“INNUMERABYLL SHOTYING OF GUNNYS AND LONG CHASYNG ONE ANOTHER:” HEAVY ARTILLERY AND CHANGES IN SHIPBUILDING IN NORTHERN EUROPE IN THE EARLY MODERN PERIOD

THESIS

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Colin Andrew O’Bannon
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Master’s Examination Committee:
Dr. John F. Guilmartin, Jr., Adviser
Dr. Geoffrey Parker
Dr. Christopher Reed
ABSTRACT

At the beginning of the early modern period in northern Europe, there occurred a transformation from shell-based to frame-based methods of ship construction. It has been demonstrated that in many places, the medieval Mediterranean, for instance, similar transitions were slow ones that occurred in stages. This was not the case in Northern Europe. In only seventy-five years, methods based on lapstrake, shell-based construction were abandoned in favor of methods that produced frame-based, flush-planked ships. This coincided in time with the application of the developing technology of artillery to warfare at sea. Shortly after guns, particularly heavy guns, were placed on ships in Northern Europe, shipbuilding methods began to change.

The technological factors that brought about this rapid and fundamental change in the way that shipbuilders conceived of ships can be observed through examination of the archaeological record. Numerous vessels from the late medieval and early modern period have been excavated in the past eighty years. The primary goal of this work shall be to collect information from these sites in a single work in order to demonstrate a chronology for late medieval/early modern vessels-of-war built in Northern Europe. Late medieval merchant and war vessels that have been excavated will be used to illustrate stages in the transition from lapstrake to flush-planked construction. Additionally, the thesis shall argue that there is evidence in the record of an experimental phase in the history of vessel construction. In vessels built during this period, one can observe that in ships intended for military purposes, builders solved problems they encountered, as a result of the introduction of artillery and southern European
building methods, by adapting shipbuilding techniques known from earlier lapstrake traditions. It is hoped, finally, that the work will prove useful to future archaeologists and historians for the assessment of potential and discovered sites. Many sites still exist which could further detail the chronology and give greater insight into the nature of late medieval/early modern ship construction.

This study will improve our understanding of different shipbuilding technologies that existed in Europe at the end of the medieval period and the way they were transferred from South to North. Additionally it will illustrate the way technological and historical events converged to bring about the transformation of the conceptual framework for the building of warships in Northern Europe at the end of the fifteenth and beginning of the sixteenth centuries.
DEDICATION

For my parents.
VITA

June 1982 ...........................................Susquehanna Township High School,  
                                      Harrisburg, Pa.
June 1983 .........................................Liceo Scientifico Segrate, Milano, Italy
1993 to 1995 ......................................Graduate Teaching Associate, Department  
                                      of Anthroplogy, Texas A & M University
1997 to 2001 ......................................Graduate Teaching Associate, Department  
                                      of History, the Ohio State University

Fields of Study:

Major Field: History

Since 2007, Colin O’Bannon has been Managing Member of CO-Weekley Ltd.  
He has been educated in History and Nautical Archaeology and has worked and  
researched in Italy, Portugal, the Dominican Republic, Haiti and in the United States. He  
has been educated here, in Italy, Germany and Austria. Colin O’Bannon has worked as a  
political reporter, a union supervisor and as a computer support technician.
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CHAPTER ONE: Introduction

In August 1512, the naval forces of England and France met in combat in the English Channel near the French port city of Brest. During the battle, the English Regent and the French La Cordelière – respectively the largest vessels in each flotilla – engaged each another in an action fairly typical of medieval naval warfare. Upon spying the 800-ton French vessel, the English ships Mary James and Sovereign approached the French ship. With both gunpowder artillery and missiles, the English ships attempted to damage the French vessel sufficiently to allow a boarding action to begin. When La Cordelière broke free of the two English ships, Regent, a three-masted carrack of 1000 tons built by Henry VII in 1496, approached the enemy on the weather gage. As it neared the French ship, Regent’s complement of over 700 soldiers and sailors pelted the French vessel with stones, javelins, arrows and gunpowder artillery. At the same time, it maneuvered to grapple the French ship. When the two ships were close, hooks were thrown out and the vessels were secured side-to-side.

Once the vessels were close enough, soldiers from each side leapt into the enemy’s ship, attempting to overwhelm the opposing complement of sailors and soldiers. For over an hour, beneath a shower of “shot of gonnys and arrows,” after “innumerably shotying of gunnys and long chasing one another,” men fought hand-to-hand. Somehow, while the engagement was under way, one of the two vessels caught fire, and shortly thereafter, there was an explosion (Figure 1). Most likely, the explosion occurred when a gunpowder magazine ignited. The explosion sent both ships – and the vast majority of soldiers and sailors on each – to the bottom.¹

¹This thesis follows the form and style of Technology & Culture.

Figure 1: The Battle off Brest (1512). La Cordelière is in the foreground and Regent is in the background. Note the guns pointed over the uppermost planking strake of La Cordelière. (From Alfred Spont, ed., *Letters and Papers Relating to the War with France, 1512-1513*, Navy Records Society, vol. 10, (Greenwich, 1897), frontispiece.)
The battle between Regent and La Cordelière was the first major naval fight of the war known in English annals as the War with France of 1512-1514. The little-known conflict was the most significant incidence of hostility between England and France since the end of the Hundred Years War in 1475. It was an attempt by the young English King Henry VIII to flex his muscles, presenting himself as a monarch to be reckoned with by other, more important European courts. The “muscles” that Henry had were initially minimal; he had the ships of his navy. Henry had inherited many of those vessels from his father, Henry VII. The most significant aspect of those ships engaged in the War with France was that, beginning towards the end of the elder Henry’s reign, ships intended for the crown were purpose-built for a new type of naval warfare. They incorporated the use of heavy gunpowder artillery.\(^2\)

Many historians have noted the way that gunpowder revolutionized warfare on land at the end of the medieval period. The “military revolution” of the late medieval and early modern periods was no less true with regards to warfare at sea. Beginning in the fifteenth century, and to an even greater degree in the sixteenth century, weapons and tactics at sea, as on land, became increasingly sophisticated as technology progressed. Changes in gunfounding technology and its application to ships drove related changes in tactics and strategy.\(^3\) Ultimately, this brought about a wholesale transformation in the way that ships were conceived and built, particularly in northern Europe.

For about a millennium, lapstrake construction methods had been the preferred method of ship construction for northern European shipbuilders. At the beginning of the early modern period, such techniques rapidly gave way to carvel building methods, introduced from the Mediterranean and Iberian Peninsula. The new techniques were first used in northern European shipyards for the construction of vessels of war. They allowed a greater variety of hull types, better accommodated the developing technology of gunpowder artillery and were ultimately

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found to be more economical in terms of materials and repair than were earlier methods.¹ By the
beginning of the seventeenth century, carvel construction techniques had wholly supplanted
lapstrake methods for the construction of large, ocean-going vessels in shipyards throughout
northern Europe.

The nature of the period of transition from “medieval” to “modern” is one that has been
debated for decades. In northern European shipyards, the period was certainly characterized by
the replacement of entrenched clinker traditions with carvel shipbuilding practices, introduced
from the Mediterranean and Iberia. This transition occurred extremely rapidly, in perhaps as little
as seventy-five years. In such an extremely short period of time, shipbuilders were asked and
required to change the methods that they had used for centuries. Such changes were demanded in
order to accommodate new and introduced technologies. The vessels that resulted appeared and
performed differently than ships built earlier. The ships brought about by the new methodology,
evident in the documentary, iconographic and archaeological record, have been noticed and
discussed.² Unfortunately, most studies have focused almost exclusively upon the documentary
and iconographic sources with only cursory examination of the archaeological record.³

Certainly much of the neglect of the archaeological record is due to the extremely
complex nature of the artifacts themselves. It cannot, however, be blamed on a paucity of
information. There are numerous vessels that date to the period from about 1470 to 1520 that
have been excavated, examined and published over the past 90 years by archaeologists, maritime
historians and naval architects. These studies allow great insight into the nature of the changes
that took place at the critical juncture in the history of shipbuilding technology. Many of the
sources remain quite obscure, however. Admittedly, a broad view of the archaeological record
can be difficult.

The principal purpose of this work is to collect in a single volume information from
excavated vessels dating to the late medieval and early modern period that were likely built in

² For example, Rodger, Sovereign of the Seas, passim, esp. 204-20; Michael Oppenheim, Naval
   Accounts and Inventories of the Reign of Henry VII, 1485-8 and 1497-9, Navy Records Society, vol. 8,
   (Greenwich, 1896), 40-1; Friel, Good Ship, 66; Unger, Art of Medieval Technology, 54. Rodger’s recent
   naval history of Britain is the most thorough in decades and is a requirement for any student of northern
   European seafaring or shipbuilding. The author incorporates much archaeological evidence in his narrative
   and in his analysis.
³ For example, Mark D. Myers, “The Evolution of Ship Design in Sixteenth Century English
   Ships-of-war,” (master’s thesis, Texas A & M University, 1987); Ian Friel, “The Carrack: The Advent of
   the Full Rigged Ship,” in Cogs, Caravels and Galleons; The Sailing Ship, 1000-1650, ed. Richard W.
   Unger, (Boulder, 1995), 77-90.
northern Europe or may have influenced northern European shipbuilders. The examples illustrate some of the most important changes that took place. The vessels examined range from the first quarter of the fifteenth century (the date of the building of *Grace Dieu*, and a likely date of construction of the Gdansk “Copper Wreck”) to the first quarter of the sixteenth century (the time of construction of the Riddarholm ship and *Mary Rose*; it is also the period of rebuild of the Woolwich ship and the period of sinking of the Cattewater and Villefranche wrecks). In conjunction with existing iconographic and documentary research, the vessels illustrate a definite learning process undergone by northern European shipwrights in the adoption of carvel construction techniques. By presenting the archaeological record in a manner complementary to documentary and iconographic research, certain generalizations regarding the progress of shipbuilding technology during the late medieval and early modern periods will be elucidated.

Based upon generalizations made of vessels in the archaeological record, a grouping of the vessels into a typology is presented. Vessels that fall into the first group of the proposed typology – and seem to have been built earliest – include *Grace Dieu*, the Aber Wrac’h vessel, the Gdansk “Copper Wreck,” and the Riddarholm vessel. Each of these relatively large ships was built in Northern Europe during the fifteenth century and is characterized by late medieval lapstrake construction. The second group exhibits the most important features of the transition from clinker to carvel construction. They include the Woolwich ship and *Mary Rose*. Each was built primarily for military purposes. Similarly, each was built or rebuilt in England between 1508 and 1512. The examples exhibit similar lower hull construction features. Some features these ships exhibit are seen on ships built later in the early modern period which have been excavated, but which had certain special circumstances attached to them. The final two vessels examined, built of carvel construction in the early sixteenth century, are the Cattewater wreck and the Villefranche ship. The two vessels exhibit carvel construction techniques consistent with ships of the Mediterranean and Iberia in the early sixteenth century. That is where they were likely built. They are important to this study because they exhibit construction technology that was transferred to northern Europe through the sixteenth century.

The second goal of this thesis is to examine the degree to which lapstrake and carvel construction techniques – and the related conceptual frameworks that define each tradition – appear to overlap in the archaeological record. This is, perhaps, the most ephemeral point I will explore in this thesis. It is also the one that has, I feel, been most poorly addressed by students of historical shipbuilding. The question particularly pertains to the two ships that comprise the
transition group mentioned above. In most traditional lapstrake ship construction much of the
strength of the vessel comes from the numerous edge fasteners that hold the strakes to one
another. In most traditional lapstrake ship construction much of the strength of the vessel comes from the numerous edge fasteners that hold the strakes to one another.7 Framing in such construction, in the most simple sense, served to reinforce a fully integrated structure. In other words, the integrity of the ship principally came from the shell, not from the frames. However, by the beginning of the early modern period, when Mediterranean and Iberian shipbuilding methods were beginning to be experimented with in the North, the ship in more southern latitudes was conceived of as a keel with heavy framing around which hull planking was wrapped. In so-called carvel shipbuilding,8 evident in the final group of ships I will examine, the strength of the vessel was derived, to a greater degree, from the frames rather than from the planking shell.

The most significant question I will address, is whether carvel techniques introduced from Iberia and Mediterranean cultures, were adopted all at once by northern European shipwrights – perhaps due to involvement of nonnative builders in supervisory positions for large ship projects9 – or rather, if techniques were borrowed by indigenous shipwrights in stages. I will show that the second group exhibits certain techniques consistent with both frame-based carvel shipbuilding and shell-based construction. Such a combination of techniques, evident in the lower hull construction of the three vessels in question, is consistent with the latter proposition. The combination of frame- and shell-based techniques in several vessels, evident only by looking at the archaeological record, serves to define the transitory nature of this group of ships.

In Wooden Shipbuilding and the Interpretation of Shipwrecks, J. Richard Steffy has convincingly and comprehensively argued that in the Mediterranean, the transition from a shell-based to a frame-based approach to the construction of ships was one that occurred gradually over the course of centuries.10 Using a series of representative examples from various centuries, excavated in the Mediterranean in the last forty years, Steffy illustrates the gradual abandonment

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7 For a clear, concise evaluation of shell vs. skeleton and lapstrake vs. carvel construction methods, see Olof Hasslöf, et al., Ships and Shipyards, Sailors and Fishermen (Copenhagen, 1972), 42-72.
8 In northern Europe by the middle of the fifteenth century the terms “carvel,” “caravel” and “karveel” (in Dutch) referred to relatively large vessels with flush planking. The term was a Northern corruption of the Iberian word caravela which referred to a small lateen-rigged ship, R. C. Anderson, “’Carvel’ or ‘Caravel,’” Mariner’s Mirror 18 (1932): 189.
9 There is evidence that both Henry VIII of England and James IV of Scotland relied heavily on foreign expertise in the first quarter of the sixteenth century, Oppenheim, Administration, 51-3; Norman Macdougall, “‘The greatest scheip that ewer saillit in ingland or france,’” in Scotland and War AD 79-1918, ed, Norman Macdougall, (Edinburgh, 1994), 42.
10 J. Richard Steffy, Wooden Ship Building and the Interpretation of Shipwrecks (College Station, TX, 1994), passim.
of a flush-planked, shell-first type of construction in favor of flush-planked, frame-first construction. Steffy’s work focuses on a period in which documentary sources are limited. Although Steffy’s method has garnered certain criticisms, particularly with reference to the degree that the archaeological record reflects general trends in shipbuilding, it is nonetheless an effective way of examining technological developments over time.

The time in question in my work, however, is much shorter than that studied by Steffy. As some small recompense, the period is much more thoroughly documented. Such documents and iconographic sources have been thoroughly examined by maritime historians and archaeologists. I hope that by establishing a typology similar to that set down by Steffy, the archaeological record will become better associated with historical and iconographic research already completed.

In an age and in a region where shipbuilding practices and knowledge were largely passed orally and records for the construction of ships tend to be sketchy at best, certain issues cannot be answered without accessing the archaeological record. To date, many of the vessels excavated have not been sufficiently documented or collected in a single work. Nor are some ever likely to achieve the intensive study they deserve. And many as yet undiscovered hulls would be plowed under, neglected, or never recognized for what they are. This is a shortcoming the typology I present will attempt to address, in some small measure.

The typology will show that a similar transition to that laid down by Steffy for the Mediterranean, occurred in the late fifteenth and early sixteenth centuries in northern Europe. In the North the transition was complicated by two additional factors. First, northern shipbuilders had to learn the methods of flush planking. Additionally, they were forced to accommodate the new technology of heavy gunpowder artillery. Abandonment of lapstrake techniques suggests that effective use of heavy artillery aboard ships was incompatible with such construction methods. Northern builders probably perceived their old methods as a problem because of the theretofore, unusual stresses that artillery placed on hulls of ships. As the amount of artillery increased, so did the stress on the hull. All the guns that a builder desired could not be carried on the main deck and in the castles. Concentrating heavy artillery high in a ship tended to decrease the vessel’s stability. For this reason there was a movement to place guns lower in the hull,

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12 In particular, Friel, Good Ship; Unger, ed., Cogs, Caravels and Galleons; Myers, “Evolution of Ship Design.”
reducing stability problems. But placing guns lower in the hull created other problems: gunports were required. Cutting ports in lapstrake vessels was a dilemma. Builders in northern yards never appear to have attempted to cut ports, be they for lading or for guns, in lapstrake-constructed ships. Although a lapstrake-built ship with ports is possible in theory, no historical example has yet come to light in archaeological, documentary or iconographic records.

For heavy artillery to become a standard feature belowdecks, a new method for building ships in northern Europe was adopted. Certainly the transition from lapstrake to carvel building was no less complicated than the one that occurred in the Mediterranean in the early medieval period. Unfortunately, it is a development that has been less comprehensively examined, or, I suspect, even contemplated, by maritime historians and archaeologists. Nevertheless, it was that critical transformation in shipbuilding techniques that allowed northern Europeans to come to dominate the world economy.

Although nowhere near as exhaustive as Steffy’s work, this thesis will attempt to construct a framework similar to that followed in Wooden Shipbuilding and the Interpretation of Shipwrecks. The thesis will address the period of transition from clinker to carvel construction in northern Europe. Because the transition occurred so quickly, the historical geography and political history of the period must also be examined. Changes in the historical geography of the age allowed ships built using carvel construction techniques to be introduced to northern Europe centuries before the adoption of such methods by northern shipbuilders. It was not until politics and technological advances – advances such as heavy artillery and its application to armies and navies in the fifteenth century – that shipbuilders changed their ways.

The final goal of this work is that it provide an additional set of criteria future ship archaeologists, historians and other scholars can look to when developing research questions. To return to the question of Regent and La Cordelière, for instance, I remain uncertain whether the ships were built clinker or carvel; how and where guns were mounted. I do not know what size they were or with how much shot and powder each vessel was provisioned. Nor are we certain of the roles were of the various members of the ships’ complements. Certainly exhaustive documentary research would shed a certain amount of light on some of these questions. It is only through archaeology, however, that a concise picture of the shipbuilding practices and technology used for naval warfare may be obtained.

When vessels from the critical period of transition from clinker to carvel construction are discovered and excavated in northern Europe, and when it seems likely that they had been used
for military purposes, I hope that some of the questions I ask and ideas I present will be incorporated into the development of research strategies. As future archaeologists and historians evaluate possible survey and excavation sites, I hope they keep in mind the chronology of early modern shipbuilding practices. I am certain that eventually, a clearer understanding of the transition from clinker to carvel building in northern Europe will be obtained.

The temporal framework for the transition from shell-based method of ship construction to a frame-based method of construction is much shorter in northern Europe than it was in the Mediterranean. In many respects, the period was much more dynamic, defining the transition from the medieval to the modern era. Because the period of transition is so short, I suspect, it will be difficult to find vessels that precisely fit temporal niches that can answer specific research questions. Therefore, it is that much more important, that when surveying or when evaluating sites, archaeologists and historians keep in mind the importance of vessels that fall into this very short window of time. The ultimate goal of this work, then, is that it serve as a base upon which future research questions can be formulated.
CHAPTER TWO: Historical Background

Many works have addressed the issue of the development of navies and seafaring during the late medieval and early modern periods. Scholars have addressed military, administrative, commercial, social, technological and conceptual aspects of naval development. In many analyses, particularly those addressing military, technological and conceptual developments of ship construction, scholars have discussed the importance of the transition from lapstrake to carvel construction in northern Europe. Some have speculated as to why the transition occurred. Generally they have offered explanations that relate to the introduction of artillery or the more economical nature of carvel construction techniques.\(^\text{13}\) As has been noted, most purely historical scholars have approached the subject without benefit of archaeological resources.

In the past forty years, since nautical archaeology as a discipline first emerged, great strides have been made towards understanding the nature of shipbuilding as an expression of culture. As with other aspects of material culture, changes appear to have occurred as a result of technological innovation, cultural interaction between societies (and the concomitant exchange of information that accompanies such interaction), or, usually, some combination of the two. With this in mind, one must understand the traditions that existed prior to changes in material culture and of certain historical developments that affected those traditions. Only with such understanding can one properly analyze the nature of transition from clinker to carvel and the factors that brought the transformation about.

Historical Geography of Shipbuilding Traditions

During the late medieval period in much of northern Europe, lapstrake ship construction of some sort was used for the construction of all categories and sizes of vessels. Subtraditions of lapstrake shipbuilding were used from the Baltic, in all the countries bordering the North Sea and

Atlantic seaboard, down to the Iberian Peninsula. The demarcation line between lapstrake and carvel construction methods for the building of large, ocean-going vessels, is uncertain. By the time heavy artillery began to be placed on ships, though, the line was drawn somewhere in southern France or northern Spain near the homeland of the Basques.\footnote{Based on documentary, iconographic and archaeological sources, it is evident that Iberian ships built for trade and discovery in the late fifteenth century were constructed using carvel shipbuilding techniques that were already well developed. This would tend to indicate that Iberian builders had adopted the techniques of carvel building from the Mediterranean earlier in the middle ages. See Roger Smith, \textit{Vanguard of Empire: Ships of Exploration in the Age of Columbus} (New York, 1993), 31-53; Robert Grenier, “Basque Whalers in the New World: The Red Bay Wrecks,” in \textit{Ships and Shipwrecks of the Americas: A History Based on Underwater Archaeology}, ed. George Bass, (London, 1988), 69-84; Roger Smith, “The Voyages of Columbus: The Search for His Ships,” in \textit{Ships and Shipwrecks of the Americas: A History Based on Underwater Archaeology}, ed. George Bass, (London, 1988), 32-68; Janet Hollinshed, “Chester, Liverpool and the Basque Region in the Sixteenth Century,” \textit{Mariner’s Mirror} 85 (1999): 387-95.} South of this line and throughout the Mediterranean, craftsmen built sea-going ships following traditions using flush-plank construction techniques.

Today, archaeologists generally recognize two large subtraditions of lapstrake shipbuilding that existed in northern Europe during the middle ages. These two subtraditions were particularly important for the construction of the bulk of vessels used for long distance trade and military sea born operations. Although there were a number of other less widespread subtraditions,\footnote{Perhaps the most important of these was the pegged lapstrake tradition used by builders in southern Baltic regions for the construction of small trading craft. In such vessels, wooden pegs replaced clinker nails, but the sequence of construction and conceptual nature followed by builders was largely the same. See George Indruszewski, “A Comparative Analysis of Early Medieval Shipwrecks from the Southern Shores of the Baltic,” (master’s thesis, Texas A & M University, 1996).} it is with particular emphasis and understanding of the two most important – clinker shipbuilding and flat-bottomed or bottom-based construction – that any discussion of medieval shipbuilding, and the changes which occurred at the end of the period, must begin.

“Clinker building,” up until the development of the discipline of nautical archaeology, was something of a generic phrase for all lapstrake ship and boat building. Even today, many unfamiliar with the intricacies of historical shipbuilding use the term as a catchall. The reason is simple; clinker shipbuilding was the most widespread of the various lapstrake traditions and the most widely discussed in historical documents. Also, to differentiate between different subtraditions of lapstrake construction based solely on analysis of iconographic sources is nearly impossible.

Over the past fifty years, through excavation and more careful investigation of documents, nautical archaeologists and historians have achieved a more precise definition for...
clinker shipbuilding. To scholars speaking in the most limiting terms, clinker is but a single subtradition within the related families of lapstrake construction methods. Among nautical archaeologists, the term refers to vessels that use clinker nails to fasten overlapping edges of strakes. Clinker nails differ from other fasteners in the way they were used; the nail was driven through the land of the strakes (the area of overlap of boards in lapstrake construction), usually through a pilot hole, previously drilled to prevent the boards from splitting. The tip of the nail then was peened over a rove or metal washer (usually square in shape). Depending upon the size of a vessel, tens or hundreds of individual fasteners might be needed to fasten two strakes along a single seam. A single vessel, therefore, would require thousands of fasteners.

Once the shell of the vessel was completed, internal framing was inserted into the ship to give it additional transverse stiffness. Usually framing stretched from sheerstrake to sheerstrake and, at least initially, was fairly widely spaced; a number of separate timbers were used to fashion each frame. In the earliest clinker ships, the internal frames were secured to cleats carved into the individual strakes. Later, framing members were fastened to strakes with treenails or clenched nails.

Frames, in the earliest clinker ships, did not serve to determine the shape of the hull. Rather they gave additional support to an already formed and fully integrated structure. The strength of the ship came largely from the thousands of fasteners that held the strakes together and the cohesiveness of the planking shell. The frames served as a secondary source for transverse strength. In the latter part of the medieval period, as vessels grew in size, frames did come to serve structural purposes. However, the planking shell remained the principal element for determining the vessel’s shape and giving the ship strength.

Other characteristics that have come to be associated with clinker shipbuilding are a pronounced keel and a heavily raked stem and sternpost. Neither of these elements, however, is strictly necessary for a vessel to be considered “clinker-built.” Throughout most of the medieval period, clinker vessels were steered using a quarter rudder attached through the hull on the starboard quarter. By the end of the middle ages, the northern European quarter rudder had come to be replaced by a stern rudder in almost all, large, sea-going ships.

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17 Terms used in this thesis shall follow the illustrated glossary in Steffy, *Wooden Ship Building*, 266-98.
Clinker ships built in the medieval period and even into the modern era have been found in the Baltic and Russia, Scandinavia, the British Isles and on the French Atlantic seaboard. Certainly the best-known clinker vessels are the Viking ships that have been so carefully excavated and recorded from Scandinavia. The Vikings were an extremely widely ranging people, and vessels built using clinker methods almost certainly were constructed in all the lands to which they traveled, with the possible exception of the Americas and the Mediterranean. Clinker shipbuilding, after all, allowed a significant variety of vessel shapes to be achieved. When one thinks of classically built clinker vessels, one might think of the Viking longship, as represented by Skuldelev 2/4, which was propelled by as many as 50 warriors over short distances or sailed over long distances with a square sail. The knarr, a deep-sea, beamy trading vessel such as Skuldelev 1, proved to be the mainstay of Scandinavian trading over long distances for much of the medieval period. In the late middle ages, clinker hulks (if that is the proper term for the vessel type which they, in fact, represent) could be enormous. Timbers from such ships have been found in Bergen in the Baltic and Dublin, Ireland. Clinker-built ships certainly appear to have measured up to every task to which northern Europeans put them throughout the medieval period.

The other subtradition of lapstrake shipbuilding that existed in northern Europe during the middle ages, that can be judged nearly comparable to clinker building in terms of a ship’s ability to travel long distances, was the flat-bottomed or bottom-based tradition. Bottom-based shipbuilding, which has come to be associated with cogs or “cog-like vessels,” only became well defined with the 1962 discovery and excavation of the Bremen cog. The principal characteristic of bottom-based ships is a relatively flat bottom, consisting of flush laid-planks held together with transverse cleats, some permanent and some temporary. From bilge to sheerstrake, strakes were fastened together in a lapstrake fashion. Unlike clinker building, though, in which the shell provides most of the vessel’s strength, the principal conceptual element in bottom-built vessels is

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18 Olaf Olsen and Ole Crumlin-Petersen, *Five Viking Ships from Roskilde Fjord* (Roskilde, 1969).
the base or bottom of the ship.\textsuperscript{21} The bottom serves, in part, to determine the shape of the vessel. Additionally, it is the principal source of the ship’s strength. Once the bottom of the ship was together, the sides were formed with lapped strakes fastened together using clenched nails. Clenched nails differ from clinker nails in that once hammered through the lands of the strakes, the end was hammered over and into the wood rather than being peened over a rove.\textsuperscript{22}

Once the planking shell of the vessel had taken shape, framing was placed into the hull. In bottom-based vessels, in order to insure that the sides and bottom of the ship are tightly secure, fairly substantial timbers must be used for framing. In cogs, the largest of ocean-going flat-bottomed ships, the framing was a more important element than it was for similarly sized clinker-built ships. For this reason, although frames in bottom based ships often do not appear to be sided any larger than in clinker vessels, they do appear to have been more closely spaced. As in clinker vessels, frames would be fastened to the planking shell using either clenched spikes or treenails.

Bottom-based ships were built primarily in northern Germany, the Low Countries and probably in parts of the British Isles. The geography in many of the regions where cogs or “cog-like vessels” were used – particularly in the Lowlands – required a shallow draft to navigate estuaries and tidal reaches in order to get into and out of port. It is perhaps a factor of such geography that resulted in the relatively shallow nature of the keel-plank(s) of most flat-bottomed vessels. In many cases the keel-plank would extend as little as a centimeter or two deeper than other bottom planks. Although this proved good for navigating shallows and tidal estuaries, it did not afford the vessels much resistance to leeway in heavy seas. Perhaps for this reason, the cog was replaced by the hulk as the vessel of choice for long distance trade at the end of the medieval period.

There is still considerable debate whether the flat-bottomed method of construction is a subtradition of generic lapstrake shipbuilding, or whether bottom-based ships form a distinct tradition unto themselves. Although I am convinced that the arguments for an independent bottom-based tradition are valid,\textsuperscript{23} for the purposes of this work, I will group clinker and bottom-

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\textsuperscript{22} The words “clinker” and “clenched” originate from the same Germanic root.

\textsuperscript{23} Hocker, “Bottom-based Shipbuilding Tradition.” For an analysis of the early, and seemingly widespread origins of this type of construction, see Béat Arnold, “Some remarks on Romano-Celtic boat
based shipbuilding as subtraditions for two reasons. First, bottom-based and clinker shipbuilding seem more closely related to each other in the materials used and method of construction than either is, individually, to frame-based building. Also, both traditions were ultimately replaced by frame-based building because they suffered similar problems with respect to the placement of heavy artillery on such vessels. That is, for heavy artillery to be successful in heavy Atlantic seas, the development of a gun-deck below the main deck with gun ports that could be closed was ultimately a necessity. Such a vessel, built in either subtradition, has never been proven in either the iconographic or archaeological record. I am skeptical that one was ever built. Because both subtraditions met the same fate as a result of similar shortcomings – shortcomings that are common, one must note, to all subtraditions of shell first lapstrake construction – they will be treated here as subtraditions of a single wide-ranging tradition.

**Historical Geography of Trade Routes and the Impact on Shipbuilding**

As technological knowledge has increased through the ages, changes in shipbuilding practices have progressed more quickly than they did in earlier times. One need only look at developments in ocean-going watercraft over the past century and a half to observe the rapidity with which new technology is applied. One hundred and fifty years ago, nearly all ocean-going ships were built as they had been for millennia, with wooden hulls. For propulsion, such vessels relied, at least in part and usually exclusively, on the natural force of wind. Today, we build ships that have titanium-alloy hulls, are propelled by nuclear power plants and can conceivably voyage around the globe without ever emerging from beneath the waves. Today, in the age of steel hulls and diesel engines, indigenous, vernacular and autocthonous shipbuilding practices have almost completely disappeared for the construction of ocean-going vessels. The worldwide leveling of traditions that has occurred has its roots in the global migration of Europeans that began at the beginning of the early modern period.

Within Europe, the leveling of local traditions and subtraditions began earlier. It began, in fact, before the end of the middle ages. Three historical events helped hasten the development of a pan-European science for the construction of armed ocean-going vessels. These were the opening of the Straits of Gibraltar by Spain in 1248, the development of rigs that could propel ships around the Jutland peninsula in the thirteenth century and the exploration of the African construction and Bronze Age wood technology,” *International Journal of Nautical Archaeology* 28 (1999): 34-44.
coast by the Portuguese during the fifteenth century. These historical events of the thirteenth through fifteenth centuries changed the political and commercial geography of Europe. The events manifest themselves in the historical and archaeological records of ships by the gradual abandonment of the cog in favor of the hulk. Later, the hulk came to be abandoned in favor of the carrack. The developments initiated a drive to develop better ship-types. Economics, war and a new political geography opened trade routes between northern Europe, the Mediterranean and elsewhere. Events forced ships to become agents not only of technological exchange, but of cultural and political change, as well. As will be shown, though, it was technological innovation, rather than specific historical events, that caused lapstrake construction techniques to be replaced by skeleton building in northern Europe.

The first important geographic development of the late medieval period was the opening of the Straits of Gibraltar to Christian trade and ships in 1248 when Fernando III conquered Muslim Seville. Quickly, seafaring industries in Seville grew. By the early fourteenth century there were a considerable number of Italian merchants residing in the town. Many of them were agents conducting trade between Italian city-states and northern Europe, particularly the Lowlands, where raw wool from England and Spain was made into cloth. The first fleet from Genoa to Flanders is recorded in the 1270s. Shortly thereafter, Mediterranean ships must have been a common sight in northern ports. In addition to the exportation of raw materials and luxury items to the north, Italian merchants brought northwards organizational and institutional technology of commerce such as banking and insurance. Such institutions rapidly found a toehold in the North and helped facilitate trade between northern centers of production and transformation of materials, and southern areas of consumption. In short order northern European vessels were themselves traveling to the Mediterranean to profit from the lucrative exchange. Northern merchants, and by extension, northern monarchs, learned of the riches to be earned through international trade. The North began to grow rich.

The second major geographic development was the opening of the Baltic in the thirteenth century. Prior to the development of rigs that could sail the extremely difficult stretch of sea around the Jutland peninsula, northern German cities of the Hanseatic League held a monopoly

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24 Smith, Vanguard of Empire, 16.
25 Janet E. Hollinshed, “Chester, Liverpool and the Basque Region in the Sixteenth Century,” Mariner’s Mirror 85 (1999): 387-95. Although the article focuses on Anglo-Castilian trade of the sixteenth century, it does discuss the antecedents of that trade in the fifteenth century.
over lucrative bulk trades from the Baltic such as timber, grain and fish. Ships carrying products from the Baltic would generally be off-loaded at Lübeck. Goods were then transported overland to Hamburg. From there they were reloaded onto Hanse-owned cogs for the voyage to the Low Countries, British Isles and French Atlantic seaports. The Hanse also controlled, prior to the opening of the Straits of Gibraltar, the principal trade route for goods going from the North to Italy. Goods traveled up the Rhine and over the Alps. Many of the towns along the Rhine were Hanse members, and each took a share of the profits.

From the inception of the League in the twelfth century until the opening of the Baltic in the thirteenth, German merchants made enormous profits trading bulk and manufactured goods to Italy. However, many manufacturing cities in the Low Countries were prevented from joining the confederation after 1384.²⁶ With the opening of the Straits of Gibraltar, Italians started trading directly with woolen manufacturing cities around the Zuider Zee. A considerable portion of profits previously collected by the Hanse became redirected. This resulted in a trade war between Hanse and non-Hanse towns, particularly those in Holland and Zeeland.

Economic competition was further exacerbated in the fourteenth century as Dutch ships increasingly made the journey around the Jutland peninsula, through the Øresund into the Baltic. By circumventing transshipment through Hanse towns, the Dutch were able to charge much cheaper freight rates for lucrative bulk products from the Baltic.²⁷ Competition eventually led to a series of wars fought largely at sea. Increased competition and the resulting wars caused a reevaluation by shippers and shipbuilders of desirable characteristics for vessels. This reevaluation resembled something of an arms race. In both the Lowlands and Hanseatic towns, it became clear that larger vessels held an advantage over smaller vessels when fighting at sea.²⁸ This is one possible explanation for the gradual abandonment of the cog in favor of larger round ships such as the hulk and later, the abandonment of the hulk in favor of the carrack.

The opening of the Straits of Gibraltar and more direct trade into the Baltic changed the balance of economic power in northern Europe and resulted in a shift of a conceptual nature concerning the purposes of vessels. New trade routes open to all powers effectively weakened the Hanse, previously the preeminent “naval” force in northern Europe. The subsequent rise of non-affiliated trading cities in Holland and elsewhere forced shipbuilders to evaluate, for the first

²⁶ Crumlin-Petersen, “Vikings and the Hanseatic Merchants,” 190.
time, the military capabilities of ships and ship-forms in addition to carrying capacities. Although cogs were built with forward and after platforms from which battles could be fought, these structures were intended principally for defensive purposes. With an increase of hostile competition in the fourteenth century, brought about by seaborne contact with the rich city-states of Italy, and open competition in the Baltic, vessel size rapidly grew. Seafarers and shipbuilders had discovered that in a pitched sea battle, ships with higher sides had a tactical advantage.

Additionally, northern European vessels were sailing progressively longer routes, frequently in swells in the open ocean. Such conditions called for watercraft that would be reliable in heavy swells and bad weather. Although flat-bottomed construction produced very good vessels for coastal and inland trade (and continues to be used to this day for the construction of barges in much of the world), cogs and other similarly constructed ships were less capable in the open waters of the Atlantic and North Sea. It would seem, then, that the replacement of the cog by the hulk, in the late fourteenth century, was driven by a combination of commercial, geographic, political and military factors.

Even before frame-based construction supplanted lapstrake construction, one can observe shifts in trading patterns and consequent changes in shipbuilding directly related to vessel use. The weight of many seemingly insignificant factors, are more likely to combine to change the cultural manifestation of shipbuilding, than simply the introduction of a new, and arguably “better,” technology. This is what is seen in the adoption of the hulk over the cog and what is later seen in the lapstrake to carvel transition. The rapid development from cog to hulk to carrack can be traced to the opening of Baltic and Mediterranean trade routes to all Europeans. These two developments of political and commercial geography, perhaps more than anything else that occurred during the late medieval period, helped speed the pace of technological transference and ship development. Such development, in turn, brought new ship-types and approaches to warfare at sea to northern Europe.

As the hulk was in turn replaced by the carrack, experimentation with ship-types continued. Ian Friel, a prominent historian of ship construction, states that the carrack was a vessel that developed in the Mediterranean at the turn of the fourteenth century. The type was an attempt by Mediterranean builders to mimic the best characteristics they recognized on northern European cogs. Known as the cocha in the Mediterranean and later referred to as a carrack in

northern Europe, the type was characterized by a sharp prow, square sails and a stern rudder. Carracks soon became the most important vessel-type for long distance trade between the Mediterranean and northern ports. The carrack also became the ship of choice for kings building vessels for their developing navies. Such ships served the combined needs of commerce, war and monarchical glorification. Although somewhat unwieldy to sail and prone to windage, carracks nonetheless proved immanently defensible. Their high castles allowed soldiers to fight much as they would while defending fortresses during land sieges. When engaged, soldiers would fling many varieties of missiles including arrows, crossbow bolts, javelins, and stones, down from the towering heights of castles and fighting tops, into the enemy ship. In fact, the first light gunpowder artillery used in ships in northern Europe, was employed in carracks in a manner little different to more basic missile weapons. In case of boarding or of mutiny by an unruly crew, artillery could even be directed from the castles into the waist of one’s own ship.

The final event of historical geography that must be addressed is the early exploration of the coast of Africa by Portuguese explorers during much of the fifteenth century. Soon after capturing Ceuta on the North African coast in 1415, the Portuguese gained papal recognition of their African exploration and exploitation. With the papal bulls Dum diversas of 1452 and Romanus Pontifex of 1455, the Portuguese crown was essentially granted a monopoly over the lucrative slave, gold and ivory trades of the African west coast. The valuable cargoes coming from Africa flowed both eastward and northward from Portuguese ports into the North Atlantic.

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30 Ian Friel, “The Carrack: The Advent of the Full Rigged Ship,” in Cogs, Caravels and Galleons, ed. Richard Unger, (Boulder, 1995), 77-90, esp. 77-9; Friel, Good Ship, 158.
31 In the first quarter of the sixteenth century, the kings of England, Scotland and France built no fewer than six carracks. See Rodger, Safeguard of the Sea; Oppenheimer, Administration; D. M. Loades, The Tudor Navy--an administrative, political and military history (Cambridge, 1922); Nathaniel Macdougall, James IV (Edinburgh, 1989); Gairdner, et al., eds., Letters and Papers, passim.
34 Smith, Vanguard of Empire, 6.
and Mediterranean. Other monarchs attempting to assure themselves strong control over their
developing nations could not have been but impressed by the considerable rewards brought to the
Portuguese crown as a result of its effective navy.

The success of Portuguese ships stimulated the Spanish to begin their own voyages of
exploration in the latter part of the fifteenth century. Additionally, Portuguese success probably
made kings aware that navies, personally held by the crown, could bring much needed revenues
at a time when funds from other sources were becoming increasingly difficult. It is quite likely
that the successes of both Iberian states in opening new routes to the New World and to the Indian
Ocean played a considerable role in the rapid construction of crown-held navies by northern
European monarchs in the sixteenth century.

In their attempts to emulate the success of Iberian seafarers, northern kings brought
craftsmen from the peninsula and from the Mediterranean to build ships that had proven success
contributing money and glory to the crown. Invariably, new craftsmen brought different ideas
regarding the way that vessels should be built. Northern builders were not unfamiliar with carvel-
built vessels. Before the coming of craftsmen bearing royal sanction to implement new
techniques, though, there was little reason to build vessels using methods other than lapstrake.
Lapstrake technology during the late medieval period had proven successful in mimicking, and
even surpassing in size – in the case of Grace Dieu – any ship-type that Mediterranean builders
could construct. With the discovery of the New World and the opening of a sea route to the
Indian Ocean, European monarchs saw the possibility of the fruits of new lands as incentive to
build and own fleets. Sea routes to the Americas and around the Cape of Good Hope, therefore,
helped increase the speed with which old techniques were abandoned and new ones adopted.

With the opening of new trade routes, previously unknown technologies spread rapidly.
The axial stern-rudder, probably an innovation of bottom-based shipbuilders, quickly moved into
the Mediterranean from northern waters and began to replace then dominant quarter rudders. The
carrack, a ship-type with early antecedents in the Mediterranean, noted for its square sail and
stern rudder, was an attempt by southerners to imitate large round ships such as hulks. The
most important element of Mediterranean and Iberian shipbuilding technology to travel north was
carvel building. It took quite some time, though. In England near the end of the thirteenth
century, for instance, galleys along the lines of those used in the Mediterranean were being built

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65-7.
by royal command, albeit with traditional lapstrake techniques. Carvel building did not seem to become a necessity until heavy artillery was used on ships. The technology was adopted only when monarchs began taking greater interest in the operation of fleets. That occurred only when kings began to see the economic, military and political benefits of owning ships.

Gunpowder and the Changing Nature of Warfare at Sea

Changing political and commercial geography resulted in a transformation in the way that the ship was viewed in northern Europe. Such developments brought about a regional leveling of shipbuilding techniques for the construction of vessels intended for long distance commerce. In and of itself, the establishment of new trade routes was not an important enough development for northern shipbuilders to abandon lapstrake building or even to value carvel-built ships more highly. The most important factor in the adoption of carvel construction techniques was the application of gunpowder, first to land warfare, and later, to war at sea.

There is an extensive historiography for a military revolution at the end of the medieval period that extends into the modern age, and its role in the development of nations and “national” consciousness. Central to the argument is the degree to which artillery changed warfare and, in so doing, changed political and social structures. More and better artillery changed the fundamental nature of warfare. Better architectural techniques were developed to protect castles and in turn, far greater numbers of people from all levels of society were required to lay siege to

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36 For an account of the construction of one such vessel, published in Latin with comments, see R. J. Whitwell and C. Johnson, “The ‘Newcastle’ Galley, A. D. 1294,” Archaeologia Æliana, 4th ser., 2 (1926): 142-196. Also see Hutchinson, Medieval Ships, 150-2; Oppenheim, Administration, 5; Ian Friel, “The Documentary Evidence for Shipbuilding in England, 1294-c. 1500,” in Medieval Ships and the Birth of Technological Societies, Volume I: Northern Europe, ed. Christiane Villain-Gandossi et al., (Valetta, Malta, 1989), 139-149. Also, F. W. Brooks, “The King’s Ships and Galleys Mainly under John and Henry III,” Mariner’s Mirror 15 (1929): 15-48, provides interesting information on procedures for the disposition of such ships, built or purchased for war in the early thirteenth century. The article gives little information on the construction of such ships, however. Eric Rieth, “Le clos des galées de Rouen lieu de construction à clin et à carvel (1293-1419),” in Medieval Ships and the Birth of Technological Societies, Volume I: Northern Europe, ed. Christiane Villain-Gandossi et al., (Valetta, Malta, 1989), 71-120, offers interesting details regarding French galley construction at the most notable French galley port, Rouen, on the Atlantic at a similar period in time. The article also discusses the use of Mediterranean shipwrights brought specifically for their knowledge of carvel vessel construction.

37 In Susan Rose, Navy of the Lancastrian Kings: Accounts and Inventories of William Soper, Keeper of the King’s Ships, 1422-1427, Navy Records Society, vol. 123, (Greenwich, 1982), 53, the author points out that two Genoese carracks of 600 tons each did not fetch appreciably more than two clinker-built vessels of 290 and 180 tons when sold after the death of Henry V.

such structures. Peasants were needed to fight and die; merchants were required to supply the armies and, increasingly, to produce the weapons necessary to fight. Conscription, widespread military-based industry and organized commerce brought common people into warfare and, eventually, into the political process. This engendered the development of national consciousness. From such feelings developed the first “modern” states. In the same way that it spread national consciousness, the military revolution served to speed the development and dispersal of technology, particularly the technology of warfare at sea.

During the High Middle Ages, sea warfare, as an extension of state power, was virtually nonexistent. Naval involvement during the Hundred Years War was largely confined to military transport. It was a rare occasion when a king or naval administrator, such as Jean de Vienne in 1377, took active effort to build a fleet and then attack the enemy. Ships and fleets were usually used to move armies. A monarch who wished to move men simply requisitioned merchant vessels in his ports at that time. If they were seized from private shippers within the realm, the shippers were generally compensated. But ships owned by foreigners were also used. The English monarchy had an arrangement to use ships, free of cost, from any of the Cinque Ports for a fixed number of days each year. An additional issue concerning those moving armies during the middle ages, was that the transportation of large armies required points of both embarkation and debarkation. For English monarchs wishing to send an army to the continent, this rarely proved a problem. From the time of William the Conqueror until the reign of Mary Tudor the English always controlled at least one port on the French coast. However, if a port was inaccessible due to weather, blockade or besiegement, troops could be landed on lightly populated sections of the coast.

Warfare from ships also existed, but on a smaller scale. Through the fifteenth and into the sixteenth centuries, raiding across the Channel by both English and French vessels was common. Rarely, though, was it done with royal sanction. Vessels carrying armed men, who would debark on sparsely populated sections of coastline to raid the countryside, characterized such operations. Along the same lines, piracy and privateering – the taking of foreign ships at sea – could be extremely lucrative. Throughout the late fifteenth and sixteenth centuries piracy

increased rapidly. By the middle of the 1540s it was practically state policy. Henry VIII even chastised the northern town of Newcastle upon Tyne for not putting enough privateers to sea.  

Actions of such small, private entrepreneurs occurred during times of both peace and war. Until navies became better organized in the late sixteenth and seventeenth centuries, wartime naval operations of monarchs frequently resembled those of their less well-placed countrymen. The main difference was that monarchs were able to marshal far greater resources, conduct more impressive invasions and put together larger fleets. In fact, one author, C. F. Richmond, has argued that as a tool of policy, the English navy during the fifteenth and early sixteenth century sought only to be a threat to the enemy. By getting a fleet to sea before the enemy early in the campaigning season (Richmond speaks exclusively of conflicts between the French and English), a monarch had succeeded in forcing his opponent into a defensive position: “If you were organized and at sea before your enemy, there was little he could do; he did not know your objective, he was unsure of your whereabouts and he was probably ill-informed in detail to your strength. With no fleet of his own ready to sail he was forced to take defensive measures along his own coastline as Louis [XI] did [in 1462 and 1468].” The threat of invasion was enough, in other words, to force a monarch into a defensive posture. With an enemy fleet at sea, a king’s ships were in danger of being captured by the enemy. Also, troops could not be concentrated at marshaling areas to prepare a counter-invasion. Instead, they had to be spread along the coast to react to possible invasion. In the late medieval period, the fleet-in-being was the key to naval strategy, at least for the English.  

This began to change at the beginning of the sixteenth century. Heavy artillery became more important to armies and to siege warfare. In fortifications built by the sea, artillery began to play a role in defensive strategy, used in shore batteries. Strategically placed batteries could prevent an enemy fleet from landing on important beaches. They could also prevent fleets from attacking shipping anchored in harbor, as had happened at both La Rochelle and Sluys during the Hundred Years War.

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43 Parker, Military Revolution, 15-21.
Quite early on, Scotland appears to have grasped the importance of such harbor fortifications. After a short conflict with England in 1490, the island of Inchgarvie at the end of the Firth of Forth was granted to a man named John Dundas with the stipulation that he erect a castle or fortalice.\(^{44}\) By 1515, there exist records for payments to the garrison there for masons, suggesting that construction on fortifications may have been under way.\(^{45}\) Shortly thereafter, around 1517, payments to gunners at the battery are recorded.\(^{46}\)

The effect of naval batteries was to push ships, and warfare between vessels, further out to sea. Such developments increased the pressure on shipbuilders to adapt new technologies and techniques to new conditions. No longer could ships attack coasts and harvests with impunity. Shore-based batteries forced invading navies to face the risks of considerable loss of life and materials, including expensive capital ships.

It was only a matter of time before the technology of artillery became commonplace on ships. By the mid-1400s, guns were common equipment.\(^{47}\) At first, cannon used on carracks complemented and mimicked missiles and missile weapons already in place. Guns were quite small and used as anti-personnel weapons during boarding actions. Large numbers of such small guns were concentrated in the castles. Equipment lists for *Holy Ghost of the Tower*, completed in 1416,\(^{48}\) *Grace Dieu*, built in 1418,\(^{49}\) for Burgundian galleys from the mid-1440s,\(^{50}\) for the English ship *Grace de Dieu*, active from 1446 to 1486,\(^{51}\) and for numerous other vessels from the middle part of the century, indicate the presence of such guns. It seems unlikely, though, that these weapons were used offensively.\(^{52}\) Rather, they were defensive tools, fired only rarely. This is evident from the small amounts of gunpowder and the few powder chambers with which ships

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\(^{46}\) Ibid., 162.


\(^{50}\) DeVries, “A 1445 Reference,” 822-3. See also the assessment made by Carlo Cipolla, *Guns and Sails*, 21-30, regarding the effectiveness of land-based artillery.


were equipped. *Grace Dieu*, for instance, was provisioned with only three chambers for its three guns, and with only 100 pounds of gunpowder. Such a penurious allocation of resources seems inconsistent with the argument made by one historian, that naval artillery “by the year 1400 was being used constantly and effectively.” I feel it was not until the end of the 1400s, at the earliest, that gunpowder weapons on ships were used regularly. Also, it was not until heavy artillery was introduced to ships, that guns were used in an offensive manner.

Heavy artillery required rapid changes in warfare at sea. With the use of guns in shore batteries, naval commanders became increasingly dependent upon blockade rather than “amphibious” raiding. Ships could no longer attempt to capture enemy vessels unawares at anchor in harbor. Instead, they had to attempt to take mobile ships, usually leaving or entering port, a far more problematic proposition considering the vagaries of wind and tide. Also, the use of even light artillery began to level the playing field for smaller vessels-of-war. Well-timed and accurate gunfire might allow a smaller ship to fend off larger watercraft sufficiently long to allow better sailing characteristics to provide an avenue for escape. Heavy artillery thus changed naval warfare in two important ways. It forced ships to put distance between themselves and the shore. Having accomplished that, it allowed smaller ships to evade larger predators.

As the engagement between *Regent* and *La Cordelière* has shown, heavy artillery also forced the largest naval vessels to put space between themselves during engagements. By the end of the first quarter of the sixteenth century, heavy gunpowder weapons could reach further and do far more damage than could the lighter arms of a century earlier. They were no longer used merely for anti-personnel purposes. Guns had the capability to cause sufficient damage to “kill” ships. It is unlikely, however, that the destruction of the enemy was ever the desired result. Rather, the capture of enemy ships, the goal of piracy, privateering and naval warfare for centuries, remained the same, albeit with more powerful tools.

The earliest heavy artillery used on ships in northern waters was mounted in the waists and fired over the rails. In vessels such as Henry VII’s *Regent* and *Sovereign*, heavy stone-

throwers were placed in the middle of ships, with lighter artillery in the castles.\textsuperscript{57} As ship-forms developed, heavy artillery began to be used in the sterns of ships as chasers as well. The engagement between \textit{Regent} and \textit{La Cordelière} illustrated to seamen and commanders that vessels armed and equipped with such deadly weapons were dangerous to sailors and soldiers within, as well as to an opponent. To better insure one’s safety, therefore, it was necessary to be certain there was space between ships during engagements. Disastrous accidents such as the loss of a ship due to an exploding magazine were to be avoided at all costs. Ships were far too expensive an investment to the crown to be thrown away for nothing more than the posthumous glorification of a commander. The tactic of grappling and boarding had to be reevaluated.

By the early sixteenth century, two principal forces had begun to drive and focus developments in shipbuilding in northern Europe. First, ships needed to carry heavy artillery. This poses certain problems for vessels built using lapstrake methods. The problem most readily apparent to seamen and shipbuilders would have been the higher center of gravity of vessels carrying artillery on upper decks. This was not a problem unique to northern Europe or to lapstrake construction. Archaeology in the Americas has revealed that early Iberian ships sailing to the New World carried their heaviest artillery in the holds of their vessels while in transit between Europe and the Americas.\textsuperscript{58} Later, with the development of more sophisticated techniques of naval architecture, some of the problems attributed to heavy deck loads would be alleviated with tumblehome, the turning inward of the sides of a ship towards its sheer. However, at the beginning of the sixteenth century, naval architecture was still in its infancy. Achieving complex vessel shapes was problematic for builders who used lapstrake methods and who rarely (if ever) designed ships on paper. The obvious solution to the problem of heavy artillery on upper decks, was to lower the deck carrying guns. Such a solution, though, would require a vessel with a sheer quite close to the waterline, or the cutting of ports through which guns could be fired. Both options could have been achieved with existing technology, but would have been very difficult. Instead, northern builders adopted methods from the South.

\textsuperscript{57} Oppenheim, \textit{Accounts and Inventories}, 216-7; Oppenheim, \textit{Administration}, 40-1; Spont, ed., \textit{War with France, 1512-1514}, 49-50.

The second force driving the direction of shipbuilding at the beginning of the modern age was the need to develop vessels that could easily and effectively direct the force of artillery carried. In the early part of the sixteenth century, the principal naval forces of the day, most notably the English and French, experimented with many different forms including galleys and galleasses. Such ships were dependent to a degree on the use of oars for propulsion. By the nature of the ship-type, vessels propelled by oars brought the level of the guns closer to the waterline. Such experimentation also led to problems with existing technology. Unlike carracks, which were entirely dependent upon wind for locomotion, galleys and galleasses could travel in any direction using oars. Human muscle power, however, is one of the most inefficient ways of moving a ship. In order to be sure a vessel could move quickly enough to be effective, vessels had to be stripped of as much nonessential structure and equipment as possible. They also had to be streamlined in order to reduce drag. Because galleys and galleasses required large numbers of rowers, they had very little cargo space. They were not independent of the shore and could only be used close to home ports or with a large contingent of support vessels. Unless there was a major invasion or attack planned, they were used primarily for coastal patrol.\(^59\)

The construction of galleries for rowers in galleys and galleasses also caused problems when using lapstrake construction techniques. In the construction of such a vessel, a builder was faced with the prospect of cutting holes in the planking shell of the ship. Such a situation using lapstrake methods would have compromised the structural integrity of the ship. The solution in the sixteenth century, with very few exceptions,\(^60\) was to build using carvel methods. Such ships were usually built under the auspices of a builder or supervisor with Mediterranean or Iberian connections.\(^61\)

From the eleventh century the size of vessels had been growing in northern Europe. Changes necessary to achieve larger sizes were within the realm of existing technology. It was only with the introduction of gunpowder artillery – in particular heavy artillery – that fundamental changes in shipbuilding traditions occurred. Artillery was a technology to which existing practices and techniques were not adapted. In the archaeological record, large vessels built in northern waters that date to the fifteenth century are, almost invariably, built using lapstrake construction methods. Ships from the sixteenth century, with some exceptions, exhibit

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\(^{61}\) Bennell, “English Oared Vessels,” 16.
carvel construction techniques. The most important factor in the rapid transformation of shipbuilding was the introduction of heavy naval artillery. However, other contributing factors, including changing concepts of sea power, as demonstrated by voyages of discovery of Iberian seafarers, and the increasing importance of the personality of the monarch in affairs of the state also played roles. The latter factor was particularly important at the end of the fifteenth and beginning of the sixteenth centuries. To understand how it affected shipbuilding, an examination of the development of early modern navies in the context of the development of “national” identity is necessary.

*Early Modern Navies and the Rise of Nations: Early Tudor England as Case Study*

As an island nation, few countries in Europe had a greater interest in the welfare of its navy than England. Few relied on their navies for economic growth more than England during the early modern period. English shipwrights and monarchs were particularly innovative in the construction of different types of vessels during the late medieval and early modern periods. This is clear in the archaeological record as evidenced by vessels such as *Grace Dieu* and *Sovereign*, as well as from documentary and iconographic sources such as the *Warwick Roll*, the *Anthony Roll* and Matthew Baker’s *Fragments of Ancient English Shipwrightery*. The role of ships and of navies, although always very important, became particularly profound in the late medieval period. This occurred, in large measure, as a result of the growth of trade and with the growth of the England’s place in the increasingly important textile industry.\(^62\) Important to developments towards a national navy were Henry VII and Henry VIII, Tudor monarchs who ruled for over sixty years during the critical phase of the transition from clinker to carvel construction.

Trade had begun to change at the end of the fifteenth century. Changes affected most strongly, southern English ports such as Southampton, where Italian merchants had dominated the Mediterranean trade for over a century.\(^63\) For about a century leading up to the rise of the Tudors, English merchants had been slowly making inroads into Italian dominance of that trade. Increased competition by English shippers occurred for many reasons. Some had roots in the Mediterranean. But, probably the most detrimental effects on Italian shippers were the continuous wars for commercial dominance that plagued the Italian peninsula. Due to losses to the Genoese and Venetians, Florentine galleys made their last trading excursion to England in


1478. Shortly thereafter, new sources of alum were discovered in Iberia. Without a monopoly over such a critical element to the textile industry, Genoese trade also suffered. With the accession of Charles VIII in France, who sought to increase his holdings in northern Italy, Venetian trade was damaged. Venetian carracks attempting to reach ports in England or the Low Countries suffered predation along the French Atlantic coast. Like Florence, Venice ceased sending fleets to northern Europe at the beginning of the sixteenth century.  

Although Italian trade was in decline at the beginning of the early modern period, shipping in general was not. While Italian shipping suffered from war at home, northern merchants increasingly sent their own ships to the Mediterranean. In England, native shipping had been aggressively expanding for some time. English ships first docked at Leghorn in 1472, “and thereafter, English sailings to the Mediterranean increased rapidly.”  

Trade in wine to Bordeaux, which had suffered during the Hundred Years War, again was on the rise. Also, with the accession of Henry VII, trade in commodities with Spain increased considerably. Henry’s close association with the Spanish monarchy also increased traffic to the Netherlands, recently acquired by the Hapsburgs. Ships from Spain frequently brought valuable ores, which earlier may have arrived from the Mediterranean or Baltic. In 1492, for instance, a Spanish tin staple was established in Southampton.  

Although the policies of Henry VII usually focused on peaceable trade, he was not slow to enact protective legislation when he felt foreign nations were interfering with his interests and with the interests of English merchants. In 1490 England concluded a commercial agreement with Lorenzo de Medici, giving England a virtual monopoly on wool shipments to Florence. In response, the Doge and Senate of Venice, unhappy with the balance of trade in Italy, prohibited sales of Greek and Malmsey wine to English merchants. This was done to prevent English ships from acquiring the most lucrative cargoes for return journeys. Henry responded with an 18 shilling-per-ton duty on Venetian vessels bringing wine to England. “This conflict was eventually won by England, largely because of Henry’s determination that his subjects should

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64 Ibid., 38.  
66 Patterson, Southampton, 38-9.
enjoy a portion of the Mediterranean carrying trade.”

Similarly, it was required that woad imported to England from Bordeaux be carried in English bottoms.

A common generalization made about Henry VII was that he was a careful and deliberate king. In his dealings the elder Henry Tudor always appears to have had a final goal in mind. When Henry VII achieved a personal goal, it improved the situation not only for the Tudor family and its hold on the English crown, but also for the English people. Whether it was legislation intended to enhance English shipping and seafaring; whether it was in the handling of crown lands from which he obtained his ordinary revenue; or whether it was in his diplomatic negotiations for beneficial marriage treaties, Henry was always foresighted in the management of his resources. His approach allowed him to solidify his hold on the throne and to ensure the future place of his family in the governing of the country. His policies placed England in a higher position in the pantheon of European states than it had been during the disastrous internal conflict of the Wars of the Roses that preceded his rise.

Henry VII’s reign has been usually been seen as quite peaceful, but Henry was heavily dependent on his military, particularly during the earlier part of his reign. When it came to his navy, or at least to the fleet of ships held by the crown, Henry VII cannot be described as neglectful. Although a complete accounting of his naval accomplishments has been well documented elsewhere, a summary is in order. Shortly after achieving the throne, in 1488, Henry Tudor ordered construction of two large ships. These were Regent and Sovereign. L. G. Carr Laughton has suggested that the vessels were built after the Breton ship Colombe due to some innovation, unconventional to English ships of the day. That innovation, however, remains unclear. Oppenheim asserted that the most revolutionary aspect of the design was their

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67 Alexander, First of the Tudors, 85.
68 Patterson, Southampton, 37.
size.\textsuperscript{71} It has also been speculated that timber from the largest ship acquired by Henry when he took the throne, \textit{Grace de Dieu} (1440), was used to build \textit{Sovereign}.\textsuperscript{72}

Supervision of the construction of \textit{Regent} and \textit{Sovereign} is attributed to Sir Richard Guildford and Sir Reginald Bray, respectively. The men were early supporters of Henry Tudor from the time of his exile in France. For their loyalty, each was rewarded with appointments to several important offices after the defeat of Richard III. The role each played in the construction of the vessels is unknown, though. Each was far more familiar with royal administration than with the construction of ships.\textsuperscript{73} It is likely that their roles were limited to project oversight. Apparently, it was felt improper, in that day, for vessels intended for the king to be entrusted to a common shipwright.

Later in his reign, Henry continued to build ships, albeit much smaller ones than \textit{Regent} and \textit{Sovereign}. In 1497, \textit{Sweepstake} and \textit{Mary Fortune} were built. \textit{Mary Fortune} was described as a bark and \textit{Sweepstake} was equipped with 52 oars or sweeps, and may, therefore, have been a balinger.\textsuperscript{74} A number of other vessels were bought from abroad or captured. By 1503, all of the ships inherited by Henry VII from Richard III had been sold off, broken up or otherwise disposed of. Thus, Henry always appears to have had a fleet consisting of relatively new and seaworthy vessels. But whether built, bought or captured, very few of the ships owned by the crown during Henry’s reign were intended exclusively for military purposes.\textsuperscript{75} In fact, with the possible exception of \textit{Regent} and \textit{Sovereign}, all were almost always used for trading purposes. Even \textit{Sovereign} undertook at least one trading venture to the Levant in 1497.\textsuperscript{76}

\textsuperscript{71} Oppenheim, \textit{Administration}, 40. The size of \textit{Regent} and \textit{Sovereign} has been the subject of much speculation. Carr Laughton, “The Square-tuck Stern,” 101, speculated that the ships were 1000 and 800 tons, respectively. More recently, Loades, \textit{Tudor Navy}, 39, estimated \textit{Regent} at 600 tons and \textit{Sovereign} at 450. The estimates of Carr Laughton and Loades represent the extremes.

\textsuperscript{72} Anderson “Grace de Dieu of 1446-86,” 585; Loades, \textit{Tudor Navy}, 36-7; Oppenheim, \textit{Accounts and Inventories}, 52.

\textsuperscript{73} Reginald Bray, for instance, had been steward to Lady Margaret Beaufort, Henry Tudor’s mother, prior to her son’s rise to the throne. Bray helped organize efforts at Bosworth. After Henry Tudor’s victory he was knighted and made Chancellor of the Duchy of Lancaster. In that capacity he aided Henry in the reestablishment of efficient methods of revenue management and has been called Henry’s chief financial advisor. He died in 1503. Richard Guildford had organized rebel movements in Kent and Surrey during the unsuccessful uprising against Richard III near the end of 1483. Shortly thereafter he joined Henry Tudor in exile in France and fought at Bosworth in 1485. During Henry VII’s reign he served as Master of the Ordnance, Comptroller of the king’s household and was a member of the inner circle of the King’s Council. He died on pilgrimage to the Holy Land in 1506, Alexander, \textit{First of the Tudors}, passim. Also see Oppenheim, \textit{Administration}, 35-6.

\textsuperscript{74} Loades, \textit{Tudor Navy}, 42-3.

\textsuperscript{75} Ibid., 41.

\textsuperscript{76} Oppenheim, \textit{Accounts and Inventories}, 218.
Henry felt that what was good for English merchants and shippers, was also good for the crown. Although he did not appreciably increase the number of ships in his fleet as had earlier Yorkist and Lancastrian kings, Henry’s efforts improved the quality of crown held ships and, thereby, the royal fleet. He also devoted considerable effort and resources to the development of naval administration and upkeep. At the time of his death, he handed over to his son, “a building and maintenance programme in full swing.”

In addition to his ability in commerce, Henry was very shrewd when it came to the important arts of negotiation and marriage alliance. Through careful diplomacy, Henry was able to keep England out of any large-scale conflicts for nearly a quarter century. During that time the country and the king prospered considerably. It has been estimated, for instance, that at the time of his death in 1509, Henry VII’s ordinary yearly revenues amounted to between £ 40,000 and £ 42,000. This figure would not be equaled or exceeded by his son until after 1536 and Henry VIII’s dismantling of the Catholic Church in England.

Among the least appreciated of Henry VII’s many accomplishments was his deft handling of affairs with England’s two principal rivals, Scotland and France. When Henry was king, he generally sought solutions to problems with his neighbors through diplomatic means. In 1488, for instance, James IV led a group of discontented Scottish nobility to usurp the throne of Scotland from his father, James III. Shortly after the elder James’ defeat by his son and the rebels at Sauchieburn, he was assassinated. The rebellion was due, at least in part, to James III’s conciliatory, even friendly, stance towards the former Duke of Richmond. Upon achieving the throne, James IV became somewhat difficult for Henry VII, particularly towards English shipping. For instance, in 1490, Sir Andrew Wood, one of Scotland’s most important ship owners, is said to have captured several English vessels in the Firth of Forth in a celebrated naval encounter. Henry did not immediately declare war on the young Scottish king, though. Instead, it was at about that time that construction on Regent and Sovereign began. Perhaps the building of the two ships should be seen as an attempt to intimidate James. In any case, except for the short-lived Scottish support for Perkin Warbeck, a pretender to the English throne who claimed

77 Loades, Tudor Navy, 55.
79 The number of ships captured by Wood is unclear. Loades, The Tudor Navy, 43, states it was five ships, while Macdougall, James IV, 226-7, puts the number at “three heavily-armed English vessels.” Robert Lindsay of Pitscottie, The Historie and Chronicles of Scotland (Edinburgh, 1899), 227-31, temporally the closest account, written in the 1570s, separates the encounter into two battles and claims Wood captured two ships.
Yorkist heritage, overt military conflict never broke out between England and Scotland. In the end, Henry was able to placate the young Stuart king by giving James what he truly desired, an alliance with England by bestowing upon James the hand of his daughter, Margaret Tudor.

In his dealings with France, Henry followed a similar policy of peaceful negotiation and coercion. He had, after all, won the throne from Richard III with the nominal support of the French crown. During the tenure of Charles VIII, France’s expansionist tendencies were focused eastwards, to territory controlled by Venice. Although Henry did offer token resistance to French annexation of Brittany by besieging Bologne in 1491, he quickly acquiesced to French rule there by agreeing to the Treaty of Étaples. In addition to bringing the English crown approximately £185,000, the treaty effectively forced a wedge between Scotland and France. For the duration of the elder Henry’s reign, this would prevent invocation of the Auld Alliance. The alliance, first ratified in 1296 and to last until 1560, was developed in order to insure Scottish independence from England and to threaten England with a two-front war in the event of Anglo-French hostilities.

Throughout his reign, one of Henry VII’s principal policies was the neutralization of that pact. Henry was successful in implementation of this policy. For the most part, moreover, he was able to achieve his goal through negotiation and diplomacy rather than warfare. During Henry’s reign England, the House of Tudor, and English merchants prospered considerably as a result of his policies toward England’s closest rivals.

If Henry VII is characterized as a shrewd, meticulous, hard working administrator of the nation’s resources who made himself into one of the most prominent figures of his time, Henry VIII might be looked upon as his playboy son, intent upon spending his patrimony. The younger Henry inherited the throne when he was only eighteen years old. At that age, the king was impressionable and precocious. Nonetheless, he was still old enough and influential enough at court to make his own decisions. The character of the young monarch had developed during the latter years of his father’s reign, after Henry VII had consolidated his position and that of his heirs. Henry VIII never really knew the uncertainties that typified the early years of his father’s reign. Henry VIII was convinced of the authenticity of his family’s royalty. In all things he did, including the construction of ships and a navy, he sought to demonstrate that fact.

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Certainly Henry Tudor’s careful husbandry swelled the nation’s coffers. Henry VIII believed in spending his inheritance for the glory of himself and for the glory of England. In the absence of account books in the public records, determining precisely how the young monarch paid for his martial excursions shortly after his father’s death is impossible. Without a doubt, though, much of his financial resources came from funds acquired during his father’s tenure. Henry VIII is correctly credited as the father of the Royal Navy. However, the enormous sums of money available at the outset of his reign were made possible by his father’s careful attention to public finance. It was only because of the healthy financial situation of the crown and the national prosperity that existed in 1509, that the enormous public expenditure on a “national” navy and on associated industries was made possible.

When he came to the throne in 1509, Henry VIII inherited nine ships, five of which had been built by his father. Upon the death of Henry VIII in 1547, the English navy numbered more than 70 ships of which at least 50 were serviceable. Although the number and quality of English ships had improved during Henry VII’s reign, the credit for building a national navy and for providing the impetus for advancements in naval construction must go to Henry VIII. The king was directly involved in almost all aspects of naval planning, including the construction of ships and the founding of guns. Although Henry VIII emptied the nations coffers for personal glory, much of the money spent went to the navy and to industries critical to naval development. In the long run Henry’s actions served as groundwork for the growth of the English navy under his daughter, Elizabeth. The administrative and industrial infrastructure, developed by Henry, served as the foundation upon which the powerful Royal Navy of the seventeenth century was built.

From a young age, Henry VIII was fascinated with armies and fortifications, and with the navy and artillery. Henry’s involvement in the building of the navy (not yet the Royal Navy) can be interpreted in the light of his active interest in things martial and the application of those things to diplomacy. Moreover, Henry VII’s son did not share his father’s pacific approach towards his neighbors. Shortly after achieving the throne, Henry VIII discarded policies of negotiation and embarked upon a course of military action and intimidation.

83 Oppenheim, Administration, 34-6; Loades, The Tudor Navy, 52-56.
84 David Loades, “Henry VIII: the Real Founder of the Navy?” in Henry VIII: A European Court in England, ed. David Starkey, (New York, 1991), 172-8. The Anthony Roll of 1546, which includes an illustration and artillery data on Mary Rose, which sank in 1545, lists 37 total ships. The list, however, is not a complete accounting of all the king’s vessels, Myers, “Evolution of Hull Design,” 42.
Perhaps no one was as conscious of the character of the new king as his brother-in-law, James IV. Like Henry, James had achieved the throne of Scotland at a young age, only fifteen years old. Like Henry VII, he was perceived by a good portion of the nobility of his country, during the early years of his reign, as a usurper. In the years shortly after his rise he had successfully survived his own period of political consolidation and had been able to neutralize opposition. In the quarter century that he ruled, James proved to be one of Scotland’s most effective kings. James was able to bring a relative prosperity to his country similar to that Henry VII had brought to England.

A very astute leader, James was not blind to Henry VIII’s ambition to refight the Hundred Years War, perhaps in order to recapture Aquitaine.86 He was also aware of Henry’s antagonistic stance towards Scotland. Until Henry had an heir, after all, James was heir-presumptive to the English throne by way of his marriage to Henry’s sister, Margaret Tudor. The importance of reinvigorating Scotland’s ties to France was apparent. The Scottish king knew that ties with France, deftly weakened by the diplomacy of Henry VII, would not be rebuilt easily. War might easily erupt before Scotland and France could reestablish the Auld Alliance. James had been foresighted enough to see this in the final years of Henry VII’s reign and had prepared. In the ten to twelve years before his death, James undertook his own campaign of state-sponsored shipbuilding.

Perhaps in recollection of Henry VII’s actions upon his own accession to the throne of Scotland, James IV, upon Henry VIII’s rise to the throne of England, began construction of the jewel in the crown of the Scottish navy. Like his contemporary, Henry VII, James IV was not ignorant of the importance of sea power. During his minority, advisors had been content to leave seafaring and shipbuilding in the hands of merchants and shippers. Scottish vessels, after all, had a good reputation. In 1457, for instance, one knowledgeable observer – the water bailiff of the Port of Sluys – commented on the size and quality of Scottish vessels. In the same passage he remarked on the poor quality of Hanseatic and Portuguese ships.87

Those who owned ships and conducted trade were generally held in high regard by the crown. Sir Andrew Wood, who had used his ships to ferry James III and his supporters to their demise at Sauchieburn, for instance, was unique among supporters of James IV’s father. Norman

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86 Macdougall, *James IV*, 207. Macdougall’s work is the foremost study on the Stuart king. Eminently readable, it gives excellent accounts of Scottish political and seafaring history as well as sketches of critical economic and diplomatic developments pertaining to England and France.

87 Ibid., 50.
Macdougall stresses that a month after usurping his father, James IV reconfirmed Wood’s feu-charter of Largo, limiting duties on his ships. James III as a reward for Wood’s support had originally conferred the charter during a similar uprising by the nobility in 1483. Macdougall further states that of James III’s supporters, Wood “was perhaps the only prominent supporter... who did not initially suffer for being on the wrong side.” Wood, in fact, was the most prominent Scottish shipowner and seafarer throughout James IV’s reign. Even in the Scottish king’s final years he played a prominent role in the naval policy of the nation.

James IV had plans and reasons for the construction of a royal fleet long before Henry VIII came to power in 1509, though. A letter from the Scottish king to Louis XII of France from August 1506 confirms this desire. Beginning around 1501, James had begun to increase funds to the navy. Total Scottish expenditure for the first ten years of James’s reign amounted to only £1,486. In the five years from 1501 to 1505 that figure jumped to an average annual expenditure of approximately £600. Norman Macdougall has attributed the expenditure increase to the arrival in Scotland of three French shipwrights, Jean Lorans, Jennen Diew and Jacques Terrell who were given responsibility for the construction of a fleet. Recently, N. A. M. Rodger has reevaluated the enormous increase in expenditure on the Scottish navy and attributed it to potential threats from England compounded with growing unrest among the clans, particularly the MacDonalds, of the West Highlands and islands. The period of naval expansion also coincided with the conclusion of the “Treaty of Perpetual Peace” with England that brought James an English bride, but which was never terribly popular in Scotland. The construction of a navy, which has been characterized by one biographer as a “royal obsession,” took advantage of a loophole in the treaty. A navy allowed James to pursue “an independent policy on the sea,” using French shipwrights and foreign timber. Funds spent early in the first decade of the century went for the construction of the Margaret, a four-masted ship of 600 to 700 tons. James also invested in new dockyards at Newhaven of Leith after the Margaret hung up on sand banks at the mouth of the Water of Leith upon launching in 1506.

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88 Ibid., 223.
89 Rodger, Safeguard of the Seas, 166-9. Rodger’s argument is based on an obscure dissertation by F. W. Robertson, “The Rise of a Scottish Navy, 1460-1513,” (Ph. D. Dissertation, University of Edinburgh, 1934). James’s attempt to pacify the Lords of the Isles had begun in earnest in 1494 when he started building ships at Dumbarton on the western coast of Scotland. Shortly after the turn of the sixteenth century, says Rodger, James’s ships, commanded by Sir Andrew Wood, began to have considerable success over the forces of the MacDonalds, after the Scots had begun to arm ships with heavy artillery.
When Henry VIII came to the throne in 1509, James’s annual investment in his navy had increased nearly thirty times since his own ascension in 1488. In the final two years of his reign, James spent over £8,000 per year on his navy. Surely much of the money spent from 1505 to 1509 went towards capital goods necessary for the construction and maintenance of a fleet. Much also went towards merchant ventures. But threats posed by England were certainly evident to the Scots. The Scottish crown was stockpiling wood, weapons and powder for the building of a magnificent ship-of-war to dwarf all other vessels of the day. When construction on the *Michael* began is not exactly clear. Rodger states that it was begun in 1506, while Macdougall indicates that it was some time between 1508 and 1510, a period for which the Scottish Treasurer’s Accounts are missing.\(^91\) *Michael* was launched on October 12, 1511 and spent the better part of the next year fitting out. The ship was completed on the eve of the outbreak of hostilities between France and England and proved a truly impressive sight. According to an account from the 1570s, *Michael* was armed with twelve bronze cannon per side, three great “basilisks” and 300 smaller pieces,\(^92\) presumably serpentines and other swivels mounted in the castles. At the time it was built, *Michael* was the largest and most heavily armed vessel in existence. Certainly Henry VIII had heard of the vessel and was affected by the threat it posed.

The English king responded quickly. In 1509, *Sovereign* was sent to a yard at Portsmouth for rebuilding and rearming.\(^93\) Once work on that ship was complete and the vessel was back at sea, the keels for two new warships were laid. *Mary Rose* was built in the very same yard where the rebuild of *Sovereign* had just been completed.\(^94\) *Peter Pomegranate* was begun the same year and launched in 1510. The ships were innovative in one important respect, “Whether it was one of Henry’s shipwrights, or the king himself, who had the bright idea of adapting ports [for the use of guns] is not known, but it was certainly an English innovation.”\(^95\) In 1512, the pace of Henry’s naval build-up increased with the construction or purchase of an additional eleven to fifteen craft.\(^96\) That same year, perhaps in response to the launching of the *Michael*, Henry began construction on a great ship of his own, of a size to rival that built by James IV.\(^97\) The 1,000-ton ship, known alternately as *Henry Imperial*, *Henry Grace à Dieu* or

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\(^{91}\) Rodger, *Safeguard of the Seas*, 168; Macdougall, “‘The greattest scheip,’” 42-3.
\(^{94}\) Rule, *The Mary Rose*, 22.
\(^{95}\) Loades, “Henry VIII: Real Founder?” 174.
\(^{97}\) Oppenheim, *Administration*, 47.
Great Harry, along with three galleys, was begun at Woolwich. It was completed in 1514. Both the French and the Scots must have perceived Henry’s military buildup as unfavorable to their interests.

The Scottish king was as shrewd as Henry VIII’s father had been, though. James IV had always sought to insure political options by maintaining correspondence with traditional allies such as Denmark and France. James was never entirely comfortable with the air of friendship and cooperation spelled out by the Treaty of Perpetual Peace. The king of England, after all, “was the only ruler who, as even James III had recognized, made war on Scotland.” As early as 1507, James had been negotiating with France for a restoration of relations. In 1512, Henry, goaded by his father-in-law, Ferdinand of Aragon, allied himself with the Holy League and decided upon involving himself in continental politics, a path largely ignored by his father.

James IV, at the time, was well placed to offer the English king resistance, considering his navy and his continental relations. Moreover, James was particularly upset with Henry regarding an incident between English and Scottish vessels that occurred in 1511. That year English merchants, upset with the actions of Andrew Barton, a captain from an important Scottish shipping family, applied to Henry to redress what they saw as piracy on Barton’s part. Barton had been issued letters of patent from James to seize Portuguese ships. The letters were granted to recover losses incurred by Barton’s father thirty years previously. Barton and his brothers, John and Robert, were particularly zealous in their attacks on Portuguese ships in 1509 and 1510. John Barton, in fact, upon encountering a Portuguese ship in 1509, seized the cargo without regard to the fact that it belonged to an English merchant. The merchants of London then petitioned Henry for redress. The young king, with characteristic brashness, did not follow the diplomatic course Henry VII might have followed by protesting to his brother-in-law. Instead, the king dispatched two of his confidantes, Sir Edward Howard and Lord Thomas Howard to handle the situation.

The Howards encountered the Lion and the Jenett Pirwin, ships commanded at that time by Andrew Barton, in the Downs in June 1511. The ship of Thomas Howard engaged the Lion. During the encounter, Andrew Barton was mortally wounded. Meanwhile, Edward Howard’s

98 Friel, Good Ship, 41,
99 Macdougall, James IV, 251.
vessel had overtaken and captured the *Jenett Pirwin.* The brothers returned to York with their prizes. When James petitioned Henry for the return of vessels, which he viewed as property of the Scottish crown, Henry responded insolently: he said, “he had done justice on a thief or pirate, and if he had shown justice instead of mercy, Barton’s men would have been as dead as Barton himself.” Needless to say, the prizes were not returned. They became part of Henry’s burgeoning fleet. For his part, Edward Howard was made Lord Admiral in 1512 after the death of the Earl of Oxford, who had been appointed to that position by Henry VII. James was left to await the completion of his magnificent ship, *Michael,* before seeking allies and vengeance on his brother-in-law.

Upon the outbreak of war with France in 1512, Henry was oblivious to the Scottish threat. Although Henry may still have been able to preserve peace with Scotland as late as 1512, such was not his wish. Henry sent an ambassador, Nicholas West, to Scotland that year to threaten, bully and goad James into the impending conflict with France. But James did not desire an alliance with Louis XII in 1512. At that time, Louis was isolated from every major European power. The Holy League was a powerful alliance forged against the French king. Pope Julius II threatened James with excommunication if he renewed the Auld Alliance. But James’s feelings of animosity towards Henry were quite strong. When Henry declared war on France and traveled there in support of his father-in-law, James saw his opportunity. The seeds sown in the Downs in the summer of 1511 were to be reaped in September of 1513 on Flodden Hill. After years of dormancy, the Auld Alliance had been rejuvenated. Scotland, for the first time in twenty-five years, braced for war with England.

Henry’s army in France made little difference to the balance of power in the war between the Holy League and Louis XII in 1512. In the first year of the war the English navy proved successful: in the spring it managed to capture several French vessels, effectively gaining control over Channel traffic. The battle at Brest in midsummer, despite the loss of *Regent,* is considered an English victory. After the victory, the English remained off the French coast, launching

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100 Sources are not clear whether it was Edward or Thomas who engaged and killed Andrew Barton. I have chosen to follow the account of R. L. Mackie, *King James IV of Scotland: A Brief Survey of His Life and Times* (Westport, CT, 1958), 209-12, which is among the most detailed accounts.


102 The Exchequer did pay £200 to the King of Denmark from whom the *Jenett Pirwin* had been illegally purchased by the Bartons and who still claimed it, Loades, *Tudor Navy,* 56.

103 Macdougall, “‘The greatest scheip,’” 47.

104 Mackie, *King James IV,* 231.
repeated raids on the port to take prisoners and prizes. Having laid waste to French shipping from Brittany to Picardy, the English fleet returned to its ports in the fall, as was the custom of the day.

But Louis XII was crippled that summer by far more than the loss of the ability to conduct commerce over the seas. In 1512, his forces had lost ground in Italy, had been beaten by the armies of Spain in Navarre and the king was uncertain of the loyalty of the Holy Roman Emperor, Maximilian. It was under such circumstances that Louis finally managed to convince James to attack England in the summer of 1513. By July, James’s fleet, led by the Michael, was finally prepared to put to sea. Rather than placing one of his experienced captains, such as one of the Bartons or Sir Andrew Wood in charge of the fleet, though, James chose to put his fleet in the hands of “the inexpert Earl of Arran.” Arran took the fleet northward, circumnavigated Scotland and attacked the English stronghold at Carrickfergus in Ireland. Scottish success at Carrickfergus, however, was fleeting.

The English fleet had set out that spring to continue the previous year’s harassment of the French. Howard was determined to gain control of traffic in the Channel early in the season and left Plymouth on April 20, short of victuals, in order to establish a blockade around Brest. But Prégent de Bidoux, the extremely capable French galley commander, had anticipated the arrival of the English. Earlier that spring he had brought a squadron of galleys to Brest from the Mediterranean. When Howard arrived he was short on provisions and consequently short on time. Howard attempted a “bold frontal attack,” that proved ineffective and even cost him a ship when it wrecked on a submerged rock. Five days later, on April 22, 1513, shortly after the arrival of English victualers, Prégent de Bidoux counter-attacked with his galleys-of-war. The encounter was described in a letter by Edward Echyngham to Cardinal Wolsey some days later:

Upon Frydaye, the which was the 22th day of Aprill, 6 galyes and 4 foysts came through parte of the Kynges navie, and there they sanke the ship that was maister Compton’s, and strake through oone of the Kynges new barkes, the which sir Stephyn Bull is capiteyn of, in 7 placys, that they that was within the ship hadde much payne to hold her above the watre.

105 Mackie, Earlier Tudors, 275.
106 Mackie, King James IV, 243.
107 Macdougall, “‘The greatest scheip,’” 49.
109 Loades, Tudor Navy, 63.
110 Spont, ed., War with France, 1512-1514, 145-6; in Gairdner, et al., eds., Letters and Papers, vol. 2, pt. 1, 1844n, it is suggested that the vessel captained by Bull and damaged by gunfire, was the Lesse Barke.
With his ego perhaps a little damaged from having lost a ship to the French galleys, Howard attempted a questionable action three days later. Having no armed galleys of his own, he attempted to attack Prégent’s flotilla, which was anchored beneath shore batteries, using only rowbarges (referred to by the French as *galléasse*).\(^\text{111}\) The defenders unleashed their shore batteries “full of ordnances, the which were so thick with guns and crossbows that the quarrels and the gunstones came together as thick as it had been hailstones.”\(^\text{112}\) Howard’s attack proved a fiasco. After boarding an enemy galley with 50 of his men, the English rowbarges were cut away by the French. Howard and his men were left to be slaughtered.

King Henry was not happy. After hearing news of the loss to the French, the king quickly dispatched angry letters to his captains condemning their “distinct lack of both courage and enterprise.”\(^\text{113}\) William Clowes has argued that one of the reasons for Howard’s failure was that under his supervision, discipline had grown lax and he had either failed to recognize it or failed to do anything about it.\(^\text{114}\) Such a simple explanation is, however, insufficient. First, the navy during the reign of Henry VIII was still in its infancy and was not yet the dogmatic, entrenched institution with a rigid set of regulations that Clowes knew. More importantly, Howard failed because he was unfamiliar with galley warfare. He had not been provided with the proper equipment to attack an enemy in a very defendable position. In April 1513, the English had learned and important lesson, that an armed galley could be a formidable weapon, quite capable of both sinking a ship and defending a port.

After the death of Edward Howard the navy was placed in the hands of his brother, Thomas Howard. Under Thomas Howard’s hand, the navy did succeed in gaining control of traffic in the Channel as it had the previous summer. The fleet also successfully carried the army, led by the king himself, to France. Henry had some success that summer, capturing Tournai and defeating the French at the Battle of the Spurs. However, the greatest English victory came in September at Flodden, where a hastily organized army under the command of Thomas Howard, Earl of Surrey and father of the two Lords Admiral, defeated and killed King James. The defeat effectively put an end to the threat from the North. The new King of Scotland, James V, was barely a year old. His uncle, the King of England, easily manipulated policy during the Scottish

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\(^{111}\) Spont, ed., *War with France, 1512-1514*, 136.

\(^{112}\) Ibid., xxxix, 136.

\(^{113}\) Loades, *Tudor Navy*, 64.

king’s minority. In 1513, although he had suffered a number of setbacks and frustrations, Henry had, at least, managed to do away with concerns from one of his principal rivals.

With Scotland no longer a threat, Henry set his sights on regaining what he saw as his patrimony in France, Aquitaine. In a treaty signed at Lille on October 17, 1513, Ferdinand and Maximilian, who had joined the Holy League at the beginning of that year, pledged to support Henry in an invasion of France to begin before June 1514. However neither the King of Spain, nor the king of the Romans was above the realpolitik of the day. With the death of Julius II in April 1513, Ferdinand and Maximillian saw an opportunity to gain ground in Italy through peace. Behind the back of the young English king, each signed truces with France in the hopes of dividing French rights in Italy between their two countries. When Henry got word of the diplomacy of his allies, he responded in a manner that would have made his father proud. He canceled the impending marriage of his sister, Mary, to Charles, Ferdinand’s grandson and the future King of Spain and Holy Roman Emperor. Then he hastily arranged a marriage of his sister to Louis XII in return for a payment twice the size of that negotiated by Henry VII under the peace of Étaples.

In the winter of 1513-1514, the Holy League, so carefully constructed by Pope Julius II and King Ferdinand, had quickly fallen apart. The three had dragged Henry into their machinations and had given him his first taste of battle. Although he would be content to let policy be conducted by ministers for much of his reign, the years from 1510 to 1514 were formative to the king’s understanding of war and international diplomacy. In the years that followed, Henry took an active role in all aspects of military affairs. It is possible, I feel, to trace the course of Henry’s actions throughout his reign, to the lessons he learned in his first half-decade on the throne.

Even before Henry became involved with the Holy League, the construction of the Michael by James IV must have been an affront to his sense of stature. The English king did not like to be second in anything, particularly to the Scottish sovereign. The construction of the largest and most powerful ship in Henry’s fleet for most of his reign, the Henry Grace à Dieu, launched in February or March 1513, must be analyzed in such a light. Simply building larger ships did not alleviate Henry’s sense of propriety and desire for superiority. Henry also wanted to have the best ships and he felt that he was probably more qualified than anyone else in the realm.

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115 Letters and Papers, I, ii. 1052; Mackie, Earlier Tudors, 283.
116 Mackie, Earlier Tudors, 284.
117 Loades, Tudor Navy, 62.
to determine what the best weapons for his fleet should look like. He soon began a campaign to construct such vessels for England.

After the developments of 1512 to 1513, Henry began experimenting with other ship forms. The most notable circumstance of this was the construction of a rowed vessel officially called *Princess Mary* or *Virgin Mary*, but almost always referred to as the *Great Galley*. The ship was completed in October 1515, and is thought to have displaced between 600 and 800 tons in modern volumetric measurement. She carried 14 guns, seven to a side, which were mounted on a gun deck above the rowers. In addition, the vessel had nearly 200 smaller weapons and had four masts capable of carrying eight sails. The ship was clearly revolutionary and had quite a long career. She was rebuilt on several occasions, the first time only eight years after her launching. In 1523, William Fitzwilliam, then a vice-admiral and future Lord Admiral, wrote the king to confirm that the ship would be rebuilt according to his orders: “The galley will not be ready before that time, for Brigandine intends to break her up and make her carvel ‘so as she now shall be made in every point as your Grace devised.’” Such a statement indicates that Henry was involved in daily and routine naval decisions. It also suggests that the *Great Galley* was likely originally built lapstrake. The ship was again rebuilt as a pure sailing ship in 1536 and renamed the *Great Bark*. The vessel, which may have been originally built in response to Prégent de Bidoux’s defeat of Edward Howard, was one of the largest ships in the English fleet for nearly fifty years.

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118 R. C. Anderson, “Henry VIII’s ‘Great Galley,’” *Mariner’s Mirror* 6 (1920), 274-81. The ship was called a galley, but it is likely that she would today more properly referred to as a large galleass. A galleass was lower to the water and tended to rely more on oar power for locomotion than did the galleass. Galleasses were larger and, by the time the *Great Galley* was built, tended to have heavy guns which could fire broadside to the vessel. The principal means of locomotion for a galleass was its sails: oars were used primarily to maneuver when in combat. See also Loades, *Tudor Navy*, 70-1; Loades, “Henry VIII: Real Founder?” 174-5.
119 Loades, *Tudor Navy*, 70.
120 Ibid. Anderson states that the heavy guns were mounted “five of them aft and two forward” on each side, Anderson, “Henry VIII’s ‘Great Galley,’” 274.
121 *Letters and Papers*, III, i. 2964, 1251.
The galley and the galleass are forms that would be experimented with by Henry for his entire reign. In the Anthony Roll, composed in 1546, there are 20 vessels called “ships,” and 15 called galleasses.\textsuperscript{123} By the middle of the sixteenth century, the galleass had become a particularly important ship-type for the royal fleet. In 1541 it was reported to Charles V that Henry had sent to Italy for three shipwrights skilled in the construction of galleys. The writer, Eustace Chapuys, Charles V’s ambassador, doubted that the king would use the builders, though. Chapuys explained that Henry already had workmen constructing galleys of his own design.\textsuperscript{124} The ambassador was apparently incorrect. Oppenheim notes that Italian shipbuilders brought to help build a fleet of galleasses along the lines of Galley Subtile, launched in 1541, (figure 2) were paid a considerable amount more for their experience than their English counterparts.\textsuperscript{125} It is

\textsuperscript{123} Myers, “The Evolution of Ship Design,” 42.
\textsuperscript{124} Letters and Papers, XVI. 1005.
\textsuperscript{125} Oppenheim, Administration, 51n. See also, Adair, “English Galleys,” 504.
clear from the evidence of reconstruction of the *Great Galley* and from payments to Italian experts that Henry appreciated Mediterranean techniques and was willing to pay for them.

As a result of the developments of 1510 to 1514, Henry also learned of the importance of good artillery. Henry knew that artillery was expensive and he desired greatly to have an independent English gunfounding industry. Henry’s father had brought French artisans to England early in his reign and had established a foundry at Ashdown Forest. When Henry VIII came to the throne he had to equip *Mary Rose*, *Peter Pomegranate* and *Great Harry* (figure 3) all within the first five years of his rule. English foundries were incapable of supplying all the weapons the ships needed, though. To arm his vessels, Henry turned to foreign sources, particularly those in Mechlin in the Netherlands. Henry soon established an additional foundry at Houndsditch and actively recruited craftsmen from abroad, specifically from the Low Countries. At the end of his reign, England was self-sufficient in the production of artillery and by the beginning of the fourth quarter of the sixteenth century the nation had become a major supplier to other countries in Europe.

Perhaps the most important way that Henry VIII placed his stamp on the English navy was in the area of naval organization. Henry was probably lucky that at the end of the War with France, Thomas Howard was Lord Admiral. Although Howard, soon to be Lord Surrey after his father’s death, was an aristocrat (and all Lords Admiral during Henry’s reign would be of noble stock), he was a good naval commander and, like his father, an able administrator. Howard had proven his ability as a naval commander first against Andrew Barton in 1512 and then against the French after his brother’s death. In the twelve years that he served as Lord Admiral, and later as vice-admiral, Howard proved an effective leader and set an example for future Lords Admiral.

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128 In 1525, Henry Fitzroy, Duke of Richmond and the illegitimate son of Henry VIII, succeeded Howard as Lord Admiral. The appointment of Fitzroy occurred about the same time Howard was named Duke of Norfolk after the death of his father. As the king’s son was only seven years old when named Lord Admiral, Norfolk retained effective control of the navy and would continue to play an important role in naval affairs until his death in 1554, Rodger, *Safeguard of the Seas, passim*; Loades, “Henry VIII: Real Founder?” 176; Loades, *Tudor Navy, passim*. 45
In 1536, William Fitzwilliam, who had spent a long apprenticeship as a vice-admiral, succeeded Howard. By then Howard had come to the end of his career. Recently he had been named Duke of Norfolk. Fitzwilliam, who owned several merchant vessels, was cut from a fabric similar to Howard’s.

Henry’s last Lord Admiral was John Dudley, Viscount Lisle, who proved to be his most effective appointment. Although knowledgeable seamen had been given important administrative positions under Lisle’s predecessors, the Viscount appears to have been

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129 Loades, “Henry VIII: Real Founder?” 177.
particularly interested in surrounding himself with good administrators such as William Gonson, Robert Legge and John Wynter. Each of the three men had had a long career on the sea before becoming administrators for the crown. It was around families such as the Gonsons and Wynters that the administration of the navy would be built for the next several generations. As each had come to the king’s service as captains of their own ships, they were serving their own economic interests while also serving the crown. When the king demanded a technological innovation be instituted, the seamen that ran his navy watched to see whether it would succeed. If it did, they usually incorporated it into their own ships. If it did not, they would discard the concept. If they felt they could improve on the king’s vision, they would do so, for their own as well as for the crown’s benefit.

When Henry became king he had a vision for his family, for his nation and for his navy. These goals may not have been well defined at first, but he could see the direction in which he wanted to move. He ordered his administrators and builders to investigate the possibilities of ship design and of the use of heavy weapons on ships. When Henry heard about innovations and developments in technology he attempted to incorporate them into his ships. He did so first, by attempting to buy it. If he could not buy it he would steal it. And if he could not steal it, he would attempt to conquer it.

Almost never did Henry have to go so far, though. His vision was quite advanced for the age. More importantly, when it came to his navy, his pockets were terribly deep. As a consequence, skilled artisans in large numbers emigrated to England and would continue to do so for years. To a degree, his brother-in-law, who had brought French shipwrights to Scotland to build a Scottish fleet and eventually the Michael, influenced Henry. We know what happened to the ship, to a degree. After James’s death the ship was sold to France and only appears once more in the records, at the blockade of the Spanish garrison of Fuentarrabia, where it led the French squadron.\textsuperscript{130} What happened to the shipwrights James brought to Scotland is less clear. It is possible that the English crown hired them after the Scottish king’s death. In the Royal Scottish Museum there is a model of the Michael. The ship is very similar in form to Henry Grace à Dieu. It even has a gun deck below the main deck.\textsuperscript{131} It is not known whether the model is contemporary or whether it was done later. What is certain, though, is that following James’s death, it was Henry’s fleet that was perceived as the cutting edge of technological development


\textsuperscript{131} Mackie, \textit{King James IV}, 213.
and innovation. This was so, because Henry had administrators who trusted his judgment and implemented his ideas. It must also be attributed to Henry’s recognition of the importance of a navy to his country’s prosperity. Most importantly, the king was willing, and I suspect, enjoyed spending large quantities of money on his navy and on infrastructure necessary for a modern shipbuilding industry.
CHAPTER THREE: Henry V’s *Grace Dieu*

*History of the Site*

Sometime in the early nineteenth century, due to changes in water flow, the eastern bank of the River Hamble began to erode about six kilometers north of where the river flowed into the Solent.\(^1\) Erosion exposed the bones of a large ship, whose name had long since been forgotten. The vessel quickly became the object of numerous local legends the most common being that the vessel was the remains of a Danish warship that had been burned by the Saxons around 877.\(^2\) The ship also served as a source for easy timber to at least one local landowner. In the middle of the nineteenth century, Francis Crawshay, undertook “an investigation of the wreck” by blowing it apart in order to recover wood from the ship.\(^3\) Crawshay did, nonetheless, record a number of important features of the site including a length of about 42 m., breadth of about 13 m. and depth of around 3.8 m.\(^4\) Additionally Crawshay noted that “the hull (planking) was in three thicknesses” and that “joints” were caulked with moss and fern leaves.\(^5\) At the end of the nineteenth century Herbert Moody, proprietor of the boatyard at Bursledon, was given a contract to remove the after part of the vessel, which was interfering with barge traffic to Botley, further up the river.\(^6\)

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\(^3\) J. S. Davies, *History of Southampton,* (Southampton, 1883), 25, cited in Friel, “Henry V’s *Grace Dieu*,” 12.


\(^5\) In Friel, “Henry V’s *Grace Dieu*,” 12, Davies’ measurements were given in English units the vessel carrying a length, breadth and depth of 130 feet by 40 feet by 12 feet. In this work, measurements given originally in English units will be converted to metric units for clarity.

\(^6\) Friel, “Henry V’s *Grace Dieu*,” 15.
In 1926, Anderson and Anderson questioned widely held beliefs of the ship’s origins and proposed further research. In 1932, G. S. Laird Clowes, the prominent naval historian, made a cursory examination of the site. Contrary to all evidence, he determined that the vessel was a merchantman of about 1840-1850. Michael Prynne and R. C. Anderson undertook the first “scientific” archaeological investigation of the site in 1933 when the two scholars visited the site on three occasions during low spring tides. Their results were published by Anderson in _Mariner’s Mirror_ in 1934, and more fully by Prynne in the _Royal Engineer’s Journal_ in 1938. The two concluded that the ship was built during the fourteenth or fifteenth century and gave a probable identification as Henry V’s _Grace Dieu_. Anderson proposed that the vessel would have had a keel length of at least 40 m. and a maximum breadth of as much as 16 m. The size coincided very nicely with figures for _Grace Dieu_, gleaned from documentary sources by L. G. Carr Laughton published less than a decade earlier. Prynne and Anderson’s findings were further bolstered in 1951 when dating of timbers using dendrochronology assigned a date in the early fifteenth century.

Since the late 1960s, the vessel has been the focus of on-going research, first by the Society for Nautical Research and the Council for Nautical Archaeology, and after 1970 by the University of Southampton. Between 1980 and 1992 the site was the subject of extensive investigation and monitoring to assess, among other things, “the state of exposed timbers and to assess degradation.” The exhaustive results were published in the _International Journal of Nautical Archaeology_ in 1993. The study details all aspects of the investigation including methods of survey – such as aerial, above water and below water investigation – recording of timbers from the wreck, dendrochronological dating of timbers, and sediment assessment. A site

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139 Friel, “Henry V’s _Grace Dieu_,” 16.
plan was developed in the course of the investigation and the probable method and sequence of construction, originally described by Anderson and Prynne, was expanded upon. 145

Construction of Grace Dieu

The first indications of the unique construction of Grace Dieu came as a result of the salvage work done by Francis Crawshay. Apparently referring to notes taken by Crawshay at the time of the salvage, A. R. Brock in 1876 gave the length of the ship as 42 meters and stated that the salvor had found timbers buried at least three meters deep in the mud. Crawshay also described planking “in three thicknesses” that was caulked with “moss and fern leaves, the latter in such good condition that their outlines could be made out.” 146 In addition, there were notes that the vessel was fastened using 3.8 cm. thick treenails (to hold the planking to framing) and with square-shanked iron nails with round heads. The nails were used to fasten the edges of the boards (planking) together. Such construction was unlike any ship being built in Britain at that time and probably precipitated the legends that the vessel was of Viking or Saxon origin.

The excavations by Anderson and Prynne in 1933 yielded much more specific information regarding the way planking, framing and other structures, including the apron of the vessel, were put together. As with most English vessels of the age, Grace Dieu was built largely of oak. The size of the remains was estimated at 40 m. in length by 12 m. breadth. A much more precise description and drawing of the way that the hull components were fastened together was also achieved. The vessel’s strakes were composed of three overlapping boards of varying widths and thicknesses. The two outermost boards of the composite strake were approximately 32 cm. wide, while the innermost board was only about 20 cm. wide in order to allow for overlap of strakes. At the lands, where upper and lower strakes were fastened together, there were, therefore, five thicknesses of planking measuring, in total, about 20 cm. thick. Boards were held together with 1.5 cm. square-shanked iron nails with round heads, driven from the inside of the planking shell. Nails were riveted over rectangular roves, measuring five cm. by 7.5 cm., on the outside of the hull. Planks making up the composite strakes were relatively short, only around 2 m. long. The builders who constructed the vessel used small iron nails along with moss and pitch.

caulking to hold the planks together, before the larger iron nails holding the strakes together, were driven.\textsuperscript{147}

Framing, joggled over the composite clinker strakes, was placed into the hull of the vessel once the sides of the ship had risen sufficiently high. The frames were sided about 32 cm. and molded approximately 25 cm. Based upon average distance between treenails, evident from planks removed from the vessel, Anderson and Prynne determined that between frames there was an average room and space of 42 to 43 cm.\textsuperscript{148} This means that from the aft face of a forward frame to the fore face of an after frame there was only a distance, the space, of around 10 cm. As has been noted, close spacing of frames was not uncommon for vessels built in northern Europe at the time. In other respects as well, the framing of the Hamble river vessel seems similar to that of typical clinker-built medieval vessels. In none of the reports that have been made of the site over the years, for instance, is there mention of ceiling, a common feature of vessels built in the Mediterranean in the early fifteenth century.\textsuperscript{149} Nor are there longitudinal internal stringers, a feature that becomes common on many clinker vessels built at the end of the medieval period. Like the planking, timbers used for frames were converted from fairly short logs. They were connected using diagonal scarfs.\textsuperscript{150}

The measurements and discoveries made by Prynne and Anderson coincide fairly closely with a description of Henry V’s \textit{Grace Dieu} written by an Italian, Luca di Maso degli Albizzi, the captain of a Florentine galley fleet who visited the vessel in 1430.\textsuperscript{151} In his description, Albizzi estimated the tonnage of the vessel at 3000 to 3300 \textit{botti} (one \textit{botta} equaled about .47 tons), and estimated the overall length of the vessel at 102 \textit{bracchia}. Such a measurement would put the


\textsuperscript{148} Anderson, “Bursledon Ship (1934),” 165.

\textsuperscript{149} Although few ships from the late medieval period have been excavated, both the Highborn Cay and Molasses Reef vessels had substantial ceiling. See Thomas J. Oertling, “The Molasses Reef Wreck Hull Analysis: Final Report,” \textit{International Journal of Nautical Archaeology} 18 (1989): 229-43 and Thomas J. Oertling, “The Highborn Cay Wreck: The 1986 Field Season,” \textit{International Journal of Nautical Archaeology} 18 (1989): 244-53. Also, Steffy, \textit{Wooden Ship Building}, has stated that ships as diverse as the seventh century Yassi Ada vessel (pp. 82-3), the eleventh century Serçe Limani ship (p. 91) and the early fourteenth century Contarina vessel (p. 93) all had substantial internal timbers secured over frames.

\textsuperscript{150} A particularly useful work for the study of the development of late medieval internal structure is Harald Åkerlund, \textit{Fartygsfyndet i den Forna Hamnen i Kalmar} (Uppsala, 1951). Numerous clinker vessels from the thirteenth through the eighteenth centuries discovered in the dry harbor of Kalmar, Sweden were excavated in the 1930s. A definite development in internal structure can be observed. For details on scarfs see Anderson, “Bursledon Ship (1934),” 165-7.

\textsuperscript{151} Richmond, “War at Sea,” 121n; Friel, “Henry V’s \textit{Grace Dieu},” 17; Peter Throckmorton, ed. \textit{The Sea Remembers: Shipwrecks and Archaeology} (London, 1987), 140.
length of the vessel between 62 and 66 m., depending upon which conversion for a *bracchio* one uses. Albizzi also gave other measurements such as a height of the forecastle above the water of 26 *bracchia*, or around 16 m.; he estimated the circumference of the mast at the main deck at 11 *bracchia*, which converts to a circumference of around 6.5 m. and a diameter of about 2 m.

Additional credence for Prynne and Anderson’s identification is found in primary documentary sources. These were first brought to light by Oppenheim in 1896, and indicate that *Grace Dieu* had been laid up near Bursledon in 1424 shortly after the death of Henry V.¹⁵² Oppenheim further described the ship’s final demise by fire on the night of January 7, 1439. Both Prynne and Anderson describe charred wood on many of the timbers found at the site.

Archaeological investigation of the Hamble River site has continued sporadically in the decades since Anderson and Prynne’s examinations in the 1930s. For the most part these have focused on confirming the identification of the ship. Such was the goal of the investigations first led by Alexander McKee in the late 1960s. Research in the late 1980s and early 1990s concentrated on determining stability, extent and siltation rates at the site. In addition, timbers that had been used for planking and framing that had been removed from the site over the years were recovered and carefully recorded. Gillian Hutchinson, of the National Maritime Museum in Greenwich, undertook much of the work. Her publication gives more specific details of the sequence of *Grace Dieu*’s construction than that of Prynne and Anderson. By carefully recording the location of nail holes in the timbers, Hutchinson was able to determine how the triple thickness planking was assembled. “[S]mall nails were used to tack the planks together before the main clenching took place. The clench nails had large shanks so that their holes would have had to be pre-drilled and it would have been an advantage to have some way of keeping the strakes together whilst this was done.”¹⁵³ Hutchinson’s work defined specific characteristics of outer, middle and inner planks. The most important characteristics for determining where the plank was located in the hull are nail holes, the width of the board and the pattern of beveling on each plank.

Hutchinson also described a number of framing timbers removed from the vessel. In her study, she noted that treenails holding framing to planking were driven from the outside of the planking shell to the inside. Also the outer, joggled surfaces of the timbers had concavities

carved in them so that they fit over the roves of the nails. This serves as a reminder that *Grace Dieu*, like more conventional clinker-built ships was built shell-first, with the frames being inserted after the planking was clenched together.

Hutchinson’s descriptions indicate the hull was built with a construction sequence very similar to that of common clinker vessels of the time. That is, that the shell was built before the framing was inserted. The framing, assembled using relatively short, uncurved pieces of lumber, in no way served to determine the shape of the hull. Rather, the knowledge and experience of the builders allowed them to design the hull according to unwritten conventions. This runs contrary to Michael Prynne’s assertion, originally given in a lecture to the Society for Nautical Research in the 1960s, regarding clinker building in general and the construction of *Grace Dieu*, in particular: “Naturally, the clinker planking must have something to be fastened to in the first place and this takes the form of molds built up on the keel, made to the shape of the sections of the ship.”

It is due to work by archaeologists such as Gillian Hutchinson, that we know that Michael Prynne’s assessment is incorrect. It is the product of a modern concept of northern European boat building. *Grace Dieu* was built, instead, using medieval conventions.

**Significance of Grace Dieu**

The working life of *Grace Dieu* was exceedingly short. It is doubtful if in her career, *Grace Dieu* sailed much more than a hundred kilometers. Her time at sea was marked most prominently by the mutiny of her crew on her maiden and only voyage. Lack of sufficient numbers of documents makes determining why such an event occurred quite difficult. Among the myriad explanations including poor pay and poor treatment of the crew by the ship’s master, one can speculate that the extreme danger and difficulty of sailing such a large and unwieldy ship using typical sails and rigging of the day may have contributed to the mutiny. Similarly, had the ship been terribly unwieldy, it would have precluded using *Grace Dieu* as a merchantman. Upon the death of Henry V, when so many other crown-held vessels were being sold off as merchantmen, the largest vessels in Henry’s fleet, *Grace Dieu*, *Jesus* (the second largest), *Trinity Royale* and *Holyghost* remained unsold. Until she was struck by lightning and burned in 1439, *Grace Dieu* never again sailed and remained a drain on the nation’s coffers. Similarly, the military importance of *Grace Dieu*, a craft that never engaged in battle and likely never left sight.

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of England, is dubious at best. One might argue that like James IV’s Michael, Grace Dieu was built in order to intimidate an enemy, and in that respect served a purpose. She did not, however, help bring an end to Anglo-French hostilities. Moreover, she was enormously costly to the English crown at a time when resources were wanting. Excepting perhaps prestige, the ship never produced any return to England either in war or in commerce.

For ship archaeologists and scholars, the vessel serves two important purposes. First, Grace Dieu is the only hull yet studied by archaeologists and ship historians that dates to the late medieval period that was purpose-built for war by northern Europeans. The second reason for including the ship in this work is that its construction illustrates the extremely versatile nature of clinker construction at a time when carvel building was surely known in northern Europe. These two factors, in conjunction, serve to illustrate the uniqueness of the ship. Also, they serve as counters to the argument made by some ship historians that clinker construction by its nature limits the size of a vessel. The complex nature of the vessel’s construction, moreover, is a testament to the sophistication of the shipbuilder at the beginning of the fifteenth century. The multiple-thickness hull shows that joinery and carpentry were very well advanced even in an age when hulls were built without benefit of written or drawn plans.

The most important element illustrating the sophistication of the shipbuilder is the multiple-thickness planking of Grace Dieu. In Wooden Ship Building and the Interpretation of Shipwrecks, J. Richard Steffy identifies two classical vessels with multiple-thickness planking, the Kyrenia ship and the Madrague de Giens.\(^\text{156}\) There is no indication, however, of sheathing on any of the northern medieval vessels covered in Steffy, nor has sheathing found on any of the other vessels covered in this work. In the modern era, sheathing, whether it was of wood or metal, usually served to protect the hull from deteriorating in the first place, or from deteriorating further if a vessel had already had a long working life. In circumstances in which such planking was used, it was assumed that rotted sheathing could easily be stripped off and replaced. Moreover, in a frame-based, carvel vessel, all planking could be removed and replaced if it was rotten enough. This was much more problematic – perhaps even impossible – in shell-based vessels. The shape of the ship, after all, was determined by the hull rather than by the frames. Frames frequently were not attached to the keel in such watercraft. Similarly, framing members were not necessarily fastened to one another. The question still remains then: What was the purpose of the multiple-thickness planking of Grace Dieu?

\(^{156}\) Steffy, Wooden Ship Building, 48, 62.
The evidence indicates that, although there may have been several other reasons for using several thicknesses of planking, one is clear: Multiple-thickness planking provided additional strength for the ship. The planking of Grace Dieu surely was not sacrificial. The men who built the ship never intended that the outer layer of the ship’s hull might be stripped off and replaced when they became worm-eaten or worn. With three methods of fastening each timber to other planking members (tar caulking, tacks and clinker nails), the construction is simply too complicated to think that dismantling the hull only to rebuild it would have ever been contemplated. Separating planks once constructed would have been impossible. The considerable craftsmanship and joinery allowed builders to use shorter timbers that were not necessarily of the best quality. With careful beveling and many fasteners, a very strong shell could be created.

Numerous fasteners, unifying all members, transfers the strengths of the individual timbers to create a very stiff shell. The considerable stiffness of the shell allowed a vessel of virtually incomprehensible size, for the day, to be built. The ship was so big, in fact, that Grace Dieu was too large for the sail technology of the day. Surely, such construction indicates that manpower and resources were in abundance, belying assertions that it was inherently a difficult and wasteful method for building a ship. Moreover, it almost appears that a degree of conservation of resources was at work, since the builders could use short pieces of wood for all of the most important structural elements. It would not have been necessary to find the best and most expensive timber to build Grace Dieu. Henry V simply sought to make an extraordinary statement with the resources available to him. Perhaps the most valuable resource he had were extraordinarily inventive and capable shipbuilders.

Henry V sought to construct a ship that might illustrate the power of his throne and intimidate his enemies. But the vessel was, for all practical purposes, unmoveable, unsellable and virtually inoperable. In no way was this due to the care or quality of the construction of her hull. Although I feel that Grace Dieu was a failure as a warship and, for that matter, as a merchantman, the construction of her hull is a masterpiece of carpentry and technological design. Moreover, the ship was constructed at a time when virtually nothing regarding ship construction was written or drawn. The ship was built to the highest specifications of the day. For the time and the place she was built, the techniques used to construct her hull were the latest and, by the people who made their livelihood on the sea, considered the best. Perhaps it is because of the care devoted to the construction of her hull, in addition to the location in which she was finally laid up, that Grace
Dieu survived in such fine condition to this day despite all of attempts at salvage over the years including dynamiting.
CHAPTER FOUR: Late Medieval Clinker Vessels

The Gdansk “Copper Wreck”

In 1975-76, the Centralne Muzeum Morskie, the Central Maritime Museum in Gdansk, Poland, undertook the excavation of a large merchant vessel, dating to the late medieval period.\footnote{Jerzy Litwin, “‘The Copper Wreck.’ The wreck of a medieval ship raised by the Central Maritime Museum in Gdansk, Poland,” \textit{International Journal of Nautical Archaeology} 9 (1980): 217-25.} Excavation was undertaken because large merchant ships that anchored in the port threatened the site. The vessel, which was designated officially as W5, came to be known as \textit{Miedsiowiec}, or the “Copper Wreck,” because of the large cargo of copper ingots found within the ship’s hull. Dr. Smolarek, founder of the Gdansk Maritime Museum, supervised the excavation, while Jerzy Litwin of the same institution, was principally responsible for analysis of the hull and cargo.

Construction and Cargo of the “Copper Wreck”

The vessel excavated by Smolarek was about 25 meters long and had been seriously damaged by fire at the time of the ship’s sinking. Through the centuries vessels that anchored above the remains had done additional damage. During the course of the excavation, three surviving sections of hull were identified and raised. The three sections comprised the starboard side of the ship from keel to waterline. The first section was raised in September 1975 and included parts of 12 frames, five strakes and inner longitudinal planking. A second, larger section was raised a month after the first portion of hull. It consisted of 22 frames, 13 strakes, two throughbeams and six inner planks (stringers). The final piece of the ship to be raised was the keel and sternpost assembly. A number of loose timbers found scattered around the site were also raised.

All of the timbers recovered from the sea floor were of oak. The keel, the best preserved timber recovered, measured 16.34 m. long, had a maximum siding of 41 cm. and a molding of between 18 and 26 cm. Evidence indicates that garboards were fastened to the keel using oak
dowels near the forward end of the keel and with iron nails towards the stern. The after end had a two-step rabbet for a “double” sternpost. The innermost piece of the sternpost, the only one that remained, was fastened to the keel with dowels driven transversely through the keel and post. The post showed evidence of a stepped rabbet for the after ends of strakes one through six. Above the rabbets for the lower six strakes, the inner sternpost narrowed considerably. Upper strakes would have run to and been fastened to the outer sternpost. The two elements of the sternpost were fastened with iron bolts.

The hull of the ship was built shell-first. Strakes were fastened together in typical clinker-style, with nails driven from the inside of the shell and peened over rectangular roves on the outside. Nails were spaced 14 to 21 cm. apart. The width of the strakes tapered from amidships to the ends. The average width was 37 cm. Thickness also varied. The lower edges of most strakes were approximately 6 cm. thick, while the upper edges were around 4 cm. thick. Each strake consisted of several planks fastened together with scarfs about seven cm. wide and 60 cm. long. Scarfs were caulked with moss and usually held together with a triangular grouping of nails. Except at the aftermost ends, strakes had luting coves that were caulked with animal hair.

Once the builders had turned the bilge of the planking shell, throughbeams with carved ends were placed into the hull. The ends of two such timbers were discovered spaced 1.65 m. apart. The timbers had a molding of 27 and 28 cm. and a siding of 24 and 24.5 cm., respectively. Although Litwin is not specific on the issue, the crossbeams appear to have been located above strake nine and probably above strake 12.\(^{158}\) The carved ends of the throughbeams are similar to those found on other medieval, clinker-built vessels, including Kalmar 6\(^{159}\) and Grace Dieu.\(^{160}\) Litwin speculates that the throughbeams “may have been used as molds to gauge the width of the hull.”\(^{161}\) They also stiffened the shell by providing transverse strength.

After the throughbeams had been fitted, framing was placed in the shell. Floor timbers were set in first, followed by first and second futtocks. This is evident from the direction of the scarfs between framing elements. Only in one instance, immediately beneath one of the throughbeams, is there evidence that a futtock was placed into the shell and fastened before the floor was situated. It is evident, because the scarf between floor and futtock faces in the opposite

\(^{158}\) This assessment is made by careful observation of photographs in Litwin, “‘The Copper Wreck,’” pp. 218, 221, 223-4.
\(^{159}\) Åkerlund, Fartygsfyndet, 154.
\(^{161}\) Litwin, “The Copper Wreck,” 223-4.
direction of all other such scarfs. The molding of the frames was fairly regular at 19 to 20 cm., while the siding varied between 17 and 23 cm. Litwin indicates that spacing between frames was from 10 to 20 cm. Treenails driven from the outside of the hull held the frames to the shell. Measuring about three cm. in diameter, the fasteners also served to secure the scarfs between framing members.\footnote{162} One of the most interesting aspects of the frames is the semi-circular steps or “joggles.” Litwin attributes this feature of the framing to a form of pre-fabrication.\footnote{163} Such a situation, in fact, would indicate a certain regularity of form in shipbuilding at the end of the medieval period.

In many instances, treenails holding frames to the shell also held longitudinal inner planking to the tops of the frames. The largest section of hull had six stringers. The boards served a number of purposes. They gave the vessel additional longitudinal strength while protecting frames from shifting cargo. Planks from which the stringers were made were of the same thickness as those used to fashion the strakes. One of the longitudinal stringers appears to have been notched under the two throughbeams,\footnote{164} giving the cross-timbers an additional point of connection with the internal framework.

Litwin describes the raising of two portions of the keelson, one 2.45 m. long and the other 3.8 m. long. The shorter portion raised, was expanded along its length to form the maststep. Litwin states, “Each fragment of the keelson has chocks for the floor timbers.”\footnote{165} Unfortunately, the author gives no other dimensions. Also, Litwin includes no drawings or photographs of the timber. It is therefore difficult to determine whether the timber was a true keelson – whether it was fastened to the keel along its length – thereby providing additional longitudinal strength to

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\item Jerzy Litwin, “Some Remarks Concerning Medieval Ship Construction,” in Medieval Ships and the Birth of Technological Societies, Volume I: Northern Europe, ed. Christiane Villain-Gandossi et al., (Valetta, Malta, 1989), 151-161. Litwin suggests that scarves between framing members usually stretched over two to three strakes.
\item Litwin, “The Copper Wreck,” 222.
\item The notches are visible in the photograph in Litwin, “The Copper Wreck,” fig. 7, 221.
\item Litwin states, “The dismantling of the one intact piece of ship structure revealed yet another interesting structural feature: the strengthening inner planking on the inside of the hull, on which the cross-beams are mounted. These planks are the same thickness as the strakes beneath them. The planks extended either side of the cross-beams; there were no signs of similar strengthening in the remaining structural parts raised.” In this passage and in the figure to which Litwin refers, fig. 10, p. 224, the author is clearly not speaking of the stringers, but to filler timbers on the inside face of the outer planking. Although the photograph to which Litwin refers is not terribly clear on this issue, an identical construction feature can be seen on the Aber Wrac’h vessel, clarifying Litwin’s information. Litwin, “The Copper Wreck,” 223.
\item Ibid., 224.
\end{enumerate}
the bottom of the hull. From the evidence of a single mast step, Litwin theorizes that the ship had only one mast.

From carbon 14 results, excavators determined that the vessel was built sometime in the beginning of the 15th century. Litwin estimates that the ship was between 40 and 60 years old when it sank as a result of a fire. When it went down the ship was carrying a cargo that included bundles of copper ingots and barrels of tar and wax. The timbers were covered in a layer of the latter two materials, which melted in the fire. The layer of pitch and wax helped protect the timbers and preserved many artifacts and vegetable matter such as onions and garlic. Other artifacts recovered from the site included copper and iron fittings and kitchenware. There was also evidence of weapons. Archaeologists found crossbow arrowheads and four stone cannonballs in different parts of the hull. One scholar has speculated that part of the ship’s cargo may have been timber, one of the principal trade products of the region of Gdansk in the fifteenth and sixteenth centuries. Samuel Turner has argued that the cargo may have floated off when the vessel sank. He bases his argument on the fact that there was insufficient ballast in the vessel for the size of the wax and pitch cargo alone. Litwin speculates that the vessel that sank in Gdansk harbor may have been a hulk. Finally, Litwin suggests that the source of the fire that sent the ship to the bottom may have been pirates.

_Aber Wrac’h I_

Ten years after the raising of the wreck in Gdansk harbor, a vessel dating to the late medieval period was discovered in the mouth of the Aber Wrac’h River on the north coast of Brittany. A survey of the site in 1986 identified the wreck as a clinker ship that was about 25 m. long and 8 m. in breadth. Archaeologists postulated a late-medieval date due to the size of the vessel’s scantlings. Two portions of the ship were excavated in 1986 and 1987. The vessel was found to have been heavily ballasted and had wrecked in an area known in the middle ages, to be dangerous for ships. The port side of the hull, onto which the ship had settled on the sea

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167 Steffy, _Wooden Ship Building_, 274.
168 Litwin, “‘The Copper Wreck,’” 225.
169 This was conveyed to me by Mr. Turner one late night in Spring, 1993, shortly after I had first become interested in some of these issues. While working on a term paper on the Woolwich ship, Mr Turner told me of a paper he had done on the Copper Wreck, and was gracious enough to share his thoughts. My term paper became the basis of this thesis. I am grateful.
floor, was covered in ballast and was well preserved. The starboard side had been subject to river
currents and was, for the most part, non-extant.

Construction of Aber Wrac’h I

Upon removal of the large ballast mound, the extremely well preserved port side of the
vessel was revealed. Removal of ballast revealed 24 strakes preserved on the port side and 37
well preserved frames. Archaeologists also found ceiling planking extending from the centerline
to the turn of the bilge, a number of thicker longitudinal stringers above the ceiling and evidence
of several throughbeams. Portions of the keel, maststep and stem were also revealed. Michel
L’Hour and Elisabeth Veyrat, who published preliminary results of the excavation, indicated that
15 additional frames could be partially restored following the excavation.

All the wooden components of the Aber Wrac’h vessel were of oak with two exceptions.
Blocks protecting the heads of the throughbeams were of elm or alder, while the keel was of
beech. Over 10 m. of the timber were recovered. The keel is described as trapezoidal in section,
deepening somewhat amidships. Garboards were nailed to the keel “abutting a slight rabbet.”
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The badly damaged stem was found unattached to the keel in a lower part of the site. It was
about 2.5 m. long and had three rabbets, “oblique hollows,” which would have accommodated the
hood ends of strakes.

Like the “Copper Wreck,” the Aber Wrac’h vessel was built shell-first. Strakes were
about 3 cm thick and 23 cm wide. They were fastened together with clinker nails driven from the
outside of the planking shell and peened over square roves on the inside. Strakes were formed of
several planks fastened together with 30 to 40 cm. long oblique scarfs. As on the Gdansk wreck,
the scarfs all faced towards the stern of the ship. Also similarly, the scarfs were caulked with
moss. Builders caulked the seams between strakes (apparently in luting coves) with “two species
of bryophytes, one moss and one sphagnum.”

Once the planking shell was completed, frames were placed into the hull. Unlike the
“Copper wreck,” in which only those frames under the throughbeams showed evidence of
futtocks being inserted before floors, about half of the scarfs on the Aber Wrac’h ship are
inverted. Usually this occurs between first and second futtock, indicating that the second futtock
was fitted before the first. Scarfs between framing members were fastened using the same

171 Ibid., 286.
172 Ibid.
treenails that held the frames to the planking shell. These treenails were driven, one per strake, from the outside. Frames had a maximum molded dimension of about 25 cm. at the keel. This decreased to around 15 cm. further up the side of the ship. Sided dimension of the frames varied from 15 to 25 cm. Clear space between frames averaged 13 cm. Frames were not fastened to the keel. Floors had square-sectioned limber holes at “the heel.”

Oak ceiling was fastened to the tops of the frames. It extended from the centerline to the turn of the bilge. L’Hour and Veyrat indicate that the ceiling was treenailed to the frames and outer planking. Whether this means that ceiling was held to the frames with the same treenails driven to hold the frames to the planking shell, as was the case with the Gdansk vessel, or whether treenails holes were drilled and treenails driven from the inside of the hull, is unclear. Further up the sides were a number of thicker stringers. These appear to have been notched over the frames or, in some cases, the frames were notched to take the stringer.

Evidence for several throughbeams was also discovered. This consisted of three carved beam heads found atop frames M98, M107 and M116. Clear indication of a fourth is evident above frame M130. Where the beam penetrated the side of the vessel, the strakes above and below the beam were reinforced with an additional board. The throughbeams sat atop the frames. As on the Gdansk vessel, they were additionally supported by a stringer fastened immediately beneath the crossbeams. On the outside of the vessel, cone-shaped blocks of wood protected the protruding beam heads. These blocks, of elm or adder, were the only components, other than the keel, that were not of oak. The discovery of these blocks, which pointed towards the stem of the vessel, is exciting because hitherto, such elements were known only from iconographic sources.

Finally, a very poorly preserved portion of the maststep was discovered. The timber measured about 2 m. and was discovered in the midships area. L’Hour and Veyrat indicate, “a similar component may be reconstructed on the starboard-side.” The maststep was held in place by rectangular wooden blocks that were treenailed to the frames. A deep rabbet was cut in the upper side of the step that would have housed “an intermediate component.”

From dendrochronological examination, archaeologists determined that frames were cut from oaks less than 60 years old and that planks were cleft from trees around 200 years old.

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173 Ibid., 287.
176 Ibid.
177 Ibid.
Unfortunately, the excavators were not able to match the 213-year floating chronology that was achieved with the North European master curve. This suggested that the vessel might have been built further south, in Bordeaux or perhaps northern Spain.

The site in the Aber Wrac’h River yielded virtually no cargo. The vessel did appear to have been heavily ballasted at the time of sinking. The ballast was quite heterogeneous and therefore gives no indication of the ship’s port of origin. Eight silver coins, in a poor state of preservation, were found together near floor timber M125. Six were from Castillian mints, while two were of Breton provenance. They were minted between 1390 and 1422. The close relationship of the coins indicates that they had, most likely, been in the same purse. Ceramic evidence also links the ship with Brittany.

Based upon ceramic and numismatic evidence, L’Hour and Veyrat believe the vessel sank in the first half of the fifteenth century, but obviously after 1422. A document found in the Breton archives, dated to 1442, states that an English merchantman belonging to Richard Barquiez wrecked when entering the river in 1435. The account reports that the vessel was carrying very little cargo when she foundered. The authors state further, “it is easy to imagine that an English merchant might own a ship built in a Spanish or Aquitanian yard,” due to the close relationship between England and Aquitaine at that time.

The Riddarholm Vessel

In the winter of 1929-30, during construction of a bridge over the Riddarholmskanal in Stockholm, a cannon, originally thought to date to the middle part of the fifteenth century, was dredged up. Before the significance of the find could be evaluated, workmen dredged up a second similar piece. Both guns were found strapped into their oak carriages. The cannons were fairly typical wrought iron breechloaders. The first gun raised had no block, but the second was fully armed with a breechblock loaded with powder and lead shot. Prompted by the discovery of such significant artifacts, further investigation of the site was determined appropriate. Divers quickly discovered the remains of a large clinker-built vessel in good condition. In addition they brought to the surface an assortment of iron and stone shot. Due to the poor visibility on the site

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178 Ibid., 298. Unfortunately, the authors do not cite the source.
179 Ibid.
it was determined that the most effective manner of excavation would be to build a wooden cofferdam around the ship, pump the water out and conduct a “dry excavation.”

Construction of the Riddarholm Ship

The vessel was discovered preserved in a thick layer of mud. As a result, the wood was in very good condition. When fully exposed the remains extended to a length of about 18.75 m. by about 5 m. wide. Significant portions of the forward sections of both the port and starboard sides were uncovered and documented. The starboard side of the ship was preserved to the seventeenth strake, while the port side was preserved to the twelfth. A 17-meter-long section of the keel was recovered along with a curved section of the stem that measured 1.25 m. Thirty-four frames were extant and three others that were missing could be reconstructed. Lying above the frames was a keelson preserved to a length of 10.75 m. All components were of oak.

As with nearly all clinker vessels, the Riddarholm ship was built shell-first. The keel, which measured 20 cm. molded by 20 cm. sided in cross-section, was laid down before the stem and sternpost were attached. The former element, which was still attached to the keel when discovered, measured 30 cm. molded by 20 cm. sided. The sternpost, which was not recovered, was reconstructed first in 1964, and then again in 1985 as a straight timber that supported a stern rudder. Once the keel and posts assembly had been raised, garboard strakes were fastened into a garboard rabbet using iron spikes. The sides of the vessel were then built up. Upper strakes were fastened to lower strakes using clinker nails. In the Riddarholm ship, these were driven from the outside of the ship and peened over roves on the inside. The joints between strakes were caulked with animal hair. Boards had been converted from radially split timbers.

Once the planking shell was completed, frames were inserted into the hull. All of the scarfs between framing members indicate that this was the sequence for all preserved frames. In none of the publications that refer to the Riddarholm wreck are dimensions or spacing of frames specifically given. From observation of photographs and drawings, one can estimate that framing timbers had a siding and molding of about 20 cm. by 20 cm. Frames appear to have had a room and space of around 50 cm. All framing members were cut from naturally curved oak limbs. Frames were fastened to the planking shell with wedged treenails driven from the outside of the

181 Ibid., 264-5.
182 Ibid., 265; Axel Lindberg, Riddarholmskeppet: Dokumentation av rekonstruktionen i Medeltidsmuseet (Stockholm, 1985), 12. Specific measurements come from either Nordberg or Lindberg.
hull. There were either one or two treenails used at each frame per strake. There seems to be little regularity in determining how many were used.

After framing was inserted, the keelson was fitted over the floors. Notches were cut in the bottom of the timber to allow it to fit over the frames. Sided and molded dimensions of the timber are not given. Nor is it clear whether the timber was fastened to the frames or to the keel. One would imagine it was. Tord Nordberg, who first reported the discovery of the Riddarholm wreck, says that in addition to notches for the frames, there was a maststep. Whether this was an expanded section of the keelson with a step or whether it was merely a mortise or series of mortises in the keelson that held the mast is unclear. Axel Lindberg, who published a report of the reconstruction of the vessel for the Medeltidsmuseum in Stockholm, also sheds little light on the issue. Further up the sides of the hull were longitudinal stringers or inwales. Evidence of these is seen only in a relatively rough sketch by Lindberg, and in one of the photographs illustrating Nordberg’s report. In both illustrations, the stringers appear to be as substantial as the keelson.

There is no specific evidence in either report that there were cross- or throughbeams of the sort seen on the Aber Wrac’h vessel or the “Copper Wreck.” However, both Nordberg and Lindberg state that the forward portion of the vessel was decked. One would assume that decking must have sat on some sort of transverse timber. Lindberg also postulates a transverse timber at deck level near the maststep that would have supported the mast.

Like the Aber Wrac’h vessel, the Riddarholm ship was discovered with little cargo. The most significant material discovered in the hull was weaponry. In addition to the two cannon, at least 31 powder chambers, a loose gun barrel and two additional carriages into which guns could be mounted, were discovered. There were around 100 stone shot and 50 lead shot recovered. Because the two complete guns were dredged up, it is difficult to say precisely where they were located in the ship. The first discovered was more substantial. The total length of the gun was 1.86 m. including the carriage. The barrel was strapped to the carriage with iron and had a bore of between 10 and 14 cm. The second was longer in length, 2.06 m., but had a much smaller bore, only 3 cm. The bottom of the gun was fitted with a swivel mounting.

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183 Nordberg, “Die Schiffsfunde im Riddarholmskanal,” 266. Nordberg’s specific words are, “Über die Mitte der Spantenringe lag das 10.75 m lange Kielschwein mit schön geschnitzen Aussparungen für di Spanten und mit dem Mastloch.”
184 Lindberg, Riddarholmskeppet, 17.
Based upon the typology of the guns discovered, Nordberg in his original report estimated that the vessel dated to between 1450 and 1523. The latter date is so precise because it was the year Gustav Wasa liberated Stockholm from the forces of Christian II of Denmark. Nordberg speculated that a vessel as heavily armed with the specific characteristics of those found on the ship discovered in the Riddarholmskanal, would have been so close to the town at such a late date only for such a reason. In his report on the reconstruction of the ship, completed in 1985, Axel Lindberg states that dendrochronological analysis dates the ship to 1520, give or take three years. Lindberg does not state from where the samples were taken. If Lindberg’s date were correct, it would indicate that vessels still being constructed entirely of oak with radially split timbers were being built contemporaneously to vessels such as *Mary Rose*. They were also being armed.

**Significance of the Sites**

Of the three vessels described, the “Copper Wreck” and the Aber Wrac’h vessels are the best known to the archaeological community. They were discovered and excavated relatively recently by scholars familiar with the techniques of underwater excavation and maritime research. Nautical archaeologists frequently use the vessels to illustrate typical late medieval clinker ship construction. In developing research questions for this thesis, it was asked of me on more than one occasion, however, the significance of the two vessels with respect to military technology and its influence on ship construction. Neither of the ships, after all, with the slight exception of four stone cannonballs discovered on “the Copper Wreck,” appeared to have had any military connections. Each was clearly used at the time of sinking for commercial purposes.

That is why I found references to the Riddarholm vessel, in a fine work by Carl Olaf Cederlund, extremely exciting.\(^{185}\) The Riddarholm ship is constructed in a manner very similar to that of both other vessels. Also, guns were found with the ship. I do not believe that artillery was “standard” equipment on merchant vessels at any point in the fifteenth century. Similarly, I do not feel that ships were usually purpose-built for military purposes. *Grace Dieu* and the Riddarholm ship, in that respect, are the exceptions and not the rule. They should not be looked upon as typical of late medieval shipbuilding and vessel usage.

The similarity of the construction of the Riddarholm vessel to “the Copper Wreck” and to the Aber Wrac’h ship is important, though. Late medieval businessmen, like late medieval monarchs, could see the changes that artillery was making to warfare. As a consequence, they began to equip their ships with guns. Guns, however, were terribly dear and not every trader could afford them. Oddly enough, one of the earliest iconographic references to heavy shipboard artillery is from a document that glorifies the deeds of an English nobleman who was also an extremely successful merchant, Richard Neville, Earl of Warwick.  

“The Pageants of Richard Beauchamp, Earl of Warwick,” also known as the *Warwick Roll*, details the exploits of the man who was known as “the Kingmaker.” Warwick was the strength behind Edward IV in the middle of the fifteenth century in England. In the document, created near the end of that century, the vessels pictured are clearly of clinker construction. The pattern of clinker nails holding the seams of strakes together is obvious (figure 4). These images, I suspect, depict ships that would have been very similar to the Aber Wrac’h, “Copper Wreck” and Riddarholm ships. Quite obvious in the drawings of ships seen in the *Warwick Roll* are the guns that point out over the wales in the waists of the vessels carrying the Earl’s forces. The ship opposing the one carrying the Earl’s forces is clearly of clinker construction. According to the *Roll*, it was of Spanish origin. However, it has no guns.  

From the document, one is not struck by the importance of the artillery to the battle. The weapons are there, but instead, one is impressed by the size and number of archers and other combatants pictured in the illustration. Certainly, artistic conventions dictated that people play a greater role than the machinery, namely the ships and the artillery. Still, the overwhelming impression is that gunpowder had very little impact on the engagement. The two ships are engaged in an exchange typical of medieval warfare in which arrows, spears and rocks killed more people than did guns. I suspect that the impression given by the *Warwick Roll* is an accurate one. It is an impression that is reflected in the archaeological record, as well. There were, after all, no guns found on *Grace Dieu*. Documentary sources, similarly, indicate that such weapons were relatively unimportant on that ship.  

Also, on the three ships detailed in this

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187 In Carpenter-Turner, “The Building,” 69, the unimportance of ordnance can be ascertained. When the vessel, already sitting in drydock, was turned over to William Soper in 1420, only three guns and three chambers were listed in her equipment. By contrast, she still had “144 measures of iron for throwing from the tops.”
Figure 4: Detail of the *Warwick Roll*. One can make out no less than five types of missile weapons employed in this engagement: spears, javelins, longbows, crossbows and rocks. The cannon on the vessel on the left are barely visible, aimed over the gunwale. Also note that on the vessel on the right, rows of clinker roves are evident. (British Library.)
section, only one carried guns at the time it foundered. And on the Riddarholm ship, guns were few in number. It is unlikely they were used for offensive purposes.

By the end of the fifteenth century, guns were certainly more common on ships conducting commerce over the seas than they had been fifty years earlier, when Grace Dieu was built. In the fifteenth century the seas had become more problematic for shippers, as piracy and predation increased. This trend increased in the sixteenth century as guns became more effective and affordable. However, at the time the “Copper Wreck,” the Aber Wrac’h and Riddarholm ships sailed, guns were still extraordinarily expensive and uncommon on almost all ships built for long-distance trade. Vessels used to transport goods would have been fitted with artillery usually on occasions when they were temporarily commandeered by a monarch for use in an international dispute. The three archaeological sites described support this conclusion.

The most striking aspect of the sites, when examined together, is that the ships, although separated by considerable distance – one in Poland, one in Scandinavia and one on the French Atlantic coast – are, nevertheless, very similar in construction. This indicates that certain basic practices for construction had spread throughout northern Europe by the fifteenth century. Some of these practices might include the thickness of the planking to be used, the molded dimensions of frames and the use of throughbeams to strengthen and stiffen the hull. Also, shipbuilders had begun using ceiling or, at least, stringers in order to provide ships with additional longitudinal stiffness. In the middle of the fifteenth century, from the archaeological evidence, there do not appear to have been any firm rules regarding the sided dimensions of frames, but clearly, they had long since become a critical structural element. In each of the ships described the frames are so closely spaced that they provided considerable strength to the hull.

None of these three ships were terribly special. None were built by royal sanction to glorify any realm. However, each, in its own way, was important to the functioning of the economy of late medieval Europe. Also, when monarchs or powerful nobles, such as the Earl of Warwick, engaged one another, it was watercraft such as the “Copper Wreck,” the Aber Wrac’h ship and the Riddarholm vessel, that were seized or engaged to transport armies, weapons, beasts and supplies when kings went on campaign. At the time, there was no science of naval maneuver or warfare in northern Europe. But such an age was rapidly approaching. When one reads,

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therefore, of the fifteenth-century sea borne exploits of Richard Beauchamp, one is tempted to believe them:

At a signal from his captain, his little squadron, marshaled in tight formation, changed course. Headed by the five men-of-war, it sailed directly for the heart of the enemy line... Gunners waited by the scattering of cannon mounted on the decks... Trumpets sounded his signal to open fire. With a roar the guns belched their stone cannon balls... The English vessels crashed into the hulls of their enemies.189

The image is clearly an anachronism, one impossible in the fifteenth century, and one that represents a scene of at least a century later. In the middle of the fifteenth century, after all, there were no men-of-war or gunners and ships rarely sailed “in tight formation,” let alone in line. Such things were a part of the great age of sail, which in the fifteenth century, was still not at hand. But the tools and the knowledge that would bring about that age when Europeans would become pervasive around the world were developing quickly. Vessels such as the three vessels described above prove this. They indicate a common system for the construction of trading vessels that voyaged throughout northern Europe. At the same time they represent the framework on which the first generation of shipbuilders of the sixteenth century would build their knowledge base. If the Riddarholm ship is any indication, they are also the platform on which people such as the Earl of Warwick and Gustav Wasa were mounting guns to engage their enemies.

189 Kendall, Warwick, 42-3. In the notes for the passage, Kendall writes, “I have conjectured details of the sea battle with the general method of naval warfare of the day and from the letter of John Jernygan, one of the combatants, which supplies a number of touches and was written only three days after the battle.” Kendall cites, James Gairdner, ed., The Paston Letters, vol. 1, (London, 1910), 416. Jernygan’s letter, is not nearly as detailed as Kendall’s description of the action, however.
CHAPTER FIVE: Northern European Vessels in Transition

The Woolwich Ship: History of the Site

In November 1912, in the port town of Woolwich, during expansion of the Borough Electricity Works at Roff’s Wharf, a large ship was found while excavation for the facility was under way (figure 5). Because the discovery came shortly after the County Hall Roman-era vessel was found, Sir William White, Director of Naval Construction, was sent to evaluate the remains. Sir William took a series of photographs and certain measurements in the course of his examination. Upon completion of his analysis, Sir William proclaimed that the vessel belonged to the middle of the eighteenth century. This date he pronounced effectively halted further archaeological investigation.  

About a year later, after the death of White, the matter of the vessel’s age was taken up in the English press. Mr. Seymour Lucas claimed the ship was about 200 years older than White had believed. Lucas postulated that the remains were those of Henry Grace à Dieu, the largest vessel and flagship of Henry VIII’s navy. Lucas’s claims were based upon documentary sources that stated Henry Grace à Dieu had been destroyed by fire at Woolwich in 1553. Lucas’s claims precipitated considerable discussion in the English press. The outcome of the dialogue was a decision to conduct further investigation of the site. In March 1914, investigation was scheduled for the fall of that year. The plans were scuttled, however, by the outbreak of World War I in August 1914. By the time the war ended, little remained of the excavated material. Left laying on the dock at Woolwich was some stone shot and a few scraps of dried timber. The rest of the remains had long since been cut up and hauled away, used as firewood during the difficult years of the war.

In May 1959, R. C. Anderson, one of the most knowledgeable naval historians in England at the time, published an article in Mariner’s Mirror relating the war of words that

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Figure 5: Plan of the vessel excavated at Roff’s Wharf. This view of the Woolwich ship was prepared in 1914 from drawings made by Sir William White in 1912. (After W. Salisbury, “The Woolwich Ship,” Mariner’s Mirror 47 (1961): 80-90.)
followed the discovery of the Woolwich ship. Anderson’s article prompted W. Salisbury to thoroughly re-examine the scanty records and photographs of the excavation. From the limited resources available to him, Salisbury was able to glean and extraordinary amount of information on the specifics of the ship. His article, published in *Mariner’s Mirror* in 1961, remains the most extensive record of the vessel’s construction. Salisbury’s report gives us the best descriptions of the ship’s remains.

*Construction of the Woolwich Ship*

The ship was discovered lying bow towards shore. From plans and sketches made in 1914, the vessel appeared to be exposed to a length of about 27.4 m. along her keel and to a width of about 12 m. Particularly evident in the drawings is the vessel’s composite mast “consisting of a spindle of pine surrounded by baulks of oak and bound together with iron bands.”192 The mast had a diameter of 1.41 m. at its heel and sat in a maststep composed of a number of timbers surrounding an expanded section of the keelson. Along most of its length, the keelson measured 23 cm. sided by 35 cm. molded. At the maststep, however, it expanded to 32.5 cm. sided by 70 cm. molded. The step was widened further with two large timbers on either side of the step. The plans give no indication whether the keel and keelson were attached in any way.

Sections of the hull, prepared at the time the ship was excavated, suggest the keel tapered towards either end. Also, the underside of the keel, in most sections, appears to have been quite worn (figure 6). Salisbury notes, however, that in the only photograph in which the keel is shown in cross-section, it is well preserved below the garboards. Because of the photograph, a measurement of 60 cm. molded by 48 cm. sided for the keel immediately beneath the mast (determined by measuring from the section), must be viewed with some caution.

Garboard strakes were rabbeted to the keel. Whether they were fastened with treenails or iron fasteners is unclear. The planking of the sides of the ship was flush laid. Strakes were not fastened to each other, as in clinker shipbuilding. Rather, they were only fastened to the frames using treenails. To keep the seams between strakes tight, they were caulked with pitch and oakum. They were then secured with a batten fastened over the seam on the outside of the hull.

The frames give the clearest indication that at some point in its life, the ship had been rebuilt. These timbers measure 35.9 cm. sided, 20.4 cm. molded and have a room between

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192 Salisbury, “The Woolwich Ship,” 85. Measurements in Salisbury were given in English units. They have been converted here to metric.
Figure 6: Sections of the Woolwich Ship. The sections shown above match the sections in the site plan in Figure 5. (After W. Salisbury, “The Woolwich Ship,” *Mariner’s Mirror* 47 (1961): 80-90.)
frames of 12.3 cm. Evidence that the ship was rebuilt shows on the outboard face of one frame in one photograph. In the photograph, one can see that the timber had joggles that had been dubbed smooth prior to having been planked. This evidence suggests the frame had been used originally in a ship constructed using lapstrake methods. Although it is difficult to make generalizations regarding all frames based upon a single frame in a single photograph, Salisbury made an important observation, “It certainly appears from the photographs of the wreck that the riders, inner and outer planking and keel were in far better condition than the frame or floor timbers.”

It is quite possible therefore, that many of the frames had been reused from an earlier ship. From the sections it can be deduced that frames were scarfed to futtocks with oblique scarfs. It is uncertain whether components of frames were fastened to one another with anything other than treenails that secured the planking to the frames.

In the lowest portions of the hull, there was flush laid ceiling planking. Higher in the hull, longitudinal timbers were placed less closely. In several of the photographs, gaps are visible between the planks. Another significant feature of the internal hull structure is a series of heavy transverse riders fastened over the ceiling. These form a second set of framing for the ship. From the site plan provided in Salisbury and from the sections he provides, the riders appear to have been spaced at about 2 m. intervals through the hull. They appear to have had a siding of about 45 cm. Determining a moulded dimension is a bit more problematic, but a figure of about 50 cm. does not seem excessive. They could not have been placed into the hull until the ceiling had been laid. From the sections and plan of the site, it is clear that the riders were constructed of a number of separate pieces fastened with hook scarfs. The riders were fastened to the ceiling and, probably, to the framing with treenails.

At about the turn of the bilge (and possibly at a level further up the side of the ship), a set of stringers is evident. In photographs these appear to run over the tops of the riders. Several of the illustrated sections suggest that stringers sat in notches cut in the riders. The second set of stringers further up the side of the hull can be seen on the plan of the site and in section L-M. Such components, if securely fastened to the heavy riders, may have provided considerable longitudinal strength to counter hogging and sagging.

To interpret the origins and life of the Woolwich ship, it is necessary to note a number of other discoveries made when the ship was unearthed. With the exception of some stone shot,

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193 Ibid., 87.
194 Ibid., 85, 88. Measurements were determined by measuring with calipers from the drawings provided.
which measured between 8 and 32 cm. in diameter, no ballast was found in the hull. Based upon a calculated beam of the vessel at section E-F, and documentary sources for the lengths of other vessels of similar beam, Salisbury calculated that the ship discovered at Roff’s Wharf would have had a length between 37 and 38 m. and a maximum beam of around 14 m. With such dimensions and knowledge of the vessel’s construction, interpretation of documentary sources regarding the life of the ship is made easier.

Identification of the Woolwich Ship

From evidence of stone shot and from the importance of Woolwich as a naval center at the beginning of the sixteenth century, Anderson determined that the vessel was, quite likely, an early English ship-of-war. In his article in Mariner’s Mirror, he stated that he had “come to believe that the Woolwich ship was the Henry Grace à Dieu, if only for the simple reason that I cannot think of any alternative.”

Salisbury’s investigation of the ship and of the documentary record was far more exhaustive than Anderson’s, though. In his article, published two years after Anderson’s, Salisbury offered two additional possibilities, the Great Galley and Sovereign.

Salisbury approached the possibility of each historical vessel being the Woolwich ship in a very methodical manner, eliminating two of the possibilities for good cause, until a single possibility remained. Henry Grace à Dieu was an unlikely candidate, in Salisbury’s opinion, because the vessel discovered was much finer in shape “than that of ‘great ships’ either before or after her time.” Also, the remains found at Roff’s Wharf yielded no evidence of fire, the cause of Great Harry’s demise.

The second candidate, Great Galley, was more likely in Salisbury’s view. The ship had originally been constructed in 1515 and was rebuilt on at least two occasions, once in 1523 and a second time in 1536-37. Between 1562 and 1565, Salisbury stated, the ship disappeared from the records. There is also evidence that the ship had originally been built using clinker construction methods. This is found in a letter from Sir William Fitzwilliam to Henry VIII written at the time of Great Galley’s first rebuild. The document states, “The galley will not be ready before (another month), for Brigandine intends to break her up and make her carvel so as she shall be made in every point as your grace devised.”

The possibility that the Woolwich ship was Great

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197 Anderson, “Great Galley,” 276. In addition to this passage, Anderson relates other interesting particulars of this fascinating vessel. The ship was originally called either Princess Mary or Virgin Mary at
Galley was left open by Salisbury. In 1971, however, Tom Glasgow, Jr. refuted that possibility in a note in *Mariner’s Mirror*: “The Great Bark, alias Great Galley, was rebuilt in 1564 as the White Bear... [T]his seems to preclude the Great Bark from its place of consideration as a possible candidate for the vessel, whose remains are known now as ‘the Woolwich ship.’”198 Moreover, *White Bear* went on to a long life in the Royal Navy. She even underwent repair at least twice during her career, the first time at Woolwich in 1574 and the second time in the 1590s.199 The ultimate disposition of this ship is uncertain. However, after nearly 90 years of use, the likelihood of her having been abandoned at Woolwich, with considerable portions of her original structure intact, is remote.

Salisbury felt that the remains were most likely those of *Sovereign*, ordered built by Henry VII in 1488. L. G. Carr Laughton has suggested that *Sovereign*, along with her sister ship *Regent*, were built after the Breton ship *Colombe* which incorporated certain innovations atypical of English ships of the day.200 However, the innovations incorporated in the *Colombe* – and possibly in *Regent* and *Sovereign* – remain uncertain. Carr Laughton has suggested that the most important feature was the “square-tuck” stern, rather than the more typical medieval rounded stern. Unfortunately, the stern of the vessel was not among the remains discovered at Roff’s Wharf.

What is clear from the documentary record is that *Sovereign* was a well-regarded ship during her lifetime. The vessel had been built in part, from the timbers of the *Grace de Dieu* which served from 1446 to 1486.201 While in use *Sovereign* engaged in numerous military actions, including the short-lived conflict with France in 1491 and the War with France of 1512-1513. There is also an account of a trading expedition to the Levant in 1496 or 1497.202 *Sovereign* was so well thought of, that in 1509 she was ordered partially rebuilt. This was done only after considerable opposition was mounted against forces that sought to break her up. Those

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in favor of rebuilding argued that *Sovereign’s* “form is so marvellously goodly that great pity it were she should die.” After rebuilding, the ship served for over two more decades. Finally, in the 1530s, she was taken to Woolwich to be rebuilt a second time or broken up for use in the construction some other ship. As late as the 1546, there is a reference to the ship sitting in a dock awaiting final disposition.

The most likely explanation for the remains discovered at Woolwich, is that they were those of *Sovereign*. After her long career she was dragged into a dock to await demolition or reconstruction. Through the years, the dock silted up and timbers that remained above ground were cut off and reused. Eventually her whereabouts were forgotten about, until rediscovered in 1912.

Mary Rose: *History of the Site*

When the remains of *Mary Rose* broke the surface of the waters of the Solent on October 11, 1982, it was the culmination of years of search and excavation. The excavation and conservation of *Mary Rose*, which continues today, has proven to be one of the most ambitious, involved and expensive underwater archaeological projects ever undertaken. Although decades of conservation, study and publication remain, the dream of Alexander McKee, one of the projects earliest supporters, to locate, excavate and raise King Henry VIII’s flagship, had been achieved.

McKee, who had been searching for the ship since 1961, finally found it in 1971, after a side-scan and sub-bottom sonar survey in 1967 revealed the probable site. But he had not been the first to discover the site. Shortly after the vessel sank during battle with a French invasion force in 1545, Venetian salvors working for the crown attempted recovery of the ship with little success. They managed to recover only a few of the guns.

Around 1836 the ship was again found by John and Charles Deane, pioneers in underwater recovery and salvage. Over the next four years, they attempted to free the ship from the sea floor and the overlying sediments using explosives. Like the Venetian salvors before them, the Deane brothers met with little success. They only managed to bring up several bronze and wrought iron cannon, several longbows, human remains and various other artifacts.

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204 Glasgow, “Notes,” 302.
205 McKee, *Henry VIII’s Mary Rose*, 325-34.
When she sank in 1545, apparently after heeling over and filling with water through open lower gun ports, *Mary Rose* quickly filled with mud and other sediments. Thus, when McKee and his loosely organized federation of amateur explorers, historians and divers found eroded timbers sticking out of the sediment of the floor of the Solent, what they had discovered was an extremely important example of early modern shipbuilding in extraordinarily good condition. The sediments overlying the wreck had served to preserve much of the ship’s structure and contents. McKee and his fellow explorers recognized that the ship was of considerable historical significance. Therefore, they sought the expertise and financing to do a proper archaeological excavation.

Between 1971 and 1978 when excavation of the site began, McKee (the principal driving force behind many early attempts to find financing and public support for the project) oversaw the establishment of The *Mary Rose* Trust, the hiring of a qualified archaeologist, Margaret Rule, to lead the excavation and, most importantly, the raising of considerable funds to ensure that the venture would be a success. When Margaret Rule took over archaeological direction of the project, she built a competent team of archaeologists and other scientists who were able to design methods of excavation, recording and conservation to ensure that a maximum amount of information would be gleaned from the site. As a result of innovative mapping systems, complex computer-generated sections and illustrations of the hull were achieved. Also, precise locations of artifacts, under very difficult conditions, were determined.

Shortly after the raising of the vessel some of this information was published by Margaret Rule in a popular volume. It is unfortunate, though, that since the vessel was raised nearly 18 years ago no substantial monograph on the site has been published. Students of historical shipbuilding must, unfortunately, turn to popular works for specific information regarding the ship’s construction.207

206 Rule, The *Mary Rose*.
Construction of Mary Rose

Like most ships built in England in the medieval and early modern periods, Mary Rose is constructed almost entirely of oak. The keel, a timber preserved to a length of 32 m., is the major exception and is of elm.\(^{208}\) The shell of Mary Rose is constructed of carved planks. These are fastened to the frames using wedged treenails. At the ends of planks, boards are secured to frames with iron bolts.\(^{209}\) Below the waterline, “chamfered seam ribbands” covered planking seams.\(^{210}\) These battens are similar to those seen on the Woolwich ship and served either to secure caulking in the seams, making the vessel more watertight, or, in Rule’s view, served as “part of this secondary strengthening necessary to reinforce a weakened and deteriorating hull.”\(^{211}\) A portion of the sterncastle fortunately survived. In this part of the ship, internal planks are laid overlapping one another in a clapboard manner. Although Rule states that this was “clinker planking,” she makes no mention of caulking or edge fasteners. The construction of the superstructure had little to do with the overall integrity of the hull, though. In no way did it have anything to do with the watertightness of the ship.\(^{212}\)

Because the hull of Mary Rose is being conserved completely intact in a purpose-built berth in Portsmouth, no disassembly of her structure has been permitted. For this reason, it is difficult to know some important information about the construction such as whether frames were secured to the keel or how framing members were fastened together. Chris Dobbs of The Mary Rose Trust has indicated that some frames appear to have hooked scarfs between floors and futtocks.\(^{213}\) Such “knuckled” scarfs have also been seen on the sixteenth century ship found at Yassi Ada and the sixteenth century Villefranche ship found near Marseilles.\(^{214}\) It is unclear

\(^{208}\) Steffy, Wooden Ship Building, 141.
\(^{209}\) Rule, The Mary Rose, 105.
\(^{210}\) Ibid., 106.
\(^{211}\) Ibid.
\(^{212}\) Ibid. When referring to this structure, Rule further states, “[T]here was some evidence to suggest that a light internal planking had been used to give added strength without seriously increasing the weight of the superstructure.” She does not, however, state what this evidence is. Moreover, on page 22 of her work, Rule, in speaking of the excavation of the Woolwich ship says, “As with the Mary Rose, there was clear evidence that clinker planking had been removed and that notches in the frames had been adzed smooth and carvel planking added in its place.” While I agree with Rule’s assessment of the Woolwich ship – that it had originally been built clinker and was rebuilt carvel – I believe her assertion regarding planking on Mary Rose refers only to the upper portion of the vessel. Rule’s use of the term “clinker planking” in this circumstance is misleading. The planking of the upper structures would more properly be termed clapboard rather than clinker. Also, there is no evidence that lower portions of the hull of Mary Rose was ever clinker planked.
\(^{213}\) Dobbs, “Recent developments,” 108.
\(^{214}\) Steffy, Wooden Ship Building, 134.
whether floors and futtocks are fastened together at these joints with longitudinal fasteners as was common on the latter two ships and on ships built in Iberia at about the same time.

Ceiling planking and “thick stuff”215 – stringers placed at about the turn of the bilge and running the length of the ship – cover the inner faces of the frames. It is quite tightly fit and extends from the centerline of the ship past the turn of the bilge. The only area of framing and outer planking uncovered by ceiling planking is found immediately around the mainmast step. The ceiling, and in particular the thicker footwales must have contributed substantial strength to the hull. In many respects it can be seen as analogous to the longitudinal stringers that lay above the heavy internal riders in the hull of the Woolwich ship. It has also been suggested that footwales served to secure floor timbers to first futtocks.216 As in the Woolwich ship, there are internal riders spaced at intervals of about 2.5 to 3 m. above the ceiling planking. Remains of up to eleven of these timbers were discovered. They were “compass-grown” and were fitted over the keelson and footwales. The timbers are securely fastened to the keelson, footwales and frames with treenails and iron bolts. Dendrochronological analysis of two of the timbers have given dates of 1522 and 1523, indicating that the riders discovered in the hull when the ship was raised, were not a part of the original construction.

Above the first longitudinal stringer above the heads of the transverse riders (apparently this is the third stringer from the centerline of the ship), run “a series of diagonal braces.”217 These run through the orlop deck, to a point immediately beneath the main deck beams. Rule states that the diagonal braces, like the riders, are “securely fastened to the keelson, footwales and frames.”218 This feature, which is common on ships in the seventeenth and eighteenth centuries is unique among vessels that have been excavated which date to the sixteenth century. Like the riders, dendrochronological analysis of the timbers has indicated that many were inserted into the ship at some point after the original construction.219 Rule states that “slipshod carpentry” and “casual alignment” indicate the feature is probably not a part of the original construction. “The political and military exigencies of 1536 may have left little time for a full rebuild and the work may have been limited to adding internal hull stiffening and replanking the hull with carvel

217 Ibid., 108.
218 Ibid., 106.
219 Dendrochronology has dated three of the timbers to 1526, 1528 and 1530, Dobbs, “Recent developments,” 108.
Regardless, the use of diagonal braces is an example of experimentation by builders attempting to strengthen a ship’s hull. The feature illustrates the latitude builders were given in the implementation of new ideas. It is particularly pertinent in an age when the king, or at least the king’s agent, was very involved in all aspects of a vessel’s construction or reconstruction.

The sides of the ship are secured together with deckbeams on many levels. Unlike beams found in earlier medieval vessels, deckbeams of the *Mary Rose* were not throughbeams. They are fastened to the sides of the hull with heavy hanging and lodging knees. Such methods of fastening were common on ships in the modern period. In 1995, Dobbs published information on dendrochronological analysis of many of the deckbeams. His work states that most date to well before the original construction of *Mary Rose*. One beam was likely replaced in the 1536 rebuild. It was offset in the hull from other timbers that supported the main deck and had a cutting date, as indicated by the presence of bark, of 1535.

The mainmast was stepped between riders five and six. The step is a thickened portion of the keelson. Forward of the step the keelson measures 40 cm. sided; aft it measures 48 cm. sided. The thickened portion of the keelson, that forms the step, is approximately 2.7 m. long has a maximum siding of 76 cm. Cut into the step were two mortises, one 30 cm. by 70 cm., into which the heel of the mast would have fit, and a second, 10 cm. by 2 cm. to hold a locking piece. Aft of the maststep was found a box-like structure that formed the base of the ship’s pump well. No evidence of either the mainmast or pump was found. It is thought they were removed shortly after the ship sank. A spare section of pump shaft was found in an aft storage compartment. The section is similar to a shaft found on the *San Juan*, a Basque whaling vessel excavated in Red Bay, Labrador that sank in 1565.

Because of the enormous quantities of artifacts discovered on *Mary Rose* and because of the fine preservation, the ship is a valuable resource for determining the way that an early ship-of-war operated. Space in *Mary Rose* can be divided into five distinct areas or decks. The lowest area was the hold, which was used primarily for stowage of ballast, consisting mostly of flint. Ballast was found in several compartments separated by light bulkheads. The brick galley, also

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220 Such a project sounds like a complete rebuild and extraordinarily labor intensive. No information regarding dendrochronological analysis of exterior planking has yet been published. Rule, *The Mary Rose*, 106.
221 Ibid., 109.
223 Ibid., 116; Grenier, “Basque Whalers,” 76.
in the hold, was located immediately forward of the mainmast step and extended into the orlop
deck above. Additionally, the hold was used for storage of spare cable, firewood and barrels of
wood tar. Remains of several men found lying on the flint ballast indicate, that at the time of the
ship’s sinking, the deck was being used as a sick bay.

Above the hold was the orlop deck, which “was inserted as a tight fit after loading ballast
and other heavy stores into the hold.”225 The deck was, in other words, removable and only
lightly fastened to other structural members of the vessel’s hull. It was used for equipment
storage, including bosun’s stores, spare parts for gun carriages and bows and arrows. The crew’s
personal effects were found in the orlop. Several seamen’s chests and officer’s possessions, such
as plates and tallow candles, were recovered there.

The main gun deck had ports for at least seven guns. Four guns were recovered from the
waist of the ship; their muzzles run out through open gunports. Three other guns, found at
purpose-built gunports, were revealed further aft. The deck had quarters for officers forward and
for idlers aft. Among the cabins aft was that for the barber-surgeon. The construction of the deck
was robust with particularly heavy lodging knees; “the whole structure was strong and sound.”226

Heavy guns were also placed on the upper or weather deck. These were fired over the
caprail, above which was discovered a series of blinds. Blinds were constructed of lightweight
boards to protect gunners and archers from small arms fire and from the sea. Only one gun,
found concreted to one of the spare anchors, was recovered from the weather deck. Others were
likely salvaged by the Deane brothers in the 1830s, or by Venetian salvors shortly after the ship
sank. A number of hatches on the weather deck allowed air to circulate into the lower decks. It
was on the upper deck that water pumped up from the bilge, spilled out on to the deck and was
carried off through a “daile” to a chute below the chainwale.227 The daile suggests that pumping
machinery was located on the upper or weather deck, as well.

In the after portion of the vessel was a half deck. The planking in this section of the ship
was relatively light, barely 5 cm. thick. At the forward end of this part of Mary Rose was
discovered a wrought iron cannon aimed forward over the waist of the ship. A number of
gunports, with no evidence of lids, were cut in the side of the ship between longitudinal stringers.
Above the half deck was the castle deck that in later centuries was called the quarterdeck. Little
of this part of the ship remained, but a bronze cannon made by John and Robert Owen was found

225 Ibid., 117.
226 Ibid., 120.
227 Ibid., 124.
leaning against a starboard stringer. Because of the way the ship settled on the sea floor, much of the rigging, including blocks, deadeyes, lanyards and other associated ropes, was preserved in this section.

**Significance of Mary Rose and the Woolwich Ship**

At the time the vessels described were being built, shipbuilders were subject to previously unknown demands. The end of the middle ages is usually marked by the end of feudalism; by the end of a provincial social structure. More importantly, the end of the medieval period is marked by the rise of commercialism and by the birth, or, perhaps more precisely by the rebirth, of technologies of trade and exchange. These came to northern Europe by way of Mediterranean Europe. In addition to technologies of trade and exchange such as double-entry bookkeeping and nautical insurance, the Mediterranean transferred military technologies gleaned from trade with the East to northern Europe. Among these was knowledge of gunfounding.

Among the most important aspects of the ships described, is that they were built at a time when shipbuilders were struggling with the limitations of their craft as a result of the introduction of these technologies. The ships were built when the nature of warfare at sea was increasingly dependent upon such weapons. Recently, Ian Friel has put forth one of the common arguments that has been made for decades regarding the transition from clinker to carvel shipbuilding. Friel states:

> An analogous situation [to the Mediterranean development of skeleton construction in response to economic factors] seems to have existed in fifteenth-century England, where clinker construction was becoming much more expensive, in terms of wage costs and the relative costs of iron nails. Skeleton construction seemingly offered an alternative requiring fewer skilled men and used a cheaper method for holding the hull together.  

Friel makes this statement, I suspect, because he is more familiar with documentary sources than with the archaeological record. *Mary Rose* and the Woolwich ship are the only two vessels that have been excavated that date to the critical period of the early sixteenth century that were even partially complete above the bilge. The lower hull construction, similar in each of the two ships, illustrates that Friel’s assessment is too simplistic.

In the case of each ship, ceiling, flush laid, extended from the keelson to above the turn of the bilge. On top of the ceiling were substantial riders, regularly spaced along the length of the ship. Each vessel also had a series of large stringers at several levels past the turn of the bilge. In

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the case of the Woolwich ship there is evidence for at least two sets fastened over the tops of the transverse riders. In *Mary Rose*, stringers were fastened to the frames themselves, above the ends of the transverse riders. The riders extended only to the turn of the bilge. It has been suggested that these “massive hold stringers” served to hold the floors and first futtocks in place.\(^{229}\)

Considering the dendrochronological date of the riders, the stringers may have been original to the construction of the ship and the riders a secondary strengthening feature placed there during a rebuild. Such a situation might explain why the riders only extend to the turn of the bilge. The existence of the riders, I feel, defines the transitional nature of the ships. They were included in construction specifically because the vessels were intended to carry heavy artillery permanently; the vessels were, after all, ships-of-war.

Each framing element, in and of itself, would have strengthened the structure of the ship. All elements found together in two vessels built at similar times indicates the necessity for considerable added strength. The most likely explanation for the discovery of all elements in two vessels, intended for war, is that shipbuilders knew heavy artillery, the principal burden of each of these ships, placed stresses on the hull quite different from those to which merchant ships were subject. We have no reason to believe that heavy artillery used on Iberian vessels at about the same time sat on deck for the entire journey to the New World or to the Indian Ocean. Archaeological evidence suggests guns were carried in the hold until they were necessary. Only then were guns brought up on deck and strapped into carriages.\(^{230}\) Similarly, galleys, the principal ships of war in the Mediterranean, did not mount heavy artillery over the sides. Rowers maneuvered such vessels to bring to bear heavy guns concentrated in the bows.\(^{231}\) It was primarily in northern seas that artillery was, of necessity, permanently placed on the broad upper decks of ships.

It is difficult to say what the stresses would have been on a clinker-built ship that carried heavy artillery on main decks without benefit of archaeological example. I suspect that damage to the hull would have been most noticeable at the turn of the bilge where floors and first frames met. This would explain the presence of the stringers in both ships described. In time, the quality and strength of scarfs between framing members improved and the size of the timbers themselves became greater. However, in the Woolwich ship we see oblique scarfs similar to those used in

\(^{229}\) Dobbs, “Recent Developments,” 108.
\(^{230}\) Smith, *Vanguard of Empire*, 165.
the “Copper Wreck,” the Aber Wrac’h wreck and the Riddarholm ship. The heavier structure of the lower hull compensated for the increased stress of heavy artillery. Such structure is only evident through analysis of the archaeological record, and runs contrary to Friel’s argument that carvel shipbuilding techniques were adopted largely due to economic factors. The added cost of ceiling planking, riders and longitudinal stringers in addition to the cost of the manpower required to shape and fit such features cannot have been more economically beneficial than building a clinker hull. I contend that such structures were included specifically to compensate for the stresses placed on the hull from heavy artillery carried on decks.

Such features are not unique to these ships. In Mediterranean and Iberian ships, flush laid ceiling planking from keelson to the turn of the bilge was standard. Later the feature became standard on northern European ships built using carvel methods. However, in the Riddarholm ship, built at about the same time as Mary Rose, there is no indication of ceiling. This suggests that its use was not common on all ships built in northern Europe at the time.

The use of heavy riders over the top of ceiling planking is also found in a number of other ships from the early modern period. The Katthavet 3 vessel excavated in Stockholm in 1915 and dated to the second half of the sixteenth century has flush ceiling planking and evidence of at least two riders over the tops of the ceiling.232 Evidence of a vessel with heavy riders has recently been found on the Island of Terceira in the Azores. Although the excavators believe the vessel dates to the late sixteenth century, was somewhat smaller than either Mary Rose or the Woolwich ship and was built in Iberia, many features are similar to those seen on both English ships.233 Another Swedish ship, Vasa, the great warship that sank on its maiden voyage in 1628, has similar riders. The vessel was modified after it was designed, when King Gustav Adolphus

232 Nils Lithberg, “Fartygsfyndet I Kvarteret Näckström No. 1. Ett bidrag till Norrmalms äldre topografi,” S:t Ericks Årsbok 1 (1917): 1-35. See in particular, fig. 5, p. 11. This ship was preserved to a length of 7.60 m. and had an estimated maximum breadth of 6.55 m. The excavator estimated, based on the location of the maststep, that the vessel would have had an overall length of around 17.80 m. Although the vessel was considerably smaller than the others considered here, there was a gun chamber discovered. The chamber measured 53 cm. long and accommodated a shot of around six cm. in diameter. None of the vessel was preserved above the turn of the bilge. Among the most noteworthy features was the ship’s extremely flat bottom. Apparently a portion of this ship is still stored in the basement of the Stockholms Stadsmuseum, Cederlund, Wrecks of the Baltic, 90.

233 Paulo Monteiro and Catarina Garcia, “Angra D: A shipwreck from Angra Bay, Azores Islands,” paper presented at the International Symposium for Ibero-Atlantic Ship Archaeology of the Medieval and Modern Epochs. Lisbon, June 1998. The excavators say that the riders were 40 cm. moulded and 25 cm. sided and were spaced approximately 1.5 m. from each other through the length of the hull. They also note the use of dovetail scarfs to fasten the futtocks to the floors of seven central frames, suggesting that “they were preassembled before being placed over the keel.”
ordered it carry 64 heavy guns rather than the 52 for which it was originally designed. Builders who knew that the increased weight of artillery must be compensated for in the lower hull may have inserted heavy riders as a result of the demands made by the king. One of the ships found near Cape La Hogue on the coast of Normandy, that was sunk during battle with the English in 1692 also has similar riders.\textsuperscript{234} In the case of the French vessel, designated Wreck E and thought to be \textit{Ambitieux}, launched shortly before the battle, each rider consists of two timbers. The structural components are spaced more closely in the forward and after portions of the hull than they are amidships. If the ship is, in fact, \textit{Ambitieux}, a ship that was described contemporaneously as having had an innovative form of construction, one must assume that structure was original to the ship since it had only recently been launched when it was sunk. One must note, however, that Veyrat and L’Hour indicate that the vessel “shows a very early example of a framing system based on double frames.”\textsuperscript{235} It could be that the use of double riders was part of the innovative nature of the construction.

Innovation did not begin in the early modern period. However, I feel it was in that period that demands by the crown to accommodate as much heavy artillery as possible were most profound. As evidenced by archaeological examples, one can see that northern builders used every trick in their bag, so to speak, to strengthen vessels sufficiently both to cut gunports in the sides and to create hulls capable of accommodating heavy guns. They did this at a time when naval architecture was still in its infancy throughout Europe and essentially nonexistent in the North. The Woolwich ship and \textit{Mary Rose} demonstrate that builders, nevertheless, had a firm understanding of the stresses the sea placed on hulls. They also show that shipbuilders understood that heavy artillery on decks caused vessels to behave and age differently. The features of lower hull construction seen in \textit{Mary Rose} and the Woolwich ship are the attempts of builders to compensate for such stresses.


\textsuperscript{235} Ibid., 27.
CHAPTER SIX: The Arrival of Carvel Construction

The Cattewater Wreck: History of the Site

On June 20, 1973, while working to dredge deeper channels for air-sea rescue craft, the Anglo-Dutch dredger Holland brought up timbers and fragments of two guns from the bottom of the Cattewater, the last stretch of the River Plym before it empties into Plymouth Sound. As a result of the discovery, considerable interest was immediately focused on the site. The site was placed under an emergency designation restricting access. Later the same year, the site was investigated and determined quite important. The wreck that was found was the first to receive official designation under the Protection of Wrecks Act of 1973.

In 1974 the Cattewater Wreck Committee was formed. In 1975 a group led by Lt. Cdr. Alan Bax succeeded in relocating the site and confirmed its value for archaeological investigation. The Cattewater Wreck Committee invited the Underwater Research Group of the Institute of Archaeology, University of London to investigate the vessel over three summers from 1976 to 1978. Investigations were led by Martin Dean in 1976 and by Mark Redknap and Berit Mortlock in 1977 and 1978.

The remains are those of a merchantman or small military vessel. The ship when afloat would have had an overall length of around 20 m. Investigators have estimated a burthen of 200 to 300 tons. Most of the evidence indicates the vessel sank sometime in the early sixteenth century, possibly around 1530. But the vessel has proven something of an enigma. Little information has been recovered which would allow a specific date or cause of sinking to be postulated. Also, archaeologists have had difficulty stating for certain that the ship was constructed in England or in somewhere else in northern Europe.

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Construction of the Cattewater Ship

The keel of the ship was of oak and was preserved to a length of 1.35 m. The section recovered is thought to have sat beneath the floors numbered by the excavators 13 to 15. At the northern end the timber was badly damaged as a result of dredging. The top of the timber had a siding of 21.5 cm between garboards. If one estimates an additional eight cm. for garboard rabbets, the timber had an overall siding of 29 to 30 cm. The timber is thought to have been originally square in cross-section. Such a shape would have given it a similar molding when the vessel was constructed. The bottom of the timber, however, was heavily abraded and as much as a third of the original molded dimension may have been lost over the years. From drawings, one can estimate that the keel had a maximum preserved molding of around 25 cm.\[^{237}\]

Floors were converted from naturally curved oak limbs. Each had a square limber hole offset to one side where it met the keel. Each floor was fastened to the keel with a single treenail located towards the side opposite the limber hole. The timbers were sided 18 to 22 cm. and molded between 20 and 27 cm.\[^{238}\] At the ends, frames were attached to futtocks with dovetail scarfs secured with treenails.\[^{239}\] The scarfs were about two cm. deep. Such scarfs closely parallel those found on the Highborn Cay, Molasses Reef and Red Bay shipwrecks and are generally associated with Iberian shipbuilding of the sixteenth century.\[^{240}\] In such vessels a midships frame can frequently be postulated based upon whether scarfs were carved on the forward or after side of the frames. As floor timber F20 has scarfs and first futtock attachments on both sides, Redknap suggests it may be the midships frame.\[^{241}\] Such an arrangement of scarfs created “a continuous belt of timber”\[^{242}\] at the about the turn of the bilge. Also, the fact that frames and futtocks were securely fastened and that floors were secured to the keel indicates that the ship was

\[^{237}\] Redknap, *Cattewater Wreck*, 96.
\[^{238}\] Redknap, “The Cattewater Wreck,” 42.
\[^{240}\] Oertling, “1986 Field Season,” 250; Oertling, “Molasses Reef;” Grenier, “Basque Whalers;” Steffy, *Wooden Ship Building*, 129-141. Although Redknap states for certain that the joints were of the dovetail kind found on vessels of Iberian origins, and he reconstructs them in a similar way, I am not certain if such was, in fact, the case. In none of the drawings or photographs of timbers raised from the wreck is it clear to me that the scarfs were true dovetail joints. They appear to more closely resemble those found on *Mary Rose* or on the sixteenth century Yassi Ada vessel. Without personally examining the timbers, though, we must accept the principal investigator’s interpretation.
constructed frame-first. Redknap states this specifically: “The vessel is skeleton-built, with no sign of refit from clinker.”\(^{243}\)

Planking, including garboards, was of oak. Boards were sawn to a regular thickness of between 6 and 7 cm. and varied in width between 24 and 32 cm.\(^{244}\) Planking was fastened to frames using both treenails and iron nails or rivets driven from the outside to the inside of the hull. Usually there were two treenails and one iron fastener per strake per frame. Treenails had a diameter of 2.7 to 3.2 cm. and nails or rivets had a shank about 8 mm. square. Redknap states that the use of multiple fasteners on the Cattewater Wreck “might be understandable in a skeleton built boat undergoing construction soon after the introduction of the technique.”\(^{245}\) He also offers the possibility that iron nails served as temporary fasteners that held planks to frames while treenail holes were being bored. Only a small sample of caulking was recovered. There were no battens found over outside seams for the purpose of holding caulking between planks. However, nail alignments on two of the planks recovered suggested the possibility of such pieces. There was also evidence of “tar-luting,” consisting of a mixture of tar and hair,\(^{246}\) found in areas where frames lay against outer planking.

Above the frames was a keelson or maststep. The timber was raised in 1973 before archaeologists using careful recording techniques were brought on to supervise the project. It is difficult, therefore, to say for certain where the timber was positioned in the hull or which end faced forward and which aft. Redknap estimates that the step portion of the 4.6 m. long oak timber would have lain over frames 20 to 25.\(^{247}\) The maststep was notched to fit over the frames (14 notches along the length of the timber) and was fastened to the keel with three iron bolts.\(^{248}\) At its largest point, the step is sided 54 cm. and molded 40 cm. The sided dimension decreases to 40 cm. in an area where a tapered elliptical hole was cut to accommodate a pump tube. The mortise for the heel of the mast is cut in the step’s widest and thickest section. The mortise is 15 cm. deep and 33 cm. wide. It is impossible to know how long the mortise was, as one end is abraded away.

Ceiling planking was found on the preserved side of the wreck stretching from the keelson to about the turn of the bilge. Boards used for ceiling were of both pine and oak and

\(^{243}\) Redknap, “The Cattewater Wreck,” 40. 
\(^{244}\) Redknap, *Cattewater Wreck*, 23. 
\(^{245}\) Ibid., 34. 
\(^{246}\) Redknap, “The Cattewater Wreck,” 43. 
\(^{247}\) Ibid., 42; Redknap, *Cattewater Wreck*, 30. 
exhibited a much more varied degree of thickness, from three to seven cm., than external
planking.\textsuperscript{249} One plank, IP4, had no fasteners holding it to the frames. It is likely that it served as
a limber board. Although Redknap is not specific on the point, ceiling was apparently held to
frames using both treenails and iron fasteners. The three uppermost boards of flush laid ceiling,
P6, P7 and P14, are notched between futtocks on their uppermost edges in order to receive short
filling pieces, which were of pine. Filling pieces prevented material from falling into the bilge.\textsuperscript{250}
Further up the side of the vessel, archaeologists found evidence of a longitudinal stringer
represented by boards P8 and P15. At 6 cm., these were the thickest of the boards used for
ceiling, indicating they were likely intended to add additional longitudinal strength to the ship.\textsuperscript{251}

The ship was discovered virtually empty. The hold was ballasted. The material that can
be securely identified as having been in the ship at the time of her sinking has been associated
with an area near the Severn Estuary and the southwest coast of England, possibly in Dover or
near London. Three guns were found with some partially melted brass artifacts recovered that
suggest the vessel was either damaged by fire, possibly hastening her demise, or that shot for
guns might have been cast on board. Other evidence to support the scenario of the ship’s sinking
as a result of fire, such as charred timbers, does not exist.

\textit{Origin and Dating of the Cattewater Wreck}

Historical documents examined to determine a possible name and date for the sinking of
the Cattewater Wreck have proven inconclusive. The vessel was not likely an important ship in
her day, and it is possible that she was of foreign origin. The destruction of such a ship could
easily have gone without notice in the historical record. However, Mark Redknap has been able
to suggest several possibilities dating from 1497 to 1638. The case he feels is most likely, is that
of the \textit{St. James}. The vessel, which is described as “\textit{ex partibus hispanis},” broke up on shore the
night of January 17, 1497 after having lost all her rigging in a violent storm in Plymouth
Harbor.\textsuperscript{252} Although size, structure and armament recorded in the documentary record for the
ship seem similar to equipment discovered on the Cattewater Wreck, the date is somewhat earlier
than suggested by other evidence. It should be noted that of the 13 other possibilities put forth by
Redknap, the other two earliest, dating to 1540 and 1575, have Iberian connections. In the

\begin{flushright}
\textsuperscript{249} Redknap, \textit{Cattewater Wreck}, 23. \\
\textsuperscript{250} Redknap, “The Cattewater Wreck,” 42. \\
\textsuperscript{251} Redknap, \textit{Cattewater Wreck}, 36. \\
\textsuperscript{252} Redknap, \textit{Cattewater Wreck}, 98-103.
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absence of better sources, it is to the archaeological material that one must turn to formulate a potential date and place of origin.

Dendrochronology, frequently the best method for placing a date and location on timber used in the construction of a ship, has proven unsuccessful in the case of the Cattewater Wreck. Artifacts suggest a date in the first half of the sixteenth century and are generally attributed to northern European sources. The three pieces of artillery recovered are very similar to one another and may have all been constructed in the same foundry. The guns found on the Cattewater Wreck are of a type Robert Smith calls a serpentine. They first appear in the middle of the fifteenth century and occur in inventories of the Tower of London only up until 1523. Serpentes were going out of use in King’s ships by the middle of the sixteenth century. Based upon the evidence of the guns, Smith suggests that Redknap’s date of 1530 seems accurate.

The Villefranche Wreck: History of the Site

On April 6, 1979, Alain Visquis discovered the remains of a large ship in 18 m. of water during a survey in the roadstead of Villefranche-sur-mer near Nice on the French Riviera. The site was referred to the French Administration of Maritime Affairs that oversaw seven seasons of excavation and examination of the site from 1982 to 1988. Max Guérout directed excavations, while responsibility for analysis and recording was in the hands of Eric Reith.

When excavation began, it was clear that considerable material was covered beneath sediment on the sea floor. The vessel lay on her port side with the bow facing almost directly south. Hull remains were preserved to a length of almost 30 m. and to a width of nearly 8.5 m. Evidence of at least two decks above the hold was apparent. Due to the enormous scope of work, it was determined that the best approach would be to excavate a transverse section of hull completely each year. Such a method would not permit the best overall picture of the vessel and its contents, though. The method would, however, allow a general view of the way that space was divided in the vessel and quickly expose portions of the hull to allow analysis to begin.

Details of the construction of the Villefranche shipwreck have been adequately detailed in Archaeonautica 9, which was devoted to the site and its excavation. The authors, Max

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253 Ibid., 113.
255 Max Guérout, Eric Reith and Jean-Marie Gassend, “Le Navire Génois de Villefranche: un naufrage de 1516?” Archaeonautica 9 (1989). Unless otherwise noted all information on the Villefranche ship was gleaned from this publication.
Guérout, Eric Reith and Jean-Marie Gassend conclude that the remains were those of a Genoese cargo carrier that sank in the first quarter of the sixteenth century. However, there are certain elements of the ship’s construction and armament that, I feel, illustrate the direction in which northern European ship construction went in the middle decades of the sixteenth century.

**Construction of the Villefranche Vessel**

During the 1984 season, an after portion of the keel assembly was found near the hull. The assembly was of oak, and measured 6.9 m. It consisted of the aftermost part of the keel surmounted by a piece of deadwood. At its forward end the assembly had a molded dimension of 42 cm. The after end had a molded dimension of 90 cm. and a rabbet into which the sternpost would have fit. The maximum sided dimension was at the bottom of the garboard rabbet where the timber measured 28 cm. The piece of deadwood measured 4.75 m. long and was secured to the keel with six iron bolts, measuring 3 cm. in diameter. At its forward end, the piece of deadwood had a hook scarf to accommodate the after end of the central portion of keel. The forward portion of keel was no longer attached to the composite after section.

Framing members were all of oak. Although sizes varied somewhat, molded and sided dimensions were 20 cm. by 20 cm. for most timbers. Where floors were in contact with the keel, they were far thicker, sometimes with a molded dimension of as much as 45 cm. Not all floors were fastened to the keel. This would suggest that not all frames were standing when the ship was planked. Framing members were fastened with “interlocked or knuckled timber connections at the wrongheads.”

Such joints were similar to the dovetail scarfs seen on the Molasses Reef, Red Bay and Highborn Cay wrecks, in that they required the cutting of mortises in order to fasten the framing members to one another. Also as on the three wrecks mentioned, scarfs on the Villefranche ship were secured with horizontal iron fasteners holding the members together, usually two per joint. There is a master-frame in the Villefranche ship located at floor 59. This timber has first futtocks attached both fore and aft. Forward of this floor, first futtocks are attached against the forward face of the frame while aft first futtocks are attached to the after face.

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257 Similar scarfs are seen on the Angra D wreck built at the end of the sixteenth century, Monteiro and Garcia, “Angra D.”
258 Guérout et al., “Le Navire Génois de Villefranche,” 47.
of the floor. The arrangement is similar to that evident on the sixteenth century ship found at Yassi Ada.\textsuperscript{259}

An interesting aspect of the framing of the Villefranche ship is that there appears to be little regularity to the way framing members were selected and fastened. Not all floors, for instance, are attached to the keel; not all joints between framing members had tenons cut.\textsuperscript{260} In fact the length of floors and of first and second futtocks was rarely regular. This would suggest that the shipbuilders understood that a substantial amount of framing was necessary. It was unlikely, though, that there was much standardization of the shapes provided to the building yard. The fact that not all floors were attached to the keel suggests that only those frames erected first gave the vessel its shape. The form of such master frames must have been predetermined indicating a degree of planning that in other ships has been interpreted as early evidence for naval architecture.

Planking was of both oak and two species of pine native to the Mediterranean, indicating that the vessel was likely built in the region. The placement of strakes of different species in the planking shell was deliberate. Oak was used in those areas where framing members overlapped. Strakes 7 and 9, where floors overlapped first futtocks, for instance, were of oak. It was the same for strakes 17 and 19, where first and second futtocks overlapped, as well as for strakes 26, 27 and 28, where second and third futtocks joined. Oak strakes were not as wide as those of pine, averaging only 21 cm.: pine strakes averaged 28 cm. Strakes were held to frames with iron nails with shanks of 1 to 1.5 cm. square. Two nails were used per strake per frame. Boards used for strakes were butt-jointed.

Internal structural elements include a complex maststep assembly, ceiling, stringers, footwales and the many elements of the various decks. The maststep assembly consisted of the keelson, substantial port and starboard sister keelsons, crutches and supporting riders. The keelson was fairly insubstantial. It was preserved to a length of 3.7 m. and badly abraded at its after end. The timber would originally have had a molding around 25 cm. and siding of about 27 cm. It was slightly notched to fit over the floors and was fastened at each surviving floor – with the exception of floor 61 – with a 3 cm. diameter treenail. Additionally, the keelson was fastened to floors 63, 65 and 66 with an additional iron nail with a 1 cm. shank.

\textsuperscript{259} Steffy, \textit{Wooden Ship Building}, 134.
\textsuperscript{260} Guérout et al., “Le Navire Génois de Villefranche,” 46-7.
On the port side of the keelson was found a larger sister keelson. This timber sat over frames 60 to 70 and was preserved to a length of 5.08 m. The sister keelson had a maximum sided dimension of 30 cm. and a maximum molded dimension of 40 cm. The timber was not secured to the frames. Rather, it was held in place using crutches and supporting riders. Crutches were carved to fit against the ceiling and hold the sister keelsons in place. They varied in size. Supporting riders were mortised into the sister keelson and were held at either end with an iron nail. They measured about 10 cm. molded by 15 cm. sided. A second sister keelson must have been situated on the starboard side of the keelson. When complete, the mast assembly would have been planked over with only the central portion of the step open.

The entire hull was ceiled. Incorporated with the ceiling were several thicker stringers and footwales at various locations through the hull. Ceiling strakes 6, 23, 24 and 31 are referred to as stringers. These had an average thickness of 12 cm. (as opposed to 3.5 to 6 cm. for other ceiling planks). Widths varied between 13 and 26.5 cm. Strakes 6 and 23 were of oak while 24 and 31 were of beech. There were also five heavier footwales. These were strakes 5, 7, 13, 20 and 22. All were of oak and were 14 to 15 cm. thick. Widths were between 15.5 and 17 cm. Placement of both stringers and footwales appears to have been deliberate in order to maximize lateral stiffness of the hull. They also served as bases for the stanchions that supported the various decks. Finally, the placement of the footwales corresponds in the hull with the placement of the oak strakes of the external planking shell.

There were three decks. The lowest of these, the *surbau*, was the hold in which the mainmast was stepped and the ship was ballasted. Above the hold was the orlop deck, referred to as the *premier pont*. It was in the orlop that many of the cannon were recovered. Stanchions were mortised into the large deck beams of the orlop. They supported the upper deck or *faux-pont* (false deck).

Numerous artifacts relating to artillery were discovered on or near the Villefranche wreck. Several large concretions were raised, that represent as many as fifteen guns. Unfortunately, only three were described in any detail in the publication. The authors state that all were of similar construction, presumably of wrought iron rather than of cast bronze or iron. In addition, there were vast numbers of shot of iron, stone and lead recovered. Many gun carriage wheels were discovered of six different types. The presence of carriage wheels, which appeared to have been in storage rather than in use, suggests some of the artillery was intended to be used by an army campaigning on land, rather than on a ship.
The three guns described were found together in the central portion of the hull and were likely used for naval defense. Two guns, CN 14 and CN 10 were found still in their carriages. The third, CN 11 was little more than a wrought iron tube. CN 14, the best preserved of the three, was discovered on the upper or false deck lying in a heap of shot. The forged tube measured 1.58 m. and had a caliber of 14 cm. The carriage had an overall length of 3.32 m. The tube of the gun took up the front 1.37 m. of the carriage. Behind the tube there was a 47 cm. long space for a powder chamber, which was not extant. This weapon fits the description of a basic tube gun, without the chamber.\(^{261}\) CN 10 was similar to CN 14.\(^ {262}\)

The second cannon described, CN 11, is a bombard type classified as a CM2 (chambered muzzle-loader) according to Robert Smith’s typology.\(^ {263}\) It had a total length of 1.53 m. and a caliber of around 24 cm. The powder chamber has a smaller diameter, 28 cm., than that of the tube, 33 cm. The gun is similar to at least one other gun found on the wreck, A 51.\(^ {264}\) Based upon their sizes, several other concretions may represent the remains of swivel guns. These artifacts, CN 1 through CN 5, were found in areas on the seafloor where they may have fallen from upper deck structures as the hull broke up on sinking. Unfortunately, the remains were either too poorly preserved or deemed too insignificant to publish.

**Date and Identification of the Villefranche Wreck**

Based upon the evidence of the wood used to build the ship and analysis of the ballast, that came from somewhere along the Riviera, archaeologists determined that the ship originated near Genoa in the first quarter of the sixteenth century. Other artifacts such as coins and pottery support such the identification. Two coins, in fact, provide a *terminus post quem* for the site of 1503. Also, a majolica jar was discovered decorated with the coat-of-arms of the prominent Fregoso family of Genoa.

This information led archaeologists to a document search of the archives of Nice, Genoa and Villefranche. Based upon records discovered in the archives, the site has been tentatively identified as that of the *Lomelina* that was lost in a storm in the port in September 1516.\(^ {265}\) In


\(^{265}\) Ibid., 137-9. The translation in French from Latin is, “...coulée par un très fort coup de vent dans le port de Villefranche.” All of the information in the paragraph is from the same source.
several documents the *Lomelina* is described as a *nave* that at the time suggested a vessel of over 400 tons capacity. The average size of *naves* in the Genoan fleet in 1509 was 700 tons. On one occasion shortly after the sinking of the *Lomelina*, officials in Nice requested permission to salvage guns from the wreck. Their request was responded to with protests from Genoan officials, including Ottaviano Fregoso, the Governor. One might assume that Fregoso was of the same family represented by the coat-of-arms discovered on the majolica jar found on the wreck. Finally, there is a document which details salvage of several guns from a wreck in the harbor of Villefranche in 1531. It is very possible that those guns were salvaged from the same vessel excavated in the 1980s.

**Significance of the Villefranche and Cattewater Wrecks**

Few good archaeological examples of ships built in England or, for that matter, in northern Europe exist for nearly seventy-five years after the construction of *Mary Rose*. For this reason, examples built elsewhere that represent the direction in which northern European shipbuilding moved must be sought. The Cattewater and Villefranche wrecks were not, I feel, built in northern Europe. Instead they represent examples of ships built around the Iberian Peninsula or in the Mediterranean at the same time as the Woolwich ship and *Mary Rose* were operating in English waters. Nonetheless, they are the two sites of early sixteenth century shipbuilding that most clearly demonstrate the direction in which European shipbuilding developed in the middle fifty years of the sixteenth century.

The most important aspect of the construction of both the Cattewater wreck and the Villefranche Ship is the evidence of pre-erected frames. On both ships this is primarily indicated by evidence of a master frame. In the Mediterranean there is documentary evidence for methods by which the shapes of frames were determined as early as the beginning of the fifteenth century. The earliest archaeological evidence from a Mediterranean vessel is from the eleventh century ship discovered at Serçe Limani in Turkey. One must assume that there was

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266 The two most important documents regarding fifteenth century Mediterranean ship construction are the *Fabrica di galere* and the Timbotta manuscript. Both are of Venetian origin. The former document details, among other things, sets of typical proportions for different types of vessels. The Timbotta manuscript is a rambling document covering many subjects. Shipbuilding is among the issues dealt with. The work tells how to lay a keel and how to determine the curvature of the posts. In addition, it gives a set of instructions on how to determine the shape of the master couple and of other important frames in the hull of the vessel. See Steffy, *Wooden Ship Building*, 93-100; R. C. Anderson, “Italian Naval Architecture about 1445,” *Mariner’s Mirror* 11 (1925): 135-54.

an oral tradition for the determination of frame shapes long before such knowledge was written down. In northern Europe, methods for determining such forms were either unknown or not used. Several sources indicate that the Dutch first attempted carvel shipbuilding in 1438 to 1440 when they disassembled a southern-built caravel in order to learn how the ship was constructed.\textsuperscript{268} Another source states that the first large carvel ship laid down in Gdansk had a keel 55 ells long and was constructed in 1488.\textsuperscript{269} However, none of these sources indicates how the shapes of the frames were determined.

In the case of the Woolwich ship, the archaeological record suggests the original vessel was built clinker. The frames of the clinker ship, after having been disassembled, were used to determine the shape of the rebuilt \textit{Sovereign}. Planking a carvel ship, once the shape of the frames were determined, was not difficult for northern Europeans and there is ample evidence to suggest that repairs of carvel ships that had been built in the South were not uncommon in the North in the fifteenth century.\textsuperscript{270} The difficult proposition was how to determine shapes of frames before the planking shell was erected.

Several features of the Villefranche ship are also important. Although the vessel was carrying a considerable amount of artillery all of the heaviest pieces appear to have been intended for use on land, as evidenced by the existence of numerous large wheels for field carriages. The ship has no indication of gunports. David Loades has stated that he feels that gunports were an English innovation of the early part of the sixteenth century.\textsuperscript{271} The absence of such devices on a vessel carrying an enormously valuable cargo, heavy artillery, seems to support Loades’ opinion. The size of the vessel itself, was likely sufficient deterrence to any ship-of-war that it may have encountered in the Mediterranean at the turn of the sixteenth century, specifically a galley.

Another feature of the ship worth noting is that many different types of wood were used in its construction. In northern Europe, oak was the wood of choice for virtually all parts of a ship as has been seen on the vessels previously discussed. The use of different types of wood

\begin{footnotes}
\footnotetext{269}{Lienau, “Danziger Schifffahrt und Schiffbau,” 79.}
\footnotetext{270}{Friel, \textit{Good Ship}, 172-5.}
\footnotetext{271}{Loades, “Henry VIII: Real Founder?” 174. Many historians of historical shipbuilding have attributed the innovation of gunports to France in the first decade of the sixteenth century. The earliest reference to such an attribution is in Oppenheim, \textit{Administration}, 91. Oppenheim does not cite his source, however, and I have found no earlier reference or traced the original document on which this statement is based. Also note Rule, “Gun-port Lid,” 184, for an example from \textit{Mary Rose}.}
\end{footnotes}
only becomes common later in the modern period. Perhaps this was another innovation brought northwards by those from the Mediterranean.

The most important feature of the two vessels, though, is the importance of the frames to the structure of the vessel and in particular, the way that framing members were joined. In the Cattewater ship and in the Villefranche wreck, although there is still a considerable amount of irregularity to the lengths of framing members, they are, nonetheless, secured in a much better manner than seen on Mary Rose or on the Woolwich ship. The use of better fastening methods for framing members seems to reduce the need for heavy riders in the hold to provide additional strength. Such a practice, in any case, appears to be confined to ships built in northern Europe.272

Ships such as those represented by the remains found in the port of Villefranche and in the Cattewater became, nonetheless, increasingly common in northern waters at the time. The need to build ships that could carry heavy deck loads in the form of heavy artillery was confined not only to northern Europe, but spread to the Mediterranean and Iberia. Although the galley would remain the warship of choice in the Mediterranean until the seventeenth century, the outbreak of the Eighty Years War required that Spain also build ships that could fire a broadside with heavy artillery and weather the difficult conditions of the Atlantic and North Sea. Spanish ships with such capability were a response to hostilities in the Netherlands. In the third quarter of the sixteenth century the Dutch had begun building vessels for the express purpose of preying on Spanish supply ships. As ships that could carry heavy artillery on one or more decks became more common, northern European shipwrights had to learn the methods of pre-determining the shapes of frames before the ship was constructed. Whether the leap was made by examining ships built in the South, or whether information was brought by southern shipbuilders hired to work in northern yards is uncertain. It is likely that a combination of the two served to spread the technology. By the end of the sixteenth century, large ships intended for use over long distances were built in northern Europe using methods similar to those seen in the Cattewater and Villefranche ships.

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272 The Angra D ship that uses both heavy internal riders and sophisticated joinery for framing members is an exception. A preliminary provenance for the vessel was determined based upon the artifacts found within it, not because of the form of the ship’s construction. I remain unconvinced that it was built on the Iberian Peninsula. Monteiro and Garcia, “Angra D.”
CHAPTER SEVEN: Conclusions

For over a thousand years, ship and boat building traditions in northern Europe and the Mediterranean developed separately. This began to change in the thirteenth century as trade patterns increasingly brought northern European and Mediterranean peoples together. Iberian and Mediterranean shipbuilders adopted from the North the square sail and the stern rudder. Forms such as the carrack, which developed in the Mediterranean, were attempts to emulate northern cogs and hulks. They were a product of this technological exchange. Northern merchants borrowed concepts of organization and finance from southerners in the later middle ages, while shipbuilding technology, tended to flow in the opposite direction, that is from north to south.

One of the few aspects of shipbuilding that passed from the Mediterranean northwards was the use of carvel construction techniques. The use of carvel building only became common in northern Europe in the sixteenth century. It is the contention of this study that carvel construction did not become widely used until the technology of heavy artillery aboard ships had progressed sufficiently for its use to be common. Shipbuilders only began to use the techniques after monarchs undertook projects for the construction of vessels that carried heavy artillery. Ships built for such purposes served, not only for trade and coastal defense, but also for monarchical glorification, troop transport and exploration. It was enormously expensive to conduct trade, to raise and transport armies and build heavy artillery. For the most part, it was powerful monarchs, who rapidly gained wealth during the late medieval and early modern periods, who could afford the ships, the ceremony, the heavy artillery and the expertise. Among the most prominent examples of this process was Henry VIII of England.

Henry’s experimentation with forms such as the carrack, the galley and the galleass, was an attempt to determine how guns could best be employed aboard ships. The process of experimentation eventually led, in the middle of the seventeenth century to a degree of

standardization of building practices, ship forms and gun calibers for the Royal Navy. In this work I have sought to augment the enormous amounts of information that have been gleaned from documentary and iconographic sources with an overview of archaeological evidence relating to the early phases of the development of the ship-of-war in northern Europe.

Henry V’s *Grace Dieu* is presented to illustrate an enormous ship that was built in the first quarter of the fifteenth century using clinker construction – albeit a form of multi-thickness clinker building that remains unique in the archaeological record. Such methods were perfectly suited to achieve the purchaser’s – in this case the crown’s – desire; an enormous ship that might intimidate the enemy. One cannot say, though, that the ship was ever particularly successful militarily or commercially. Such shortcomings should be attributed to the limitations of the of sail and rigging technology rather than to the hull construction. Clinker shipbuilding was not, I feel, inherently “better” or “worse” than carvel shipbuilding. *Grace Dieu* is an extraordinarily complex structure that illustrates considerable ability of the clinker shipbuilder at the end of the middle ages.

The Gdansk “Copper Wreck,” the Aber Wrac’h vessel and the Riddarholms ship, all built in a very similar manner at the end of the medieval period, are typical of the ships that would have been commonly hired or seized by monarchs for naval expeditions at the end of the medieval period and into the early modern era. The absence of any artillery on the first two ships, and a limited amount on the third, suggests that at the time they sank, it is unlikely any were being used for military purposes (except, perhaps, the last). When compared to ships of the later sixteenth and seventeenth centuries, monarchs in the fifteenth and at the turn of the sixteenth centuries had few crown-held ships. Most were ordinary vessels, constructed similar to those used by common merchants. When a king required ships for war, usually to move an army or transport supplies, he would requisition or seize merchants’ ships. Seized vessels served only to temporarily augment a monarch’s small fleet. Occasionally such ships would be armed while engaged in the king’s affairs. I suspect that the Riddarholms ship was used in just such a fashion.

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274 By the seventeenth century all of these facets of naval power and organization were well developed. However, Caruana, *History of English Sea Ordnance*, 3, points out that Henry VIII first standardized the calibers of guns in the second quarter of the sixteenth century, probably during one of his reorganizations of the navy in 1528 or 1534. The original shot gages are listed among the king’s effects in the inventory of his goods made upon his death.

275 As noted above, p. 65, Tord Nordberg speculates that the Swedes might well have used the Riddarholm vessel – the only clinker vessel discussed in this work that was found with artillery – during Gustav Wasa’s liberation of Stockholm in 1523. Under such circumstances the ship can be accurately characterized a “ship-of-war.”
Although the vessel did carry ordnance, the size and amount was quite small: guns were not standard equipment on such ships while engaged in ordinary commerce.

*Mary Rose* and the Woolwich ship, represent the first generation of ships built in northern Europe at the beginning of the modern era. They were built largely for military purposes. They were also constructed using methods uncommon for the time for merchantmen. Such ships would more likely have been built using clinker techniques and would have resembled the three ships mentioned earlier. Such a conclusion is evident from the frequent references in historical sources to shipwrights from southern locales hired by the crown to build or modify crown-held vessels. It is likely that references to such craftsmen are frequent in the historical record not because they were common, but because they were uncommon. Moreover, it is likely that they were expensive and, therefore, hired by kings for the building of extraordinary, rather than ordinary ships.

Ships built by Henry VII, James IV and Henry VIII were intended to carry heavy artillery and they had sufficient men and stores to man the weapons for extended periods at sea. Builders had to manage the difficulties of the odd stresses that heavy deck loads caused the ship’s hull. In both the Woolwich Ship and the *Mary Rose*, there is evidence of similar lower hull construction: the use of internal riders and heavy stringers to reinforce framing and ceiling. Such elements, in conjunction with new methods of fastening frames and futtocks, were a response to those odd stresses. Such developments in construction illustrate the ability of shipbuilders to adapt to new conditions brought about by the application of new technology; heavy artillery at sea. Whether northern shipwrights working for the crown made the adaptations or whether it was southern shipwrights hired by the crown to implement such methods – or some combination of the two – remains unclear. I suspect the last proposition is the most likely; to date, no vessel built in the Mediterranean or on the Iberian Peninsula has been found that employs heavy riders over flush ceiling planking.\(^{276}\) Such an arrangement is limited to ships built in northern Europe.

Nonetheless, the use of flush-laid outer planking (carvel construction) was clearly introduced from the South.

The Villefranche and Cattewater ships are watercraft that operated contemporaneously to *Mary Rose* and *Sovereign*. I believe neither is of northern European provenance. They are included in this work for two reasons. First, they illustrate the direction in which vessel construction in northern Europe moved in the sixteenth and early seventeenth centuries, that is,

\(^{276}\) See above, 100n.
towards the use of heavier, pre-erected framing consisting of paired floors and futtocks. Secondly, the presence of a master frame in each differentiates the ships from the others examined in this study. A master frame indicates that builders had a conception of the shape of the hull when the frames were erected. To a certain degree, the shape of pre-erected frames helped determine the form of the hull. Archaeologists and ship historians usually attribute such evidence to Iberian or Mediterranean shipbuilding practices. Archaeological evidence shows that Iberian builders used complicated dovetail mortise-and-tenon joints, fastened longitudinally, to erect pre-formed frames. It remains unclear from either archaeological or documentary sources when such techniques began being used in northern shipyards. At some point, though, builders in northern yards did begin fastening floors to first futtocks and then first to second futtocks and so on. Mediterranean and Iberian shipbuilders clearly used such techniques before their co-practitioners in the North. Framing timbers also got significantly larger in sided dimension. It is not clear that this development began in the South, though. The process will only be revealed through further archaeological exploration.

When this study was originally conceived, I expected the use of heavy framing (riders) within ceiling planking to be the cornerstone of my argument. As this work took shape, though, I found that the use of scarves between floors and futtocks to be equally important to determining a vessel’s provenance and age. I discovered, for instance, that there are lapscarfs between some floors and first futtocks on Mary Rose. Archaeologists were uncertain, though, whether those scarfs were pinned longitudinally. The only way of discovering would have been through a partial disassembly of the boat. Such an eventuality, though, will not happen. The idea that some framing members were fastened together necessitated a reevaluation of some of my ideas.

I believe now that the use of pinned (fastened longitudinally), lapped (fastened transversely on one face per member) or scarfed (fastened transversely on two faces per member) floors and futtocks was the logical progression of techniques as carvel construction become more familiar to builders in northern Europe. Such progression is evident, for instance, in the fastenings holding frames and futtocks together in ships built in the Mediterranean during the medieval period. As ships are excavated that were built in northern Europe during the sixteenth and seventeenth centuries, I suspect archaeologists will observe similar techniques.

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277 Rule and Dobbs, “Recent Research,” 33.
278 Steffy, Wooden Ship Building, passim.
When discussing shipbuilding at the end of the Middle Ages and early modern period, scholars frequently invoke the natural conservatism of shipbuilders to explain change. Scholars too infrequently, in my opinion, discuss the ingenuity and inherited body of knowledge that builders possessed. I am sure that shipbuilders in northern Europe had knowledge of, could repair and probably could build vessels using carvel methods as early as the fourteenth century. Only when builders were required by kings and by the application of new technologies, such as heavy artillery, though, were ships built using carvel methods in the North in any great numbers. Using their ingenuity and innate understanding of the forces that worked on a ship, builders solved the many difficulties they encountered. Stability problems were solved by cutting gunports in vessels with flush-planked hulls. I suspect, moreover, that builders tried to cut holes in clinker hulls as well: it proved too difficult, however. Clinker shipbuilding and heavy artillery at sea, in combination for practical purposes, were incompatible. An alternative had to be found.

The alternative adopted by northern Europeans was, of course, carvel building. However, I suspect that they were much slower in discovering deficiencies in another, perhaps more important aspect of shipbuilding technology; the joining of transverse timbers – scarf technology. An understanding of the importance of developments in scarf technology by northern European builders will, I suspect, be the most significant contribution of this study.

In *Grace Dieu*, there appears to have been no internal construction over the framing. The strength of the ship came largely from the shell and the frames that supported it. If there were additional strengthening timbers higher on the sides of the vessel, such as throughbeams (which, if they existed, must have been massive), they did not survive. Between framing members were relatively inconsequential oblique scarfs. Fasteners holding framing members together were limited to those holding the shell to the frames. They were driven with little regard to overall strength of the entire framing member. By the time of the construction of the Riddarholms ship, the Aber Wrac’h vessel, and the “Copper Wreck,” though, the fastening of framing members to one another and to the shell had become more important. At the very least, some aspects of construction were thought out more carefully before building commenced. Whether a framing piece fit underneath or over a throughbeam, for instance, was clearly the purview of the shipbuilder. Longitudinal stringers over the tops of the frames provided additional strength. It is evident that by the end of the medieval period, builders had come to understand that in order to construct larger ships, even using clinker techniques – a technology that has been characterized as antiquated by many historians – more substantial internal structure was necessary.
The ships characterized in this work as transition vessels, *Mary Rose* and the Woolwich ship, illustrate this development applied to the recently adopted techniques of carvel construction. The most obvious indications of more substantial internal works are the more closely spaced framing timbers. The process of decreasing room and space between framing members in larger ships, however, did not begin in the late medieval period. Such developments can be seen well back in time, as early as the High Middle Ages. In transition vessels, however, decreased room and space appears to have been taken to an extreme. These developments are much clearer in *Mary Rose* than in the Woolwich ship, since the ship was recorded more carefully and has been preserved. Framing members are no longer fastened through oblique scarfs. Instead, floors and futtocks lie side by side and in certain instances are further interlocked with a lapscarf. It is possible that at such joints, timbers also reinforced with longitudinally driven treenails pinning the members together. But it has not been possible to determine if that is, in fact the situation despite the use of a fiber-optic probe.\(^{279}\) The use of such a technique on *Mary Rose*, seems to me of peripheral importance, though: I am certain that such a technique was used fairly extensively in northern Europe at some point. Moreover, builders with knowledge of Mediterranean and Iberian construction methods were common enough that even more sophisticated types of scarfs, such as pinned dovetail joints, were also used on ships built in northern shipyards. I am certain that this assertion will be borne out with further research.

Archaeologists and historians have made much of the adoption of carvel construction methods by shipbuilders in northern Europe at the beginning of the early modern period. The transition from the widespread use of one set of techniques to the use of another set was, of course, a great stride to the establishment of naval mastery by northern European powers. The use of new techniques did not become common, however, until rich kings required that vessels built for them employ new and expensive technology, heavy artillery. Some historians and archaeologists have asserted that the principal reasons for the adoption of the new techniques were that they were more economical and easier. Although I believe that such explanations have some merit, I believe the truth is more complex. The application of heavy artillery to ships-of-war at the demand of monarchs of developing national states was the critical stimulus for the adoption of a new method of shipbuilding.

\(^{279}\) Rule and Dobbs, “Recent Research,” 33.


---------. “‘Carvel’ or ‘Caravel.’” *Mariner’s Mirror* 18 (1932): 189.


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