1249 from the Saracens. The earliest known reference to a cog as a Cantabrian and Biscayan type in Lisbon dates to 1297. Cogs are mentioned in the 1313 statutes of Genoa: "Chuod aliquis patronus alicuius navis, coche, galee, etc." In 1320-3, 1327, 1341 several instances are noted in which particularly Castilian and Basque corsairs were involved in several captures in the Balearic Sea, of which the Mallorcan trade of Catalans suffered substantially. While the exact origin of the Castilian corsairs remains unmentioned, it seems likely that they –like the Basques– originally came from the northern Iberian Peninsula, possibly Cantabria.

Ships and crews from the Bay of Biscay must have been considered an asset worth hiring. It is reasonable to suggest that all these vessels shared characteristics with the ‘Bayonese cogs’ mentioned by Villani. The latter also described how Count Guy of Flanders besieged a Dutch town with 1000 Flemish warriors and 80 castellated cogs ‘of the style of this sea’. This, and the explicit mention of ‘Bayonese cogs’ suggests that regional differences were perceived in the way how a Flemish cog differed from a Bayonese cog. It even seems that a ‘Bayonese cog’ might have become a "brand", which was not necessarily indicative of the vessel’s or owner’s actual origin. This is indicated by a reference from 1336, in which a Bayonese cog is said to be commanded by a Portuguese for a Mallorquin owner. In the years 1321, 1324, 1332 and 1340 Portuguese cogs sailed against the Saracens, of which 1332 four in five were cogs specifically named to be Bayonese.

Majorcan sources identify a whole range of Basque-Cantabrian towns as home port for cogs that have been chartered for the pan-Iberian route from Palma to Bruges and other Flemish towns for the years 1312, 1328, 1341, 1352, 1380, coming from Santander and Bayonne, while corsair cogs based in Seville were hired 1320 from Castro Urdiales and San Sebastián. In 1320 the Mallorcan fleet was restructured, in which cogs and naos were replaced by galleys, demonstrating that cogs were already in use, but were not the preferred vessels for all purposes, such as coastal defence. Basque shipping also played a central role in the alum trade from central Italy to north-west Europe in the 14th century.

It is notable that cogs are sparingly mentioned in Castilian and Portuguese sources, were they are attributed mainly to a Cantabrian, German or English origin. In Catalan sources, however, the term coca features more prominently, and Santander, San Sebastián and Bayonne are usually mentioned as ports of origin for cogs known to have entered the Mediterranean. The absence of cogs in Castilian sources seems paradoxical, since Santander and San Sebastián formed part of the Kingdom of Castile, yet are said to originate from these cities in Catalan sources. This seeming paradox highlights that the term cog cannot be understood as an objectively fixed ship-type category. The difference may be purely owed to a regional dialect or difference in classifying ships, as the same three ships described 1320 in a Mallorcan source as cacas were described in a Castilian source as carracas. Majorcan records indicate a steady increase of cogs of Castilian and Portuguese origin from 1321 to 1340, with peaks in 1321 and 1330 and a total of 66 cog mentionings. Ortega Villoslada points out that the Bayonese adjective could be only found in 1330 and 1332, whereas a Bayonese or Cantabrian origin was implied when the vessel was of Castilian denomination. There are instances where the master of the ship was said to be Bayonese, yet his cog not explicitly referred to as ‘Bayonese cog’.

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49 ROSE 1999, 565.
50 ORTEGA VILLOSLADA 2008, 432.
51 HEINSIUS 1986, 79 after JAL 1877, 483.
52 SANTAMARÍA-ARANDEZ 1980, 91f.
54 "Consta que en 1336 Domingo Pérez de Lisboa patroneaba una coca bayonesca propiedad de los mercaderes mallorquines Joan Safont y Guillem Borsa (…)' SANTAMARÍA-ARANDEZ 1980, 99.
56 ORTEGA VILLOSLADA 2005.
57 SANTAMARÍA-ARANDEZ 1980, 68.
58 LOEWEN & DELHAYE 2006, 100.
59 EBERENZ 1975, 108f.; it would be an interesting question whether cacas described as English were also synonymous to those from Bayonne, given that the latter was an English liefe.
60 EBERENZ 1975, 104.
61 ORTEGA VILLOSLADA 2008, 439.
63 ORTEGA VILLOSLADA 2008, 438F.
It is interesting to note, that the hired Biscayan cogs and other vessels were not serving the trade with their respective home ports, but operated on the pan-Iberian long-distance route, predominantly between Palma and Bruges. Both towns were often not the final destinations, as the goods were transshipped in Palma for Genoese and Venetian clients. Biscayan cogs were continued to be individually hired, which also had—besides their great deadweight capacity—the advantage of sailing under a neutral flag during the conflicts between Genoa and the Crown of Aragon. As the Aragonese-Genoese rivalry peaked in the early 15th century, the Castilians and Portuguese traded with Genoa, whereas Basque ships served the Aragonese-Catalan port of Barcelona, emphasising the great link between the Basque region and Aragon. Basque mariners also came in large numbers to Marseille, after the city’s fleet was destroyed in 1423 and in need of ships.

Now the question arises what made these ‘Bayonese cogs’ so special? They were certainly distinctive from the local carvel-built Catalan ships, which were propelled by lateen-sails and oars, as the Culic VI wreck from the late 13th/early 14th century, or the Sorres X wreck from the late 14th century. These local types, however, were deemed inapt to compete with Genoese ships and thus made it necessary to hire vessels from the Basque country. What were the principal differences? A 14th-century depiction of a coca ballonesa in a Majorcan document sheds light on the issue; a potentially very insightful source, as Mallorca was a hub for Basque cogs (Fig. 3). An important feature might have been the advantageous stern or median rudder. Mediterranean ships, in contrast, usually had quarter rudders. Interestingly, the Sorres X wreck demonstrates a rare case, where both quarter rudders and a stern rudder were used, which may reflect a gradual transition which occurred at this time. The highly detailed depiction of the rigging might not be accidental, as the drawer might have intended to demonstrate how square-rigged vessels could be sailed close-hauled, namely with bowlines, with which the windward luff was stretched via the bow-sprit to allow for close-hauled sailing. Mediterranean mariners accustomed to lateen sails—i.e. fore-and-aft type sails predestined for close-hauled courses—might have wondered how northerners managed to sail close-hauled with square-riggers. This drawing might be testament to explain it. What made the coca ballonesa distinctive to northern European ships believed to be cogs—like ship-depictions on Hanseatic town seals—is the great and curved rake of the stem post. This would have reduced the lateral plane, which might have been considered an advantage when tacking, increasing the manoeuvrability. Naturally, it can be only hypothesised what exactly Giovanni Villani meant when he referred to the greater seaworthiness of the Bayonese cogs, but this inference would serve as an explanation. Another favourable

Fig. 3. Interpretation of a “coca ballonesa” from a 14th-century document in the Historical Archives of the Kingdom of Majorca. Key: green: Fairstay and shrouds, blue: halyards, red: braces, orange: bowlines (Graph: Daniel Zwick. Redrawn and interpreted on the basis of a line drawing in GOYHENETCHE, BEGIA 1998, 154).

64 ORTEGA VILLOS LADA 2008, 434.
65 SOBERÓN RODRÍGUEZ 2010, 150.
66 SANTAMARIA-ARANDEZ 1980, 90.
67 SOBERÓN RODRÍGUEZ 2010, 150.
68 Cf. SANTAMARIA-ARANDEZ 1980, 89.
characteristic of Basque cogs appears to be their capabilities as cargo carrier, specifically suited for equestrian transport. Written records of 1338 and 1343 indicate that Catalans used cogs for horse transport. In terms of construction, Catalan sources indicate that at least some cocs were built in the northern European way by the occasional inclusion of the epithet tinclat. The etymology suggests that tinclat is the Mediterranean term for the clinker-technique, i.e. in which the overlapping strakes are fastened with clinker-nails, i.e. rivets. This formed a stark contrast to Mediterranean shipbuilding, where planks were not only flush-laid—in a carvel fashion—but which entailed also the skeleton-first principle, which was almost complete absent in clinker vessels. A cocha tinclata was mentioned in 1362 and a ship owner of a coche tinclate from San Sebastián was mentioned in 1374. The epithet tinclat is regularly found in connection with cogs, but also with other vessels from the Iberian Atlantic coast, particularly the barcha, or barxa tinclada. In 1380, Majorcan merchants were reportedly chartering a clinker-built vessel of Diego Diez from the Cantabrian town of Castro Urdales to sail to La Alcudia and then to Flanders. It is not astonishing that the vessels from the northern part of the Iberian Peninsula were clinker-built, as they shared a shipbuilding tradition with other northern Europeans. The similarities are not restricted to the Atlantic coast, as a relief of a ship in the Cathedral of Vitoria from the late 13th or early 14th century depicts a ship with an uncanny resemblance to the ‘Bremen Cog’ of 1380, featuring lapstrake-planking, protruding cross-beams and straight stem and stern posts. Another similar ship depiction, but with a curved stem, is to be found in the Cathedral of Bayonne from the late 14th century (Fig. 4).

Fig. 4. A modern ship-model based on the ship-depiction (top left) at a vault in Bayonne Cathedral, from the late 14th century (Source: Lizarraga, cf. http://www.navalmodel.es/Naval_Model/La_pluma_de_Lizarraga.html).

Despite many instances of cultural contact between northern and southern Europeans through mercantile cooperation and the crusades, this method seemed to be still considered alien in the Mediterranean, as the epithet appears to have been used as exceptional and non-local feature, as it was differentiated between «naves nostratae»—our ships—«et alie (...) tinclatae». The presence of such “other” clinker-built vessels in Catalonia has been recently confirmed by archaeological evidence, namely by the discovery of two wrecks in Barcelona. The better preserved Barceloneta I wreck is a shell-first construction, in which the lands of the oak planks were luted with moss and connected by clinker-nails. The origin is almost certainly Basque or Cantabrian, as indicated by a palyontological analysis and the negative result of a dendrological analysis, suggesting a timber provenance somewhere between Aquitaine and Porto; i.e. one of the few regions which have been—until
recently—lacking a timber chronology\textsuperscript{80}. According to a C\textsubscript{14} of the moss, the Barceloneta I wreck was built around 1410 (Fig. 5). It was broken up somewhere between 1439 and 1477, as could be stratigraphically established by the construction of a wharf and a breakwater, respectively\textsuperscript{81}. The presence of medium to large Basque ships in Barcelona is corroborated by written sources for the period between 1438 and 1449\textsuperscript{82}. For this period in particular, many vessels from the Biscay were registered in the \textit{dret d’ancorage records}\textsuperscript{83}. Although the lapstrake-technique is regularly associated with cogs, there is no compelling reason to imply that the Barceloneta I wreck would have been identified as such by contemporaries, as virtually all Basque ships from this period appear to be clinker-built.

Fig. 5. The Barceloneta I wreck: A slab of clinker-planking with joggled, closely-spaced futtocks (Photo: Mikel Soberón).

5. CATALONIAN AND ITALIAN COGS: A MEDITERRANEAN APPROPRIATION IN CARVEL?

It has been argued that northern and southern cogs only share few common criteria, i.e. a square sail, a stern rudder, a full hull shape and a flat bottom\textsuperscript{84}. Even this fairly minimal common denominator has been called into question regarding stern-rudders, as two rudders are listed in inventories for not few—especially small—cochas, which may be interpreted as the conventional Mediterranean side rudders\textsuperscript{85}. However, such inventories often listed the entire inventory including materials for repair, so the presence of a second rudder may be also interpreted as spare rudder.

There is a detailed inventory for a cocha named \textit{Sent Climent} in Barcelona from 1331, which includes, amongst other things, two sails—\textit{dos treos}—and two bonnets—\textit{dues bonetes}\textsuperscript{86}. Bonnets are commonly used in the Mediterranean to extend the sail area, whereas in northern Europe reef lines—with the first iconographic evidence around 1200\textsuperscript{87}—were common, but inversely used to shorten the sail area. The presence of two sails and two bonnets may indicate a two-masted vessel, if one is willing to accept the premise that they were not spare sails. Canvas for repairs was in the inventory too—\textit{un tros de canamas}\textsuperscript{88}. The presence of multi-masted cogs is confirmed few years later by a Catalan reference from 1353, which refers to a cocha with bowsprit, a main mast and a mizzen mast\textsuperscript{89}. Iconographic evidence suggests that besides the square main sail also other features from the cog were adopted, like the stern rudder and the capacious hull\textsuperscript{90}. The advantages were recognized by a

\textsuperscript{80} Only recently, in the context of the Newport Ship research, new dendrological master curves for this region have been reconstructed, cf. http://www.bbc.co.uk/news/uk-wales-south-east-wales-19646068.
\textsuperscript{81} PUJOL I HAMELINK & SOBERÓN RODRÍGUEZ 2011, 121F., SOBERÓN RODRÍGUEZ 2010, 142.
\textsuperscript{82} VELA I AULESA 2000, 633f.
\textsuperscript{83} VELA I AULESA 2000, 637ff.
\textsuperscript{84} FRIEL 1994, 77F.
\textsuperscript{85} NICKEL 1999, 73.
\textsuperscript{86} CF. EBERENZ 1975, 99. Eberenz’s translation of the \textit{bonetes} as lee sails on page 106 must be dismissed on the basis that they appeared several centuries later.
\textsuperscript{87} MÖLLER-WIERING 2003, 311.
\textsuperscript{88} EBERENZ 1975, 106.
\textsuperscript{89} FRIEL 1994, 90.
\textsuperscript{90} FRIEL 1994, 78.
Genoese law of 1341, which refers specifically to the *coche baonesche* as having more loading capacity than other vessels and it was safer and cheaper to operate it.\(^{91}\)

Cogs are mentioned in the Adriatic Sea as early as 1258, but not before the late 1340s Venetian shipbuilders are known to have built cogs in Ragusa's arsenal.\(^{92}\) A shipbuilding contract from Ragusa dating to 1382 specified that a *navigium* built at the local shipyard should assume the "shape" of a cog – "construendo...in formam coche" – and that a sixth of the building costs was added for the additional effort of this new form – "pro adictione nove forme ipsius navigii". The fact that the bottom width, the beam and the height of the hold were specified strongly indicates that the vessel was built as skeleton-first construction in which all these parameters could be more easily predetermined. There is no evidence that a northern shipbuilding method was employed, but that merely shape and dimensions were modified for the construction of this *coche*. The additional specifications would have made the vessel's bottom wider and the sides steeper, thereby increased the deadweight capacity. After this *coche* – named *Sanctus Nicolaus* – was launched, four caulkers were employed to finish the ship before its first voyage into the Levant.\(^{95}\) The mentioning of caulkers after the hull was completed strongly indicates that the hull is a carvel construction, because in clinker constructions the overlapping seams and scarfs are luted during the process of adding planks. Apart from an *antenna* – a lateen mizzen – a later document refers to this ship as *navis quadra*, which is used in Dalmatia and Venice synonymous for cogs; undoubtedly a reference to the characteristic northern square sail. Ship depictions that represent such square-rigged Mediterranean ships are shown on the portolan map of 1367 by the Italian Pizigani and the portolan map of 1426 by the Genoese Becharius (Fig. 6).

A lateen sail – the typical Mediterranean sail – was evidently added as mizzen to one of the ships shown for better manoeuvrability, as it would have increased the weather helm. Moreover, the ship depictions on the portolan show also wales and skids, which are typical for carvel built hulls, giving strength to the structure, which becomes especially important whenever the ship is careened, a practice necessary to overhaul and caulk carvel-built ships from the outside (Fig. 7). It seems reasonable to suggest that the local carvel tradition was retained in Mediterranean-built *cochas* and that shipbuilding techniques remained essentially the same.

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\(^{91}\) FRIEL 1994, 78.

\(^{92}\) NICKEL 1999, 75.

\(^{93}\) NICKEL 1999, 75.

\(^{94}\) The added specification in brackets: 12 passo length (+0.5 passo), 7 piedi (+0.5 piedi) bottom width, 17 piedi beam at deck level and 7,5 piedi (+0.5 piedi) height of the hold. On the assumption that the specifications are based Venetian *passo* and *piede* that would be 20.92 m (+0.87 m) length, 2.44 (+0.17 m) and 5.92m beam and 2.61 m (+0.17 m) hold height, according to the calculations of Nickel 1999, 74f.

\(^{95}\) NICKEL 1999, 76.

\(^{96}\) NICKEL 1999, 74F.
Fig. 7. The practice of careening commonly used for the maintenance and caulking of carvel-built vessels as shown in this excerpt from Sandro Botticelli’s “The Judgement of Paris”, ca. 1445-1510 (Source: Cini Foundation, Venice).

The differences between northern and southern ships in this transformational period is highlighted by two ship models from this era, i.e. the Ebersdorf model –a votive offering filled with gold donated by a German knight on a pilgrimage after he barely survived a stormy passage from Acre to Venice—, and the Mataró model from a chapel near Barcelona (Fig. 8).

Fig. 8. Irrespective of the type-labels attached to the Ebersdorf “cog/holk” model of ca. 1400 (left) and the Mataró “carrack/nao” model from 1389-1449 (right), they appear very similar, judging from the stout impression rendered by the high freeboard, the short length-to-beam ratio and the curved stem. To contemporaries they might have appeared as a same category of ship, yet the underlying constructional principle of shell-first lapstrake in the former and skeleton-first carvel in the latter could not be more different (Source: left: Holger Strauß, right: Maritime Museum Rotterdam).

Both models are true miniatures. The amount of details suggests that the model-builders were professionals or at least acquainted to the methods employed in shipbuilding. The former model represents a Baltic type and obviously not a ship-type used by the knight on his return passage to Venice. Whether this type would have been called cog or hulk cannot be said for certain. The Mataró model on the other hand is often described as nao or carrack. While nao was the generic term for a ship in the Mediterranean, the term carrack was used by the northerners for the Mediterranean cocha, which might have become current through the Spaniards who used this term since the 13th century and who were significantly involved in the Genoese coche voyages to England. In 1320, for

97 STEUSLOFF 1983.
98 CHRISTENSEN & STEUSLOFF 2012, 97.
99 WINTER 1978.
100 GARDINER 1994, 81.
101 HUTCHINSON 1994, 43.
instance, the same three ships referred to as coca\textsuperscript{102} in a Majorcan source were referred to as carraca\textsuperscript{102} in a Castilian source\textsuperscript{102}. These mix-ups in written sources are not uncommon with the advent of new ship-types. Whether coca, cocha or coche was just another term for an early carrack is however not the decisive question. The factual similarities and differences are far more interesting and render speculations on etymological similarities obsolete. These include the bulkiness of both hulls, with much freeboard and a very low length-to-beam ratio. This has been often attributed to stylistic reasons, but some contemporary wreck finds indicate that this may in fact be a truthful representation. Both models are square-rigged and both are equipped with a stern-rudder. Both features are fairly recent in Mediterranean-built vessels; the stern-rudder was adopted for cochas not before the second half of late 14\textsuperscript{th} century\textsuperscript{103}. Stern-rudders could be more easily fitted to the straight raking sternposts as they were common in northern Europe. The curvature of the sternposts in Mediterranean craft may have delayed the introduction of this rudder. But this would not have been the only difference. The Timbotta manuscript, one of the earliest treatises on shipbuilding published in Venice somewhere between 1444 and 1447, indicates that the eventual introduction of the stern-rudder was facilitated by a skeg\textsuperscript{104}.

Whether the Ebersdorf model had fore- and aftercastles –like the Mataró model– cannot be established, but the transom beam indicates at least the possibility of such superstructure.

So, essentially, the main differences consisted in the preference of carvel-technique of Italian and other Mediterranean shipbuilders, while other northern “cog”-features were adopted. At the same time the Venetians tried to get hold of another foreign technology, which proved to be more influential than the northern tradition in terms of hull construction: The skeleton-first procedure. It is not entirely clear when and where the first genuine skeleton-first procedure occurred, but the latest Byantine wreck indicates the full completion of this development and the Venetians have probably inherited aspects of Byzantine shipbuilding technology when they occupied the shipbuilding area of Constantinople during the Fourth Crusade in 1204 and again around 1400 when ‘Greeks’\textsuperscript{105} were mentioned as formidable galley builders in the Venetian Arsenal\textsuperscript{106}. There was a concerted effort to record and preserve features of existing vessels by means of simple sketches, which eventually led to the writing of several treatises since the early 15\textsuperscript{th} century, of which the Timbotta manuscript was one\textsuperscript{107}.

The carvel-technique originally encompassed –just like the clinker-technique– a shell-first building sequence, facilitated by the cumbersome mortise-and-tenon technique\textsuperscript{108}. The Byzantine Yenikapı wrecks from the 10\textsuperscript{th} to 11\textsuperscript{th} centuries show the last transitional phase towards a pure skeleton-first principle\textsuperscript{109}. This development entailed also the profession of caulkers, as planks that are fastened to the frames are not as tightly flush-laid as in the work intensive mortise-and-tenon technique, in which mortises were chiselled carefully for a tenon to be fitted in and butted with wooden pegs to hold the planks tightly together\textsuperscript{110}.

6. GENOESE CARRACKS IN ENGLAND: EXPOSURE TO A FOREIGN TECHNOLOGY

Roughly a century after the building of cochas began in the Western Mediterranean and the Adriatic Sea, a Mediterranean type of ship challenged English shipwrights during the Hundred Years War. Shortly after King Henry V returned victorious from the Battle of Agincourt, the English seized 1416/17 eight Genoese carracks in French service. It is no coincidence that these were ‘Genoese carracks’, as this type seems to be a specific Genoese “brand”, not unlike ‘Bayonese cogs’. While there are several references to French and Venetian carracks, Genoese carracks feature most strongly in written sources and are also said to be the best in a reference from 1454\textsuperscript{111}.

\textsuperscript{102} ORTEGA VILLOSLADA 2008, 439.
\textsuperscript{103} HUTCHINSON 1994, 43.
\textsuperscript{105} i.e. Byzantines.
\textsuperscript{106} DOTSON 1994, 162.
\textsuperscript{107} DOTSON 1994, 163; Cf. ANDERSON 1925; Cf. LANE 1934.
\textsuperscript{108} Cf. STEFFY 1994.
\textsuperscript{109} KOCABA\textsuperscript{Ş} 2012, 12.
\textsuperscript{110} PRYOR 1994, 66.
\textsuperscript{111} EBERENZ 1975, 94, see also ROSE 1999, 573.
At this time, the English monarch has gained possession of wide parts of France, including Rouen in 1419, which had been a major French shipyard in which galleys with Genoese expertise were constructed, but which was burned down before the English could occupy it\(^{112}\). The captured carracks were regarded as an entirely new type of ship in England, primarily admired for their size. The Libelle of Englyshe Polycye of 1436 referred to these Genoese carracks as being "orrible, grete and stoute" from a narrative in the context of the siege of Harfleur in 1415\(^{113}\). Their cargo capacity amounted to between 400 and 600 tons, whilst only few contemporary English ships exceeded 300 tons\(^{114}\). Six of the Genoese carracks bore next to the main mast a lateen-rigged mizzen mast as seen in the abovementioned cochas, like the Sancta Maria & Sancta Brigida, which was already seized in 1410. This mast was a novelty and it was not before 1420 that the term mesan maste (mizzen mast) was in use in England\(^{115}\). The carving of a two-masted carrack on a church pewage in King's Lynn of ca. 1415 testifies this early development, depicting the 'cutting edge' of naval technology\(^{116}\) at that time (Fig.9).

Between 1416 and 1422 six royal English ships were rigged with a second mast, according to the Genoese model, in which also the "flaill" – probably a Spanish windlass – was introduced to ease the hoisting of the mainsail\(^{117}\). But soon thereafter, a third mast was added. The earliest evidence indicates a date around a period of 1420-1436 in England\(^{118}\), not long after the earliest known illustration of a three-masted vessel from a Catalan document of 1406\(^{119}\).

As could be anticipated after such a capital capture that incorporated advanced foreign technology, no efforts were spared to make use of the Genoese carracks for English royal service. But soon problems with the maintenance became apparent, when the keeper of the king's ships begged in a petition for the permission to hire "carpenters and caulkers of foreign country[s]...for in this country we shall find few people who know how to renew and amend the same carracks"\(^{120}\). It was an event when northern European shipwrights – being deeply imbedded in the tradition of clinker building – were faced for the first time with the substantially distinctive carvel technology. Although carvel-built ships were not new from the mere appearance, as Italian vessels sailed to Southampton since the late 13\(^{rd}\) century for trade\(^{121}\), this was probably the first direct exposure to this foreign technology. Thereupon Catalan, Venetian and Portuguese shipwrights and caulkers were contracted by the English to carry out the specialised maintenance works on the carracks. One of their specialties was the practice of careening (Fig. 7), which they carried out on the two carracks George and Christofre, i.e. a practice until then unknown in England\(^{122}\). For this purpose ships had to have skids\(^{123}\) as vertical reinforcements, as could be seen on nearly all contemporary depictions of large carvel-built vessels like the Mataró model (Fig. 8) or the Kraeck (Fig. 14). Nevertheless, the maintenance costs were considered too high and both carracks were eventually sold in 1423 and 1424 to merchants, for just a fraction of the costs to which the upkeep has amounted to\(^{124}\).

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\(^{112}\) RUNYAN 1994, 56.  
\(^{113}\) "And whan Harflew had his sege aboute / There came carikkys orrible, grete and stoute / In the narowe see wylynge to abyde / To stoppe us there wyth multitude of pride" WARNER 1926, 51, cf. also FRIEL 1994, 77.  
\(^{114}\) FRIEL 1994, 85.  
\(^{115}\) FRIEL 1994, 80; HUTCHINSON 1994, 44.  
\(^{116}\) It would be an uncommon sight to find an aircraft carrier on a pewage in a modern Anglican church, but in those days, in which crowns were bestowed by the 'grace of god', the crown's worldly tools of power achieved prestige too in the ecclesiastic sphere, as is also reflected by the sacred names given to ships in this era.  
\(^{117}\) FRIEL 1994, 80.  
\(^{118}\) MOTT 1994.  
\(^{119}\) FRIEL 1995, 173F.  
\(^{120}\) HUTCHINSON 1994, 35.  
\(^{121}\) FRIEL 1995, 174.  
\(^{122}\) also known as futtock riders or braces.  
\(^{123}\) FRIEL 1994, 86.
7. ENGLISH “DROMONS”: REACHING THE LIMIT OF CLINKER TECHNOLOGY?

Already few years before the aforementioned Genoese carracks were seized, their terrifying sight in previous encounters must have inspired Henry V to built ships of similar or even greater dimensions. This resulted in what could be confidently called a naval arms race, which culminated in a shipbuilding programme launched in 1413 for dromons, as they were retrospectively called in *The Libelle of Englyshe Polycye* from 1436. It can be conjectured that the English dromon had nothing in common with this Byzantine type, but that the term was used generically for large ships and possibly always for ships of war. As such, it was already characterised by the 13th-century chronicler Matthew Paris as the largest type of ship: «navis permaxima, quam dromundam appellant».

However, the use of such alien term –originally Greek or Byzantine– for a ship that «passed other grete shippes of all the comons» indicates a conscious break with the own practise of shipbuilding, and may even be seen as an attempt of elevating Henry V’s rule by attributing dromons –a “legendary” type of ship that is mentioned in the contemporary English translation of the Alexander Romance to his fleet. Obviously, the English dromon would have looked very different to a Byzantine dromon. This point in particular illustrates that the use of ship-type labels in historical sources should not be taken at face value to infer constructional similarities. The *Grâce Dieu* –launched in 1418– was the largest and last of Henry V’s four great dromons with 1400 tons, which would have even outclassed the Genoese carracks in size.

A shipwreck in River Hamble in Hampshire, England, has been identified as the wreck of the *Grâce Dieu*. Its study has revealed that the *Grâce Dieu* was built in the shell-first clinker technique. One might ask whether the difficulties to maintain the carvel-built Genoese carracks persuaded English shipwrights to built *Grâce Dieu* in a technology more familiar to them, yet appropriated to the new gigantic specifications. The drawback of using this technique was the cumbersome triple-planking (Fig. 10). This unique feature can be doubtlessly explained by the limitations of the shell-first clinker technique for large hulls. It was opined that the triple construction was a longitudinal reinforcement to prevent hogging. This is a feasible explanation for a construction based on the shell-first principle, for which there cannot be a slightest doubt, as demonstrably proven by wedges driven between the planking and the frames before trunnel-holes were drilled. Hogging however, might not have been the main reason for this unique construction, as the hull could have been adequately supported by struts during the assemblage of the shell and –once the construction was finished– the longitudinal stresses of the shell could have been sufficiently compensated by the massive stringers and thick ceiling planking that were inserted afterwards.

The observation of the planks only measuring 6-7 foot on average seems to be more significant in this respect to explain this unique triple construction. The availability of sufficiently long boards seemed to be a general problem in England, as the use of imported wainscot timber from abroad indicates. What is more, the use of iron was extremely wasteful, as each bolt-sized “nail” –2 cm thick, 15 cm long and 20 cm spaced apart– had to protrude five layers of planking. According to a documentary record, about 23 tons of iron were used for roof & nayll –i.e. roves and nails–. Although the captain of the Florentine galley fleet Luca di Maso degli Albizzi was visually impressed by the *Grâce Dieu*, exclaiming that he «never saw so large and so beautiful a construction», it can be doubted that the ship construction was regarded as overall success. Aside from the wasteful use of material for this triple-clinker construction and the obsolescence of great ships after the supremacy of the English Channel has been decided in

125 *Henry the fift, what was hys purposyng / Whan at Hampton he made the grete dromons, / Which passed other grete shippes of all the comons, / The Trinite, the Grace Dieu, the Holy Goste (...)*, ct. WARNER 1926, 51.

126 WARNER 1926, 98.

127 WEBER 1810, 397f.

128 FALK 1912, 87f.

129 Cf. WEBER 1810, 233.

130 next to the TRINITY ROYALE of ca. 540 tons, the HOLIGHOST of 760 tons and the JESUS of 1000 tons (Friel 1994).

131 ANDERSON 1934, 160.

132 Reminding of southern European shipwrights who acted similarly when they were required to built ships similar to Bayonese cogs: They were primarily inspired by visually deducible criteria, such as the square-sail and the hull shape, rather than the intrinsic technology employed in hull construction.

133 HUTCHINSON 1994, 30.

134 ANDERSON 1934, 165.

135 stringer (11 x 4 inch) and ceiling (1.5 inch thick) according to ANDERSON 1934, 169.

136 ANDERSON 1934, 165.

137 Cf. TINNISWOOD 1949, 287.

138 FRIEL 1993, 5.


140 FRIEL 1993, 5.

141 ROSE 1977, 5.
England’s favour, a contemporary report of a mutiny onboard the vessel may be ascribed to the difficulty and danger in ship-handling, although there is admittedly no clear indication\(^\text{142}\). But it seems nevertheless conspicuous that *Grâce Dieu* had been permanently moored in River Hamble for almost 10 years for representational purposes when visited by Albizzi, without having seen much active service. Thus, the attempt to outclass the mastery of Genoese carrack-builders in the local clinker-technique was evidently not regarded as success, given that the triple-clinker method remained a unique feature. However, the attempt itself reflects a very genuine aspect in social learning called a ‘perceptional set’, where the mode of solving problems is guided by the habitual constraints of the own tradition, even when simpler solutions are possible\(^\text{143}\). Thus the triple-clinker can be seen as a genuine strand of development within the locally practiced clinker-building tradition, but prompted by and erroneously appropriated to an external influence. Not only in England but also elsewhere, the same trend to larger ships connected to the same constructional problems can be observed. So a German merchant in Bruges lamented in a correspondence dating to 1412 about how nefarious the construction of ships have become lately\(^\text{144}\). This may be linked to the limitations of building ever larger ships in the shell-first method.

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\(^{142}\) Cf. ROSE 1977, 5.

\(^{143}\) MORGAN et al 1992, 130.

\(^{144}\) Hanserecesse I. 6. 77, 1889, 80.
8. THE ENGLISH-BASQUE LINK: A COMMON NAVAL LEGACY?

Roughly simultaneous to the building of the *Grâce Dieu*, another building contract for a ship that would have even superseded the former was outsourced by King Henry V to Bayonne –his Basque enclave– as detailed in a letter from 1419. The building progress of this ship was described by the king’s inspector John Alcetre thus «xxxvij strakys in hyth y bordyd, on the weche strakys byth y layde xj bemys» – i.e. 36 strakes in height and boarded, on which the strakes beeth there laid 11 beams. This description too reflects the rationale employed in clinker construction, in which the shell is assembled with the strakes added first and, moreover, in which the finished shell is held together by protruding crossbeams, which are rebated in order to lock the curvature of the upper strakes. Protruding cross-beams were also present in the Aber Wrac’h wreck from ca. 1425, which was most likely also built in this region, and probably also in the *Grâce Dieu*, although they were initially interpreted as riders. Also in terms of workmanship there are similarities, as radially cleft planks were used for the English-built *Grâce Dieu* (1418) but also the Basque-built Barceloneta I (ca. 1410), Aber Wrac’h (ca. 1425) and Newport (after 1447) wrecks, although tangentially sawn planks have been also used in the Aber Wrac’h wreck and the *Grâce Dieu*. The use of radially-cleft planks was not uncommon in northern Europe at that time: A study by this author has found that roughly three-quarters of over 50 clinker-built wrecks hitherto known from the extended North Sea area in the period between 1300 and 1540 were built with radially cleft planks. Large bottom-based ships in contrast – often perceived as the epitomisation of the ‘Hanseatic cog’ – were regularly built with very wide tangentially sawn planks, as reflected by the wrecks from Bremen (1380) or Doel (1326). Although the lines of archaeologically verifiable shipbuilding traditions on the one hand and historically determinable ship-type categories on the other hand are blurred, this essential difference fuels the assumption that a ‘Bayonese cog’ might have indeed differed from a ‘Flemish cog’, as implied in Giovanni Villani’s earlier quoted reference.

Many aspects point to a clinker tradition that was shared between English and Basque shipbuilders, and arguably other coastal regions of the Atlantic such as the northern Iberian Peninsula, France and Ireland, and in the wider sense—as seen above—all of northwestern Europe. The outsourcing of building contracts of the English crown to Bayonne shipbuilders is a recurrent practise, particularly for large ships: From as early as the 13th century, galleys were built in Bayonne for the English. In 1302, King Edward II commissioned the building of a large nef of 300 tons at a time when the average tonnage of nefs was 180 tons, and in 1411 King Henry IV commissioned the building of a large ship of 60 m length. The historical link between English and Basque shipbuilding is well testified for over two centuries, but it was not exclusive, at least in the earlier period, as other powers also made use of the Bayonese shipbuilding expertise: In the 13th century King Alfonso X of Castile used lumber and shipwrights from Bayonne, and King Philip of France had galleys built in Bayonne.

This raises the question of whether a discrete English-Basque shipbuilding tradition could be corroborated by archaeological findings? The westernmost extent of the clinker tradition can be arguably embraced as a discrete ‘Atlantic clinker tradition’ (Figs. 11, 12). There is evidently no singular ‘Nordic’ or ‘Scandinavian’ clinker-technique, but spatiotemporal variations, as particularly well demonstrated by the range of ship-types of iron fasteners. Although it has been claimed that ‘clenching’ and ‘riveting’ describe the fastening techniques for hooked nails and clinker-nails, respectively,
there is no etymological grounds for this definition, as the term ‘clenching’ has been historically used to describe clinker-fastenings. This is highlighted by an English account from 1336, which distinguishes between *tenecium contra clenchantiores* –holders and clenchers–. The presence of holders is a clear indication for what would be today called riveting. ‘Clenchers’ were involved in repairing *Grâce Dieu* and ‘clenchnaill, roeffs, spikes, bolts, bondes’ were made in the royal forge at Southampton in the same year. *Clenchnaill* are obviously clenched nails and roeffs are roves, and the latter are being typically associated with riveting. But not exclusively so! Normally the tip of the nails were pinched off and the remainder deformed over a rove. However, there is also a variant where nail-tips were peened over roves, which McGraill associated with a French method. This fastening method is in fact neither limited to France nor to shipbuilding, but it is a technique very common in Basque vernacular architecture, aside from shipbuilding. Thus it is referred here as the “Basque clinker-technique” in order to highlight its distinctiveness (Fig.10).

In the case of the Basque-built Barceloneta I wreck, the nails appear to be peened over a rove at a 90° angle. At least one nail peened over a rove in this manner was also found in the 15th-century clinker-built Drogheda Ship, Ireland, while the strong concretions did not permit an assertion on whether this is also the case with other nails. In the Newport ship the concretions were too severe to determine whether the tip of the nail were deformed or peened over the rove. It has yet to be shown whether this way of fastening is a feature that can be consistently associated with a Basque, Biscayan or even Atlantic clinker tradition. Iron fasteners with roves may have been prematurely typified as generic clinker-fastenings in the past, as iron fastenings are usually strongly corroded.

Another aspect in which the Atlantic clinker tradition is distinctive to Scandinavian shipbuilding are the massive scantlings of frames and small frame interspaces, which may be an indication for the gradual transfer of hull strength from a shell- to a skeleton-oriented principle. The Barceloneta I, Aber Wrac'h and Newport ships all have closely spaced frames, a feature that has been also observed in 13th-century clinker wrecks on the Island of Guernsey.

Despite the regional and cultural distance, English- and Basque-built ships may have become indistinguishable from each other at the time when *Grâce Dieu* was built due to longstanding historical links. It would be interesting to know whether Basque-built ships matched Henry’s expectations better than those built in England proper. This suggestion is not unreasonable, with regard to the prominence of Basque masters in English shipyards. As early as 1294, King Edward I of England had a clinker-built galley constructed in London by a Basque shipbuilder called Arnold de Bayonne. Another master shipwright from Bayonne was called into consultation in Southampton a little later, and the king considered to have galleys built in Bayonne in 1276. Basque shipbuilders were consulted whenever advice on the construction of galleys was needed and may have also affected the introduction of new types, like the balinger or the pinnace. Also more than a century later, we see the same pattern. Shipbuilding in Southampton was still supervised by master shipwrights from Bayonne, whilst privateers from Dorset and Devon collaborated in 1406 with pirates from Bayonne, who had a longstanding reputation in piracy. This English-Basque link is also highlighted by archaeological evidence: The Aber Wrac’h wreck –which was most probably built in the Basque country– appears to be the wreck of an English merchantman foundered in 1435, as indicated by historical records.

Conclusively, it can be said that not only the attempt to maintain the carvel-built Genoese carracks were improvident, but also Henry V’s clinker-built dromons –judging from the fate of the *Grâce Dieu*—
might have been likewise considered an unsatisfactory attempt to emulate large ships in the clinker tradition. Whether the Basque-built ships for the English crown matched Henry's expectations better remains an interesting question. The interest to obtain Mediterranean technology was evidently unabated. In 1430, the captain of the Florentine galley fleet Albizzi visited Southampton and was dined aboard the *Grâce Dieu* by William Soper \(^{176}\), the keeper of the king's ships who—probably not incidentally—was the same individual who supervised the building of Henry V’s great ships \(^{178}\). Very impressed by the large and splendid construction, Albizzi was even allowed to take measurements of the ship \(^{179}\). Was William Soper merely chosen as an adequate peer, or in the hope to extract some secrets of Italian shipbuilding, especially by closely following the reactions and comments of his Italian counterpart on board the *Grâce Dieu*? There seems to be an interesting pattern, as Soper was again chosen to host the captains of the Florentine galley fleet Martelli, della Stufa and Ridolfi in 1442-43. The Italians had no other choice than to be hosted by an Englishman due to the restricted residence permit for foreign merchants \(^{180}\). The true intentions can be only speculated upon, but there can be no doubt, that the English had a vested interest in obtaining Mediterranean technology at a time, in which other northern European sovereigns and cities had similar aspirations in obtaining large modern warships for their fleets.

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\(^{177}\) FRIEL 1993, 17.

\(^{178}\) FRIEL 1993, 3.

\(^{179}\) FRIEL 1993, 17.

\(^{180}\) RUDDOCK 1946, 36.
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<td>Grâce Dieu</td>
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<td>Aber Wrac'h</td>
<td>Newport</td>
<td>Uribia</td>
<td>Cavalaire-sur-Mer I</td>
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<td>total beam</td>
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Fig. 12. Overview of predominantly Basque-built 15th-century vessels with clinker construction in comparison to two large ships built for the English crown, one built in Southampton and the other in Bayonne. Key: C = radiocarbon, D = dendrological, H = historical, N = numismatic, P = pottery, S = stratigraphic (Compiled by Daniel Zwick).

9. IBERIAN AND BRETON CARVELS IN THE NORTH: ADOPTION OF A CONCEPT?

Around the mid-15\textsuperscript{th} century a noticeable change occurred when shipwrights from the Atlantic coast were employed in northern European shipyards. Their mentioning by name in written sources is remarkable, demonstrating that those shipwrights were anything but ordinary craftsmen. The caravel appeared already in the 1430’s in northern waters, which was probably square-rigged apart from a lateen mizzen, for the lack of iconographic evidence of a full Mediterranean lateen rig\textsuperscript{181}. The name caravel already indicates the terminological origin of the carvel-method, which revolutionised northern European shipbuilding within a comparatively narrow time frame. This development can be traced in various written sources as summarised in the following, which undoubtedly only represents the tip of the iceberg (Fig. 13)\textsuperscript{182}.

\textsuperscript{181} cf. MCGRAIL 2001, 245.

\textsuperscript{182} Please note that carvel-planked vessels incorporating skeleton-first technology were also built in Roman provinces, with corresponding wreck finds from the Rhine area and England (cf. Mcgrail 2013), but if remains highly speculative what aspects of the technique were retained. While carvel planking could be encountered in bottom-based shipbuilding (cf. Hocker 2004),
In 1438-1440 a carvel was built in Sluis, Flanders\textsuperscript{183}, and in 1439 the Count of Flanders commissioned the Portuguese shipwright Jehan Perouse to construct a nao and «une caravelle» in Brussels, which might have been eased through dynastic bounds, i.e. the marriage of Duke Philip of Flanders and the Portuguese princess Isabella\textsuperscript{184}. Only after a quarter of a century after Henry's V extensive shipbuilding programme, carvel-built ships feature also strongly in English sources, but –as opposed to the “great ships” of Henry V– these were of modest dimensions and not built locally, but captured. Between 1443 and 1450 a chancery document refers to a carvel of Foway in Cornwall, in 1448 an English royal grant of protection was given to «a certain ship or barge called le Carvell of Oporto» of 80 tons, and in 1449 a Clais Stephen was named as master of a 60 ton Carvel of Calais, which formed part of the royal fleet, and in 1450 as privateer and master of –possibly the same– carvel in Portsmouth\textsuperscript{185}. This new type of vessel became also known in wider parts of the British Isles: In 1449 a Spanish caravel of 55 tons was captured off the Irish coast and taken to Kinsale and between 1449 and 1450 a kervel of the King of Scotland underwent repairs\textsuperscript{186}. Between 1450 and 1455, three Portuguese and one Spanish caravel were captured by English pirates, in 1453 William Lord Saye purchased a carvel –perhaps one of the captured prizes– in Sandwich, and in 1453-1466 documents indicate that over 20 caravels were in English ownership\textsuperscript{187}.

\footnotesize
\begin{itemize}
\item \textsuperscript{183} OLECHNOWITZ 1960, 10; FRIEL 1995, 177.
\item \textsuperscript{184} SLEESWYK 1990,345; FRIEL 1995, 177.
\item \textsuperscript{185} FRIEL 1995, 177.
\item \textsuperscript{186} FRIEL 1995, 177.
\item \textsuperscript{187} FRIEL 1995, 177.
\end{itemize}
Apart from Flanders and England, carvels could be also encountered elsewhere in northern Europe. In 1451, a carvel was built in Dieppe, Normandy, for a Breton owner and until 1484 Dieppe’s municipal records indicate the construction and repair of 19 other carvels. Also the late 15th-century customs account of Bordeaux indicates that Bretons owned many carvels. Bretons seemed to have played a central role in spreading this new technology eastwards beyond the English Channel. In 1459, a carvel was built in the Dutch town of Zierikzee in Zeeland by Juliaen de Bretoen, which appears to be echoed by a mid-sixteenth century compiler of the Chronicles of Zeeland, stating that caravels instead of hulks and crayers were built at this time, by following the example of a Breton. A strikingly similar development took place in Hoorn one year later, in which an early 17th-century chronicler retrospectively referred to events taking place in 1460: «(...) boyers, smacs and suchlike; until now they had nothing but hulks, square-sailed vessels and crayers that were all built with overlapping planks.» A quote from a later edition of the same chronicle states that the old method incorporated only planks that were overlapping each other, but that one has started to built in carvel as was still practiced to the day on most shipyards. But not all ships defined by historical sources as carvels were built the same. In the Noorderquartier—the northern Netherlands—an aspect of the bottom-based method prevalent in the Hanseatic sphere was retained, i.e. bottom planks were laid out first, held together temporarily by cleats, until floor-timbers were inserted. In contrast, in the southern region Maaskant, which formed part of the Spanish Netherlands since the mid 16th-century, a moulding system existed that adhered exactly to the Iberian method. This suggests that the political circumstances were a decisive factor for local shipbuilding and the mobility of foreign shipwrights.

Only two years after the significant change occurred, as mentioned in the Chronicles of Horn, the Breton carrack Saint Pierre de la Rochelle of 600 tons anchored off Danzig (today Gdansk) in 1462 and was confiscated by the city when the owner went bankrupt. This year is often seen as a key date, in which three-masted kraveels or kraffells were first encountered in the Baltic Sea. However, brick inscriptions from a monastery in Helsingør from the 1430’s depict three-masted vessels already several decades earlier. It seems very likely that the term carrack, carvel and caravel were
 synonymously used for multi-masted vessels with carvel planking. The most renowned depiction of a carreck was made by the Flemish engraver William A. Cruce (Fig. 14)198 as draft for 30 gilded carreck models, designed for elaborate banquettes on the occasion of the marriage of Charles of Burgundy to Margaret of York in Brussels199. This reflects the high prestige that these novel multi-masted ships must have had, being not only the cutting edge of technology, but the pride of navies. Thus, it is not surprising that the said Breton carreck –renamed to Peter van Danzke and colloquially known as det groote Kraweel– was perceived by contemporaries as the mightiest ship of its age200. The groote Kraweel was fitted out as a privateer in the war of the Hanseatic League against England and France. Its master Bernd Pawest reported to the City Council of Danzig the problems that the ship encountered during its privateering voyage in 1472: Although the vessel was caulked in the Zwin in the Low Countries201, great problems with water-tightness were still experienced soon thereafter. Pawest reported the formation of two great leaks in the night, which could not be brought under control even after a night of pumping. The distress is quite literally reflected in the description, according to which the crew used everything “they knew and could” to caulk the leak in a makeshift-manner, using tablecloth, pieces of wainscot, moss and tar, which seemed to have amended the situation little, as the main leak in the forepeak remained inaccessible for caulking from inside the hull, making the grounding or careening of the ship necessary202. Ironically, the groote Kraweel’s crew seem to have encountered similar problems as the English with their Genoese caracks half a century before. This comes not as a surprise, due to the vast differences in caulking clinker and carvel constructions. At the same time, other Hanseatics apparently appreciated the novel technology more than their trouble-stricken brethren from Danzig: Hamburg fitted out own caracks for war against England —«dat grote Kraweel” and «dat lutke Kraweel”– i.e. the great and the small carval203. In the previous course of the war from 1470 to 1474, prizes from Spanish, Bretonic, English and Irish origin were taken, which reinforced the fleets of the Hanseatic League204 and may have increased the familiarity and experience of maintaining or even constructing such ships.

The trend to fit out carvells for imminent wars is repetitive. In 1509, Lübeck prepared for war against Denmark and Holland and –aside from fitting out converted merchant hulks– also owned carvel-built warships referred to as «des rades kraffell”–the council’s carvall– named Marie, which was the flagship, and the Barthun and Spanniert. The latter two names leave no doubt to the Breton and Spanish origin of these ships205. Denmark –likewise preparing for war– built in the same year two carvells as well206. Interestingly, carvel technology in Danish shipyards seemed to spread by the employment of German and Dutch shipwrights from 1485 to the 1560’s, with a marked change to an influx of English and Spanish shipwrights thereafter207. With the rise of the kingdom of Sweden under the Vasa dynasty, a third power emerged in the Baltic Sea to employ carvel technology for naval warfare. Initially, this new player had to revert to hiring such ships from Lübeck, Danzig and other Hanseatic cities. A shipwreck in the Stockholm archipelago is tentatively identified as a ship described in written sources as one of his majesty’s beste kraftwells sunk in 1525. The southern Baltic provenance of the planks cut in 1512 indicates that this might be one of the Hanseatic carvells hired by the Swedish king208. The transom-stern construction with curved fashion-pieces atop is an innovation that found entrance with the skeleton-first method (Fig. 15) and is comparable to the Red Bay wreck in Canada –tentatively identified as the Basque whaler San Juan sunk in 1565209–. This construction was certainly an innovation in the Baltic Sea at that time, but –once again– slightly lagging behind the

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198 SLEESWYK 1990, 348.
199 SLEESWYK 1990, 346, 349.
200 OLECHNOWITZ 1960, 10; FRIEL 1995, 177.
201 Hanserecesse II.6, Nr. 528, ed. van der Ropp 1890, 484.
202 “Ock wetet erszenen leven hem, dat wy am sonnaveende up den sondach reminiscere in der nacht kregen eyne grote leke, alzo dat wy pemped de nacht over und kendent nicht vorvynmen und wart vo lenck yo groter und mehr, alzo dat wy in groter sorge und noet weren, wy hadden sorge, dat schip solde mit uns alien synken. Alzo dat wy lepen in de Dwnisz und rumenon dar tho. Wy hadden gehapet, wy wolden ein hebben geholpen und brudeten allein dat wy wosten und konden, wy treden dar vor handokker, taflaken, haren und halden buten vor 1 barrnit und makeden secke mit grotte und volleden alle wargen met stucche wagenschattes, mosz und there, und vsorchent mancherley, alzo leven hem, dat ik grote sorge hadde, wy selden schipp und volk den Engelschen gebracht hebben, umme dat lieff tho bergan, (.....) Alszuus leven hern hefft uns de grote noet uth der szee gedreven, und dat is all van gebrekes halven der tymmerlude, went ick mach dat jw in der warheit schritten, dat dat gude schip ny grunt geror hefft, sadder dat wy van der Wysele segelden; und de grotteste leke is vor im peke unde der andern leke is suszelt vele, und men kan van bynnen nicht beteren.” Hanserecesse II.6, Nr. 538, ed. van der Ropp 1890, 500f.
203 KAMMLER 2005, 132.
204 KAMMLER 2005, 130.
206 HAHNKE 2006, 85ff.
207 BILL 2009, 253.
208 ADAMS & RÖNNBY 2013, 115.
209 ADAMS & RÖNNBY 2013, 108.
development in the North Sea, where it appeared several decades before, as indicated by a painting from St. Cosmas Church in Stade near Hamburg, dating before 1450\textsuperscript{210}.

Despite earlier reservations concerning the employment of foreign shipwrights in Hanseatic ports – probably due to exclusively organised guilds– the restrictions were eventually lifted: Lübeck conceded in 1569 that skilled foreign shipwrights could work in Lübeck as long as they wanted, while Danzig did the same in 1552 and already few years later many foreign shipwrights, especially Dutch, worked there\textsuperscript{211}. Nevertheless, the Polish king still reverted to contract particularly Venetian shipwrights in 1570 for the building of the first Polish galleon\textsuperscript{212}. It becomes clear that there was more to it than the technical knowledge of building "Kraweels" and that the technique itself did not automatically conveyed the whole secret and art of designing a hull.

While in previous decades small carvels have gotten into English ownership by capturing or acquiring vessels from mainly the Iberian Peninsula, the new technology was now implemented in English shipyards. In 1463-1466 a three-masted caravel was built for Sir John Howard in Dunwich\textsuperscript{213}. In 1487 and 1488, respectively, the \textit{Regent} of 1000 tons and the \textit{Sovereign} were launched for King Henry’s VII royal fleet. The first was inspired by the French carrack \textit{Columbe} and the king explicitly demanded that his ships should be built like her, i.e. in the “novel construction”, which doubtlessly incorporated carvel technology, as \textit{carvel nayles} were listed in the accounts\textsuperscript{214}. Although there is no mention of foreign shipwrights when the \textit{Regent} and \textit{Sovereign} were built, it is testified that during Henry’s VIII reign (1509-1547) many Venetian shipwrights were employed in the royal shipyards\textsuperscript{215}. The Woolwich wreck has been identified as the abovementioned \textit{Sovereign}, which frames feature bevelled notches as though it used to be a clinker-construction. This had been interpreted as re-planking a clinker-built ship in carvel\textsuperscript{216}, but it appears that the \textit{Sovereign} was in verity built as carvel construction from the very start, as the bevelled notches can be explained by the order of the kings' clerk to break up \textit{Grâce Dieu} for the «makying of his Ship cald the Souveraigne»\textsuperscript{217}. Thus, the notches date from the \textit{Grâce Dieu}'s clinker construction, which were evidently bevelled off before being reused for the \textit{Sovereign}. The reuse of frames made from crooked timber was a very common practice at that time. It is not only

\begin{footnotesize}
\textsuperscript{210} WINTER 1978, 8f. and tab. 6.
\textsuperscript{211} OLECHNOWITZ 1960, 30.
\textsuperscript{212} LITWIN 1991, 56.
\textsuperscript{213} FRIEL 1995, 178; he rightly points out however that the absence of clench-nails and roves alone does not necessarily imply that the vessel was built skeleton-first.
\textsuperscript{214} ADAMS 2003, 66.
\textsuperscript{215} RIETH 2003, 27.
\textsuperscript{216} SALISBURY 1961, 86.
\textsuperscript{217} i.e. the second \textit{Grâce Dieu} of 1449.
\textsuperscript{218} OPPENHEIM 1896, 47, cited by ADAMS 2003, 66.
\end{footnotesize}
the notched frames that illustrate in an exemplary way the gradual transition from clinker to carvel, however. The caulking of carvel-constructions remained a problem for northern shipwrights too, which led to a makeshift appropriation: Battens were nailed to the outside of the Sovereign’s hull to keep the caulking material in place. Several decades later, this makeshift technique can be also observed in Swedish carvels: The seams of the Stora Kravlen—built around 1532—were apparently covered by strips of lead after caulking, and carvel-caulkers were explicitly mentioned, and the Elefantén—another large Swedish warship built around 1554—had battens between the frames. The use of battens or caulking laths were not a novelty in northern Europe, as they were used already for centuries in bottom-based constructions, held in place by cramps or sintels, which could have been synonymous with the aforementioned ‘strips of lead’. The fact that such makeshift aids were not used by accomplished carvel-shipbuilders reveals that northern Europeans still encountered problems in embracing the accumulated know-how of carvel-technology.

It can be conjectured that the introduction of the carvel technology in northern European shipyards occurred within a relatively short period, but that the transition to this new technology—as could be expected—did not occur wholesale and minor difficulties were overcome and amended with local techniques.

10. EVOLUTION TOWARDS AN ALTERNATING FRAMING-STYLE VIA A BASQUE HUB?

Amongst historians, there is a common—yet unspecified—realisation that some kind of mixture between Atlantic and Mediterranean influences must have occurred in 15th-century shipbuilding, which created new types of ships that plied the seas in the beginning period of the great ocean explorations. Although the details of this transition remain largely obscure, there are several indications in both historical and archaeological sources, which seem to reflect this transition. Not surprisingly, the Basque region appears to be yet again central to this development.

The introduction of carvel technology in northern Europe often seems to be tantamount to the breach with the local shipbuilding tradition, where foreign shipwrights were allowed to implement their own method from scratch. But this is only partly true, as some aspects of the local tradition were often retained and may have even abetted the adoption of carvel technology as a whole, like the Dutch-flush method in the northern Netherlands (Fig. 10). Some evidence suggests that the Atlantic clinker tradition may have likewise abetted a smooth transitional process from shell-oriented clinker to skeleton-oriented carvel technology, often involving both methods in the same construction. This has been hypothesised for the aforementioned Bayonne Ship of 1419, for which construction the use of moulded frames was suggested (Fig. 10). Moulded frames would have been an uncommon feature in a shell-first clinker construction, where frame dimensions were conditioned by the shell, and inserted and fashioned by the rule of thumb once the shell had been completed. A skeleton-first feature, however, was inferred by the term hameron, which was interpreted as tailframe on the basis of etymological and contextual information, for which fixed measurements were given, i.e. «...the mast beam is in length 41 common feet, and the beam of the hameron afore is in length 39 feet, and the beam of the hameron behind is in length 34 feet...». Can this be seen as evidence for a skeleton-oriented method for three masterframes? Not necessarily, as it can be objected that Alectre’s 1419 letter to King Henry V was merely meant to inform him about the progress and as-is state of the building of his royal ship. The measurements taken at the mast and hameron beams may have been a generically agreed upon measure for principal dimensions, rather than a skeleton-first feature for hull control. Besides, why should Alectre include such mundane aspects in the report when the dimensions are understood to be predetermined?

While the question of whether the construction of the Bayonne ship of 1419 incorporated some skeleton-first principles has to remain hypothetical, the presumably Basque-built Cavalaire-sur-Mer wreck dating to 1479 terminus ante quem undoubtedly combines features from both techniques. The

220 Börjeson 1928, 155.
221 Börjeson 1928, 149.
225 Loewen 1997a, 329.
226 Loewen 1997a, 329.
floor timber and first futtocks were pre-assembled, as evidenced by mortices, whereas second futtocks simply overlapped and were therefore added at a later stage (Fig. 10). This coincides with tangentially sawn carvel bottom planking up to the water-line, continued by radially cleat clinker planking above. Roughly speaking, the building sequence was divided into two parts, the first being skeleton-based carvel and the second shell-based clinker construction. By analogy, this wreck would have looked similar to bottom-based ships from the Hanseatic sphere, but in verity, the sequence was inverted with a high degree of predefined geometry in the master frame228, which is not the case in shell-oriented bottom-based shipbuilding. The alternating framing style in conjunction with the hull design and consistent growing and harvest patterns for crooked timbers indicate that the Cavalaire-sur-Mer wreck is the product of a cohesive shipbuilding tradition and not a product of chance229. Moreover, the Cavalaire-sur-Mer’s clinker-planking above the water-line was made with radially-cleft planks to which—in a true shell-first fashion—the second futtocks were inserted later. This reflects that the ship was built within a community with a clinker-tradition, but may have been retained for a practical reason: Planks above the water-line wore out faster than those below the water-line, as they would have weathered faster, exposed to due to rain, spray and sun radiation. Radially cleat planks were more durable than tangentially sawn planks, as they were less permeable and less susceptible to form cracks. A similar way of planking can be also observed a century later in the Chalupa 1 wreck, the whaleboat of the Basque Whaler San Juan wrecked 1565 in the Red Bay, Canada, where the first three strakes are flush-laid and the topmost two strakes are clinker-fastened230.

Unlike other Mediterranean ships, the Cavalaire-sur-Mer wreck is not a genuine skeleton-first construction, which raises the question of origin. In this respect, there is a current debate on moulding systems and its diverse traditions, which cannot deny a certain Venetian influence, whilst many other indications point to an independent Atlantic or Iberian tradition. The only common denominator of this debate is the realisation that the evidence is incomplete and sketchy, so it remains speculative how exactly the moulding systems spread. It is assumed that Venetian moulds must have had an impact on English ship design, as Mathew Baker noted in ca. 1570 that Venetian shipwrights have used twenty years earlier a master frame on the basis of four arcs of tangential circles of different radius231. This reference is credible, as Baker participated in his youth in 1550 in a training voyage for English navigators to the Mediterranean232. It was pointed out that the early moulds in the Fragments of English Shipwrighty are indeed similar to the Venetian moulds and that Baker might have used the Venetian style of 1550, though more cumbersomely233. More cumbersomely because it lacked the sheer-narrowing scale and hence might have rather resembled the method of ‘whole moulding’, which application in itself is highly obscure due to the lack of contemporary documentary evidence234. The origin of this technique is still a contested issue, believed by some to be Mediterranean235 or of an Atlantic or even discrete Basque origin236. As the case may be, there seems to be a basic agreement on that Mathew Baker was at least initially inspired by the Mediterranean method that encompassed a master mould, a rising square and a sheer-narrowing scale, which indeed Baker recognised—implying that he knew at least a similar system—by commenting on the drawings of the Venetian main frame «partysane and stely which we do call the rising and narowing»237. However, the system applied by the English around 1570/1580 was neither the Mediterranean method nor ‘whole moulding’, but was based on tangent arcs within a grid of narrowings and risings, or in other words by ‘hauling up/down’ the futtock after which principle allegedly the Mary Rose was constructed.238 Despite the shipbuilding centre of Bayonne ceased to be under English rule in 1451, a continuing link of England to its former enclave cannot be excluded239. In fact, the moulding systems between Mary Rose (1509) and the Basque whaler San Juan (1565) appears to be similar, as the futtocks were also ‘hauling up/down’240. In the Mary Rose the framing and planking advanced in an alternating fashion, as indicated by the timbers, of which only a few are actually fastened and scarfed together. The pre-fastening of few planks relieved the strain from the ribbands, which determined the shape of the frames in between the

229 MOORE 1998, 38.
230 RIETH 2003, 27; cf. LANE 1934.
232 BARKER 1991, 64; BARKER 2003, 42.
233 Cf. RIETH 2003, 29.
234 Cf. RIETH 2003, 29.
236 Cf. BELLABARBA 1993, 288.
237 BARKER 2003, 33ff., 43.
238 BARKER 2003, 35.
239 RIETH 2003, 29.
master frame and the tail frames. The same procedure was applied to the San Juan, in which frames and planks were also installed in an alternating fashion and nail holes indicated the position of temporary ribbands or battens. An alternating way of construction was also observed in Grâce Dieu (1418), where several futtocks were apparently inserted before their corresponding floor-timbers. Not only in geopolitical terms, but also in climatic terms, the Basque region was an important hub in shipbuilding between the north and the south, as evidenced by the unique way of fastening frames to planks. While in northern Europe only treenails were used, in southern Europe iron nails were used, as softwood treenails would have deteriorated faster in warm waters. In the Biscay area, however, the frames of 16th century ships were fastened with two treenails as well as two iron nails. In the case of the wreck of the Basque whaler San Juan, however, the iron nails were driven in at the quick assembly of planks and frames, and later solidified by treenails. The same “peculiar” feature was observed a century earlier in the Basque-built Newport ship, where iron spike nails were also used in addition to treenails in plank-to-frame fastenings. This technical solution may be testament to the Basque’s mediating role between northern and southern Europe, and the vastly different climate zones Basque ships were operating in.

Fig.16. Alternating sequence in frame-led building of the Red Bay wreck – tentatively identified as the Basque whaler San Juan (1556) (Source: GRENIER, LOEWEN, PROULX 1994).

11. OUTDATED CLENCHER HULKS: ECLIPSED BY CARVEL TECHNOLOGY?

The carvel revolution heralded in a new age in which large clinker-built ships were gradually superseded by carvel-built ships in many –though not all– northern European ports. In England the changes were so profound that between 1500 and 1510 no large clinker-built ships were used for royal service anymore and even dismissed as ancillary vessels. Some large German hulks described as clenchers were arrested on the Thames for royal service in late July 1545 and sailed to Portsmouth, where the Lord High Admiral rejected them as unsuitable for naval use: «clenchers, both feeble, olde, and out of fashion». While rejected in England, hulks were still used in the Baltic Sea in the 16th century. A war fleet summoned in Lübeck in 1509-1510 included both hollicks (hulks) and carvels. This indicates that the term hulk was synonymous with that of a large clinker-built ship. The same distinction was made in the Swedish Navy under King Gustav Eriksson Vasa, in which the king's favoured kravels sailed alongside the large holcs. Fernando de Oliveira referred unfavourably to a bowl-like hull shape of a 16th century hulk from Riga, anchoring off Belem, Portugal, which reflects...
the absence of skeleton-oriented guiding principles. This bowl shape impression is not only caused by the absence of a tumblehome, but also the tapering bow and stern sections in a strong arch, as observable in the Ebersdorf model. Despite these ships were disdained in places where the transition to carvel technology has been completed, large lapstrake constructions were continued to be built in the Baltic Sea region in particular. The survival of such constructions can be ascribed to the mercantile nature of its use, where predominantly unfinished bulk commodities were transported, from rural communities that did not undergo the same pressures as the densely urbanised areas in the Low Countries and the English Channel, which fuelled innovation in the shape of carvel technology. Although hulks were occasionally fitted for war by Hanseatic merchants, the Dutch and Flemish in the 16th century, the advances in naval artillery rendered them obsolete for close combat, but deemed sufficient as mere supply vessels. The number of ordnance in the hitherto customary arrangement above the gunwale—in the fore and aftercastles—was restricted by the increased centre of gravity, jeopardising the hydrostatic stability. The only viable solution of cutting gun ports below the deck would have weakened clinker-built shell-first structures considerably. The strategic necessity to deploy larger calibres of guns and to cut gun ports, however, became a driving force in Renaissance shipbuilding, especially in England. Although the Frenchman Descharges is often named as the inventor in 1501, the seal of Maximilian of Burgundy of 1493 and a ship depiction of 1497 from Hamburg’s naval law shows gunports as well. Documents indicate that the Mary Rose was rebuilt in 1536 and dendrochronological analyses revealed more specifically that riders, diagonal and vertical braces and heavy transom knees were added around that date alongside with massive deck beam knees, probably to bear the increased strain of artillery recoil on a continuous gun deck. Although the early inventory of 1514 already indicated an impressive ordnance, the Anthony Roll lists an even heavier armament after her rebuilding with 6 bronze pieces of considerable size, 2 cannons, 2 semi-cannons and 2 culverins, which reflect great diversity of antiquated and modern guns. While such rebuilding measures provided no structural problem in carvel-built ship—at least with regards to structural stability rather than hydrostatic stability—such measure would have posed a problem in clinker-built vessels: As shell-first structure, principle stresses are transferred via the shell, and cutting holes into it would have weakened the hull structure considerably, despite being reinforced by frames. This is probably the reason why the abovementioned Lord High Admiral had such a disdain for the German clenchers. Despite—or even perhaps—of the limited use of hulks for warfare, northern European merchants still relied heavily on hulks, particularly Hulkes of Dantsick, Easterlings Hulks, Hulks of Flanders and hulks are known to have sailed from Russia, Norway, Denmark, Friesland, Holland, Zeeland and Brabant. How widespread this ship still was, could be estimated on the basis of a late 16th century Iberian source, which notes that there is in Lisbon upon 80 sails of hulks from 100 tons to 800 tons, of Holland, Zeeland, and Hamburg. The flagship of the Spanish Armada’s only northern European squadron of 1588 was the 650 ton merchant hulk El Gran Grifón, built in Rostock, which sailed with other hulks from the Baltic and the Netherlands. Interestingly, only few additions were made to the hulks’ light armament, and all ships of that squadron were used as troop carriers and supply vessels for the impending invasion, rather than for naval action. At the sight of these hulks, Sir Walter Raleigh noted that Easterling hulkes, who were wont to paint great red portholes in their broadsides where they carried no ordnance at all. The fake gun-ports painted onto the hulks’ sides to deceive the English is another clear indicator that their hulls were not suited to cut gun ports into their sides. This period is marked by the gradual establishment of professional navies and purpose-built warships. However, the practise of arresting merchant ships by sovereigns and city states to fit them out for war was still widespread, as illustrated above. By relying on the “outdated hulk”, merchants may have attempted to evade the arrest of their ships. Thus, the refusal to adopt modern carvel-built ships may have been a calculated choice rather than a sentimental adherence to the native shipbuilding tradition.

251 ERIKSSON 2010.
252 KAMMLER 2005, 135.
253 LITWIN 1985: 140.
254 KAMMLER 2005, 151.
255 DOBBS & BRIDGE 2000, 258.
256 GUILMARTIN 1994, 148.
258 CARR LAUGHTON 1912, 156.
259 MARTIN & PARKER 1988, 42.
260 MARTIN & PARKER 1988, 42.
261 NANCE 1912, 103.
12. CONCLUSION

By examining trends in shipbuilding from a diachronic perspective of more than three centuries, several recurrent patterns crystallise in the way different ship-types were perceived by contemporaries in a different way than the modern observer may expect.

Historical ship-types are primarily indicative of origin rather than construction, but may have evolved into a “brand” in its own right, such as a ‘Bayones e cog’ or a ‘Genoese carrack’. These identification labels indicate that innovation in shipbuilding may have been driven decisively in a very regional –if not urban– context, rather than a general development on a broader scale, so gaining possession of cities or fiefdoms with renowned centres of shipbuilding –like Bayonne or Rouen– may have been a major strategic factor in an age in which city states and sovereigns aspired to safeguard trading routes. Ship-types should not be taken at face value, as they encourage stereotypical thinking: The distinction between late cogs and early carracks, for instance, might have been blurred by regional concepts, and archaeologists should therefore think outside historical type categories in tracing influences within shipbuilding. This study provided historical evidence, which supports that clinker-built and even carvel-built vessels were referred to as cogs in southern European sources, which should be incentive enough to stop referring to seagoing bottom-based vessels as “cogs in the archaeological sense”, which is plainly inaccurate, considering the accumulated evidence from an all European perspective.

Intrinsic insights in the mechanisms of the “naval arms race” can be gained by tracing modular solutions archaeologically, especially those that can be seen as flawed, anachronistic and transient, as they tend to reflect active phases of change by trial and error. Three major levels of technology transfer can be identified.

First level innovation

The first is exemplified by the Grâce Dieu, where a new construction is prompted to accommodate new specifications, inspired by foreign ship-design –i.e. Genoese carracks– but occurring within the boundaries of the own clinker tradition. This is the most isolated form of change and innovation.

Second level innovation

The second level is exemplified by the gradual introduction of carvel technology in communities, where some form of skeleton-oriented construction was already practised, as hypothesised for the Basque case. This transition occurred simultaneously –but different– in other Northern European centres of shipbuilding, like in the northern Netherlands in which this technology is appropriated to the local bottom-based tradition, retaining an aspect of the shell-first method in the initial stage of construction, but admitting the permeation of skeleton-first technology into the “Dutch flush” method, aptly described as cross-fertilisation, and leaving an unmistakably local mark in the way of adoption. Other aspects of this technology –like the use of batten cramps for the water-proofing of flush-laid plank seams– has also permeated the transitional phase. Ocularly, the transition to carvel-ships was complete, but not on a modular level, where several work processes were amended by familiar techniques carried out in the local shipbuilding tradition.

Third level innovation

Genuine and complete adoption however, tended to occur only by the hiring of foreign shipbuilders who were allowed to implement their skeleton-first carvel construction method from scratch. The fact that they were mentioned by name in historical sources reflects their importance and social status, which is far beyond that of ordinary craftsmen. The high cross-cultural mobility of specialists appears like a strikingly modern concept, but it was not uncommon for the examined period.

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HOCKER 1999, 22.
The impulses of technology transfer changed from a north-south and later to a south-north direction, highlighting the transience of innovation centres. This is a stark reminder that we—speaking from a northern European perspective—should not take our current state of affairs for granted in an ever more globalised world order, which may change swiftly beyond recognition within the rate of few decades and less.

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