THE EVOLUTION OF HULL DESIGN

IN

SIXTEENTH-CENTURY ENGLISH SHIPS-OF-WAR

A Thesis

by

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Submitted to the Graduate College of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

May 1987

Major Subject: Anthropology

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ABSTRACT

The Evolution of Hull Design in 16th-century English Ships-of-war.

(May 1987)

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During the 16th century, English warships underwent design changes that were to have a major impact on the history of the world. Responding to pressures from the major European land powers, English monarchs were forced to realize that England's best defense, as an island nation, lay not in a large army but in a strong navy. With the reign of Henry VIII, English shipwrights began experimenting with various designs that would enable them to keep their country from being invaded. By the end of the reign of Elizabeth I, the English Navy was the most powerful afloat.

The nature of the evolution that transformed the bulky ships of the 15th century into the sleek men-of-war of the 17th can be traced by several means. First, it is necessary to understand all of the ships with which 16th-century English shipwrights were familiar. This gives us a technological "gene-pool" of characteristics from which the English had to draw. Second, we must study documentation and works of art from the period in question. Although the

documentation is sparse, there is enough to show the different types of design that were being tried, and the kind of succes that they enjoyed. Third, we must study the ships of England's enemies, particularly Spain, so that we can get an idea of the pressures that were put on English ships, and what strategies were employed to overcome them. Through this combination of research methods, it is possible to show that designs invented during the reign of Henry VIII, with the aid of Italian shipwrights, eventually evolved into the famous 17th-century English ship of the line.

ACKNOWLEDGEMENTS

I would like to acknowledge the following people for their contributions to this thesis:

First, the members of my committee, whose editing and expert comments have made this a much better thesis than when it was first presented to them.

Second, all of the people who helped me with my research in England, particularly Dr. Robert Luckett of the Pepysian Library, and his very helpful assistant, whose name I wish I could remember. It is safe to say that I never would have been able to write this thesis without their help. Also I would like to thank David Lyon of the National Maritime Museum in Greenwich for his encouragement and comments.

Finally, I would like to thank the people who had to plow through this work looking for typos and defacement of the English language. Joy Moore read this thesis at least four separate times, and put up with a lot of grief in return, and I thank her especially. Denise Lakey did the final proof reading.

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CHAPTER I

INTRODUCTION

The sailing ships-of-war of both England and Spain saw unprecedented design changes during the 16th century. The clumsy floating fortresses and light oared galleys of the turn of the century evolved, within one hundred years, into the seaworthy galleons and men-of-war which remained basically unchanged throughout the age of sail. The nature of that evolution and the nomenclature of the ships associated with it are the problems to be explored in this thesis. This study will concentrate on English, rather than Spanish, warships and will cover the period between the coronation of Henry VIII in 1509 and the death of Elizabeth I in 1603. However, the nature of the rivalry between England and Spain at that time, and the fact that English ships were often described by comparing them to their Spanish counterparts, makes it virtually impossible to discuss the ships of one country without discussing those of the other.

I have encountered both modern and 16th-century obstacles in my research. In the late 19th and early 20th centuries, when many of the earlier discussions on the evolution of warships were penned, there was a tendency among naval historians, with notable exceptions, to take too much for granted. Even worse, opinion was often misrepresented as fact. Many basic references contain broad

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Journal model: The International Journal of Nautical Archaeology and Underwater Exploration

generalizations and lack adequate citation. Others are extremely culturally biased. To make matters worse, reputable modern historians who are not naval experts, but who need to offer a piece of nautical information to their readers, have few reliable secondary sources and thus perpetuate this misinformation by citing it. Wherever possible, it is necessary to go back to the original documentation to see exactly what was said, as well as who originally said it and in what context.

The other problems are 16th-century problems. A great deal of change occurred over a very short period of time during that century, and the specific design changes of naval vessels did not figure highly in the priorities of writers of the day. The people who did write about ships, usually naval officers themselves, took it for granted that the recipients of their dispatches knew as much about the ships in question as they did. Therefore, no elaborate description of the special characteristics of a Genoese carrack, for instance, was required. Conversely, land-lubbers who wrote about ships often had a great deal of understandable confusion as to which attributes were characteristic of what sort of ship. For a modern parallel one can look to automobiles. How many people today could explain the difference between a sedan and a coupe? For that matter, how many archaeologists five hundred years from now will be arguing over the difference between a sedan, a coupe and a car? It would be quite difficult to figure out the specific characteristics that separate a sedan from a coupe, and that the word "car"

is a generic term to describe any automobile, solely on the basis of random memos between automobile company executives or non-drivers.

This is the very problem that we have with 16th-century documentation concerning ships. Typically, the documents that have survived to the present are communiques between naval officers, letters from passengers or observers to other unknowledgable individuals, or second-hand accounts put to print for general consumption by the public. Every now and then a specific reference will be made to a feature on one or more of these ships, perhaps by comparing it to another type of ship. Often it is possible to find out how big a certain ship was, where it was constructed, or how well it sailed. By using both reference and inference, such documents allow us to draw a few solid conclusions about the design of English warships of the 16th century.

The information from these documents can be supplemented by a careful study of the pictorial evidence. Very few technical drawings exist of English ships from the second half of the century, and none at all from the first half. In fact, there are comparatively few works of art from this period that even have ships or naval battles as their subjects, and they are often not technically accurate for two reasons. First, they were painted by artists, not shipwrights. Second, the technique of portraying perspective was relatively new, even by the end of the century, and some artists were not as adept as others. However, if these cautions are kept in mind, certain diagnostic features can be found consistently enough to help differentiate

one type of vessel from another. Among these features are the overall size and shape of the vessel (especially in profile, as this helps to eliminate the perspective problem), the height and configuration of the superstructures, and the shape of the bow.

This thesis is about sailing ships, and there will only be limited discussions of galleys and other oared craft. Galleys, as oared ships of war were generically known, were at no time a chief, or even important, portion of the English fleets (Oppenheim, 1896: 5). Some comparitively large ones had been built by Edward I and Edward II, but the inherent distaste of the free Englishman for the mechanical drudgery of rowing had rendered ineffective any attempt to keep up a free service. Although there must have been plenty of vagrants available, the idea of utilizing them does not appear to have appealed to any monarch before Elizabeth, and until nearly the end of her reign, there was only one galley on the Navy List (Oppenheim, 1913b: 108).

In addition, the galley was not cost-effective. Oppenheim points out that a large man-of-war like the 400-ton Dreadnought, built in 1573, could be kept at sea throughout the year at a charge of only £303 per month, while the galley, only doubtfully practical during the summer due to the rough seas of the channel and the Atlantic, cost very much more (Oppenheim, 1896: 127).

The only exception to this rule was the 'pinnace,' a word used to signify all oared craft larger than ordinary ships' boats. They were of two classes, decked and

undecked, or first or second class in modern parlance. The former were counted as independent units of a fleet, while the latter were often attached to, and even carried by, the larger ships. They ranged generally from twenty to sixty tons, and were considered indispensible as the eyes of a fleet and for landing and cutting-out operations. Their oar propulsion was regarded as auxiliary only, and with the exception of those acting as tenders to flagships, they usually were organized as an independent light squadron (Corbett, 1898: 1). There has been very little analysis of pinnaces as a class, but since they will be mentioned throughout this thesis, some understanding of their function is necessary. Particularly important is the fact that they were primarily sailing, and not oared, vessels.

The motives behind England's naval advances during the 16th century were many, but a few stand out. England, obviously, has always been an island nation, but it was not until the 16th century that the monarchs and politicians really began to appreciate the implications this had in regards to naval policy. Furthermore, it was not until the defeat of La Armada Invincible in 1588 that the skeptics, among them Queen Elizabeth herself, were convinced that with a powerful navy, England could defend her shores with only a very small army.

There were three main historical circumstances which more or less forced England to improve her navy. By the beginning of the 16th century France, England's "ancient adversary," had been unable to mount a systematic attack by sea for more than one hundred years. However, the situation changed with the

consolidation of that kingdom and the accession of Francis I in 1515. One of the first acts of Francis I was to order the construction and fortification of the Port of Havre in 1516-17, and he built ships and brought fleets from the Mediterranean to contest supremacy of the channel. A related event, the union of Brittany with the French crown, further forced the hand of the English. This loss was both an emotional and a strategic one to England, as France gained one of its most valuable arsenals and ports, as well as the command of a renowned race of seamen (Oppenheim, 1896: 45, 46).

The Spanish navy was also a motivating factor for the English Admiralty, but not until later in the century. Since the discovery of the New World, Spain had been busy building more and larger ships. The Americas were more than a month's sail from Spain, and large-scale colonization required numerous huge merchantmen, bullion carriers and passenger ships that could make the long ocean voyage with regularity. All of these vessels needed protection both from pirates and eventually from the privateers and navies of hostile and envious nations. The Spaniards had to invent the basic techniques of trans-oceanic voyaging, and the development of more, bigger and better ships was one of the cornerstones of their New World empire. The sheer size of the Spanish fleet intimidated the English, who diplomatically side-stepped any major confrontations until late in the 16th century. However, with the union of the Holy Roman Empire, Spain, and the Netherlands under Charles V in 1518, England had to face the real possibility of having to repel

Spanish fleets as well as Imperial troops. England's strategic location between the peninsular and northern possessions of the Empire was a fact that could not be overlooked by anyone on either side of the channel (Oppenheim, 1896: 46).

By the time of the famous clash between the English navy and the Armada Española in 1588, England had surpassed Spain as the ruler of the sea. As an island nation, this superiority made her virtually untouchable. All of the great continental land powers were required to keep large, standing professional armies in order to overrun or contain their enemies, plus at least one fleet. Every time one of them managed to overthrow all of its rivals on the continent, England held out. Short of putting together a fleet to outmatch the best in Europe, no attack on the Isle could succeed (Bass ed., 1972: 226).

These ideas had long been understood by many English strategists, but it took a major threat from outside to make it take hold. In 1570, while England was still nominally an ally of Spain, John Montgomery (1570:4) wrote on why England must have a strong navy:

> Which thing the prudent counsaile of Venetians might well understand for they know that otherwise assaults by sea would be spedy and suddaine, and might come upon them without warning, even in time of peace soe provide for warr that they have alwayes in redyness two hundred sayles of gallies, besides other goodly shipps wherewith, ever as ocasion serveth, they worthely defend their coasts and anoye their enemies.

International politics aside, the other factor which was to have a major impact on the design of ships of war was a change in the techniques of naval warfare. At

the beginning of the 16th century, ships were used mostly to bring troops of soldiers to battle, or to prevent ships with troops of enemy soldiers from landing in one's territory. In either case, the way that one capital ship took another was by boarding it. In this procedure, the attacking ship would clear the decks of the enemy ship with a rain of arrows (or later with small anti-personnel armament) and send in a troop of infantry to take possession of it. For both of these operations height was a great advantage. Therefore, in the early parts of the century, the distinctive structural feature of a warship was a tall fighting platform forwards, projecting well over the bows (Bass ed., 1972: 227). Later, when Henry VIII introduced field- and siege-sized artillery onto his men-of-war, the broadside was suddenly capable of actually sinking enemy ships. This made position, and thus maneuverability, speed and seaworthiness, increasingly important, a situation which had a dramatic impact on ship design.

The next great advancement of the navy took place under Elizabeth. Elizabeth did not know the weapon that she had, and greatly overestimated the force of the organization and the strength of the fleets that Philip could pit against her. For this reason, she went out of her way to avoid confrontations through negotiation. She In her favor, it may be said that by waiting until Spain challenged her with all that she had, England was able to deliver a decisive blow to Spain's naval might (Oppenheim, 1896: 113-17), and for the rest of the age of sail, Spain had to play catch-up with England.

The body of this thesis is divided into eleven chapters which weave themselves around the reigns of Henry VIII and Elizabeth I, the two most influential monarchs in the history of English ship design. Chapter II is the literature review, and Chapter III contains a short discussion of tonnage as it was understood in the 16th century. Chapter IV deals with the period preceding the reign of Henry VIII, so the reader can more fully understand what that king had to work with when he set about revolutionizing the navy. The fifth chapter covers the reign of Henry VIII, and demonstrates some of the specific changes that he made and how they affected naval warfare in Europe. The sixth chapter is entitled "The galleon question" and covers the history of the galleon in the Mediterranean and how both the word and the ship type came to England. Chapter VII covers the period between Henry's rule and Elizabeth's rule, the latter being covered in Chapter VIII. Once we get to Elizabeth, it is no longer possible to discuss the English ships without devoting some attention to those of their Spanish enemy. Therefore, Chapter IX, entitled "La armada española," gives a brief history of the Spanish warship, with some insights into the ways in which the Spanish and English shipbuilding industries affected each other. Chapter X contains a short discussion of the directions that these two nations followed after their famous confrontation in 1588, and the final chapter contains the summary and conclusions.

Historical circumstances, combined with the individual personalities of the monarchs who had to face them, changed the concept of naval warfare in

16th-century Europe. The ships themselves were only part of the story, but they are the part that shall be explored here.

CHAPTER II

LITERATURE REVIEW

There are a few contemporaneous documents that stand out as exceptional sources for the student of 16th-century English warships, some of which I have been fortunate enough to study personally. All except one are found at the Peypsian Library at Cambridge University.

Samuel Pepys, noted 17th-century diarist, was Secretary of the Navy from 1684 to 1689, and his prodigious collection of manuscripts and early printed books, now housed at Cambridge University, contains a good deal of nautical material. The two sources that have been most helpful to students of 16th-century ship design are Anthony Anthony's A Declaration of the Royal Navy of England, or the Anthony Roll, and Mathew Baker's Fragments of Ancient English Shipwrighty.

The Anthony Roll was composed in 1546, and the introduction, with modern spelling from Howard, 1979:49, states: "This is the first Roll declaring the number of the King's Majesty's own ships with every ship's name, with their tonnage and number of men. As also the ordnance, artillery, munitions and habiliment for war for the arming and defense of the said ships against their enemies upon the sea." It is nothing less than a data sheet on every ship owned by the crown in 1546, and there have been few documents like it in history, either before or since. The page for each ship includes a painting of the ship, its tonnage, and figures for numbers of

gunners, mariners, soldiers and marines, archers, guns of brass, guns of iron, powder requirements, and shot of iron, stone and lead. The paintings of the ships are not, strictly speaking, technically accurate, but noticeable differences between them make it quite clear that Anthony reproduced each ship individually with some eye to detail. It also includes ships that we know were built in 1546, so it is up-to-date. Rolls one and three, the Roll of Shyppes and the Roll of Pynnaces respectively, can be found in the Pepysian collection, cut into pages and bound as a book. Roll two, the Roll of Galleasses, was donated to the British Library in the 17th century, where it can still be studied in its original roll form.

The value of Baker's Fragments of Ancient English Shipwrightry derives from the fact that it was written and drawn by an actual shipwright, rather than by an artist. The document was compiled between 1570 and 1620, and it contains drawings of dozens of ships that give some of the first scientific methods for deriving the shapes of ship members without mathematics. Many of the ships have their dimensions given, as though they were meant to be constructed, while others seem to be studies. This gives modern students the opportunity to study the personal sketchbook (though most of the drawings are beautifully painted with water colors) of an Elizabethan royal shipwright.

Fragments was written in 16th-century English script, which makes it very difficult to read. Ease of access to this work has been greatly enhanced by M.S. Robinson, who transcribed the text into modern English lettering. This transcription

has never been published, but can be found in manuscript form at the Pepysian Library. Neither the Anthony Roll nor Fragments have ever been published in full, although individual illustrations from both can be found spread throughout the secondary literature.

The other primary sources are of less significance, but bear mentioning. The Mariner's Mirror by Luke Waegener is an atlas of Northern European shipping routes released in 1588. Each of the more than twenty maps contained therein has at least one ship drawn on it, and the ships are of a variety of types, including harbor and river craft. Like the two manuscripts mentioned above, this document has never been published, though not from its lack of importance as a source of information on 16th-century ships.

John Montgomery's Book of the Navy is a study of the navy as England's primary means of defense. Written as two pamphlets in 1577 and 1588, it has been combined into one volume at the Pepys Library. The first section deals with why England must have a strong navy and is quoted in this thesis. In the second, Montgomery discusses his perception of the "suggested proportion for a standing English navy (Montgomery, 1588: 15)," including the use of Mediterranean galleasses. Of the author, nothing is known, except that he had given special attention to national defense since the time of Mary I in the 1550s (Corbett, 1899a: 345).

Last among the original documents is Sir Walter Raleigh's Essay About

Shipping, published in 1650. Although written after the period covered here, Raleigh discusses the English and Spanish navies going back as far as Elizabeth.

While many aspects of this thesis have been covered by various authors, there has never been a solidly documented work that has covered all of the points that I wish to discuss. Along the way, some of the questions that have been raised have generated a good deal of debate, and, in some cases, even emotion. I have done my best to stay away from secondary sources unless they are very well documented.

Almost all of my secondary source material have one thing in common: they cited Oppenheim's A History of the Administration of the Royal Navy and of Merchant Shipping (1896). This volume is unquestionably the best, most complete history of the early history of the English navy. Although the author's opinions are given regularly, they are not misrepresented as fact. Often, as in the case of tonnages of individual ships, he had to sift through many conflicting reports before giving his final interpretation of what the actual tonnage was. He usually explains his decisions, and in all other cases, he cites the document which contains the critical information. Those documents are, in more cases than not, Official Papers or Admiralty Manuscripts. I have analyzed many of the issues addressed in this thesis by using raw data supplied by Mr. Oppenheim's primary research. In doing so I join distinguished company.

Another source which is almost universally quoted when the discussion turns

to galleons is Julian S. Corbett's Papers Relating to the Spanish Navy during the Spanish War (1898), in particular appendix B, "Galleons, Barks and Pinnaces." Corbett is also a reliable source, although he is not as meticulous in his documentation as Oppenheim. However, his opinion is generally recognizable as such, and in both Papers and in Drake and the Tudor Navy (1899), his direct quotations from original documents have supplied me with valuable information.

Frank Howard's Fighting Ships of War 1400-1860 (1979), along with Armstrong's "l'évolution des navires de guerre anglais" in Le Petit Perroquet (1973), are probably the two sources that have most specifically dealt with the evolution of the English warships during the second half of the 16th century. Armstrong's work, which was pointed out to me by Mr. David Lyon of the British Maritime Museum, relies mostly on pictorial evidence. The scheme presented is similar to one that I propose, but I have striven to present that evidence in a more detailed manner and use independent documentary evidence to expand upon it. The text is, unfortunately, not very well cited, and snatches of Oppenheim are apparent, even through the French. But in spite of these problems I have found Armstrong's work to be a reliable and thoroughly business-like approach to the problem of tracing the lines of evolution of English ships of war.

Howard's book is relatively modern and is the most thorough work to date specifically on the history of the English warship. In Fighting Ships Howard covers virtually every aspect of these ships, from hull construction to guns, rigging, anchors,

capstans, cleats and support craft, during the entire age of sail and then some. While its value as a basic reference cannot be overestimated, the negative side is that many of the more complex subjects, like the history of hull design, cannot be covered thoroughly in only a few pages. While his documentation is admirable, he is often, due to the medium, forced to summarize large amounts of research in a one- or two-paragraph statement. As with Armstrong, I generally do not cite Howard without presenting independent research to explain why I may agree or disagree with something he says. Fighting Ships of War is probably the best-illustrated book on the subject of English men-of-war in the age of sail.

Williamson's Sir John Hawkins (1927) is another good secondary source for information concerning ships, both generally and specifically. He cites Oppenheim and Corbett quite a bit, but he adds a good deal of original research and is especially useful for learning the sailing qualities of a few specific ships. His documentation is above average, but he has a slight problem with taking certain facts about the ships for granted (See Chapter VI "The galleon question").

Charnock's History of Marine Architecture (1800) and Chatterton's Sailing Ships (1914) have only been of limited use. First of all, both cover the period from the earliest sailing ships to late 19th-century England, and such a broad approach necessitates a comparitive lack of detail. Secondly, cited and uncited paraphrases from both Corbett and Oppenheim abound when ship types are discussed, exposing those two experts as the basis of much of their information. Charnock was

particularly bad about documenting his references. However, as historians, they were able to offer some original insights into the background of some of the changes that were taking place during the 16th century, and thence comes their value.

Bass's History of Seafaring (1972) is another good basic reference. McKee's chapter on English shipping and Scandurra's chapter on medieval Mediterranean shipping provided me with good background, a general overview of the periods in question, and some specific data that were not easily available elsewhere.

A major forum for the discussion of early English warships has been the Mariner's Mirror, an English journal concerning all things nautical. Ever since its inception by a small group of English naval enthusiasts in the early 1900s, literally dozens of papers have been written on various aspects of the English warship. Often the articles were quite specific, such as Anderson's 1957 offering, the publication of a 1591 navy List which covered slightly more than one page. Some of the papers took the form of open debate between two or more scholars, at times spread over several years. In any case, this journal allowed me to find, in one place, discussions of various aspects of 16th-century English shipping by people like L.G. Carr Laughton, R.C. Anderson, T. Glasgow, Jr., W. Salisbury, R.M. Nance, A.H. Taylor and W.J. Turner. D.W. Waters' Maritime Monographs publication originally appeared in Mariner's Mirror as well.

The two most important papers to come from this source were Lane's 1934

article on 16th-century Venetian naval architecture, and Glasgow's 1964 article on the shape of the ships that defeated the Spanish Armada. The Lane work is one of the most important papers to come out on galleons since the discussions by Oppenheim and Corbett at the end of the 19th century, and the addition of this information into the discussion of English galleons may be one of the more important contributions made by this thesis. The Glasgow article is an analysis of the hull proportions of Elizabethan ships of war. While I do not agree with all of his conclusions, Glasgow did some tedious legwork that made my analysis much less time-consuming. In addition, his division of the Elizabethan period into subperiods of ship design is very insightful and makes the progress achieved during those years much more understandable.

The information on Spanish shipping has come primarily from English sources, since I was concerned mostly with the influence of this shipping on English shipbuilding. Most notable is Corbett's Papers relating to the Spanish Navy, written in 1898. This book contains translations and interpretations of contemporaneous Spanish and English documents, including reports of English spies that were placed in Spain. Also useful was the five-volume Naval Tracts of Sir William Monson, published by Oppenheim between 1902 and 1914, which contains both English and Spanish documents. The latter are given in translation, along with analyses by Oppenheim and Monson comparing English and Spanish ships of war. Most of Oppenheim's information comes from Fernandez Duro, with whose works

he seems to be quite familiar.

The historical background of Spain's shipbuilding industry can be found in the medieval Mediterranean, and the source I have chosen for this aspect is Dotson's Freight Rates and Shipping Practices (1969). This book contains a relatively thorough analysis of the early medieval sailing craft which were the distant ancestors of 16th-century Spanish ships. Dotson discusses the subject clearly, and since it is a doctoral dissertation, it is extremely well documented. Another very useful source on medieval Mediterranean shipbuilding has been Pryor's recent three-part article in the Mariner's Mirror concerning crusader transport ships. The most important thing about this work is the fact that it lists actual dimensions of 13th-century vessels.

Other sources for Iberian ship design are Palacio's Instrucción Nautica, written in 1587 (1944); El Buque en la Armada Español by Manera Regueyra et al. (1981); Barros' 1933 Traçado e Constução; and Boxer's From Lisbon to Goa (1984). Palacio, whose translated work has recently been published by Bankston, mostly deals with merchant ships, although there is a short section on warships which is very important. The importance of this source is magnified by the fact that it was written in 1587, before the Armada enterprise. Manera Regueyra's tome is a very useful work done in a manner similar to that of Bass' History of Seafaring. Each chapter is written by a different authority, and covers a specific aspect of Spain's naval history. The chapter I have cited is wrtten by F.-F. Olesa Muñido. Published in

1981, this is a relatively up-to date reference. It is also beautifully illustrated.

Boxer is one of the world's greatest authorities on early Portuguese trade, and From Lisbon to Goa contains information on the histories of different types of ships, particularly the carrack and the galleon. This data is especially precious, since very few scholars of Portuguese naval history ever publish in English. Barros' Traçado is a classic example of a Portuguese book that would be find wide readership as a basic reference if it were ever translated into English or even Spanish. Since I know very little Portuguese, I was able to obtain only very general information from this important book.

No matter how much archival work is done, however, answers to most of the questions that need to be asked will only be able to come from the field of nautical archaeology. Having the actual remains of an early ship can go a long way (though rarely all the way) toward quieting controversy. So far, only three early English ships have been investigated that have some bearing on this thesis. Several Spanish wrecks have been found, especially from the later part of the century, but only two have had significant hull remains. The English wrecks are the Burlesdon ship, purportedly from the early 15th century, but whose identity is in much doubt; the Cattewater wreck, a small merchant ship from the early 16th century; and the Mary Rose, flagship of Henry VIII and lost in 1545. Unfortunately the dimensions for the Mary Rose have not been published as of the writing of this thesis, and the Cattewater wreck, as a merchant vessel, is of only limited importance for this study

(Redknap, 1984: 95). The Spanish shipwrecks are the Santa María de la Rosa, a Spanish-built vessel that foundered during the Armada enterprise of 1588 in Blasket Sound in south-west Ireland, and the San Juan, a Basque whaling galleon recently recovered from Red Bay, Labrador. Many other Armada ships have been identified off the coasts of Great Britain, but no significant hull remains were found or reported (Muckelroy, 1978:98-105).

CHAPTER III

A FEW WORDS ABOUT TONNAGE

Throughout this thesis I will be referring to the relative sizes of various ships in terms of 'tons.' A full explanation of this term would be unnecessary and very lengthy. However, since it will come up time and time again, I feel a responsibility to briefly explain ship tonnage as it was understood in 16th-century England. There are three main points that need to be made here.

First, tonnage was a measurement of volume, not weight, which had its origins in the medieval Bordeaux wine trade. It originally measured the number of tuns of wine, the standard shipping container of the time, that could fit into the hold of a ship, the tun and the space around it measuring 57 cubic feet (1.7 cubic meters).

Second, the first known English rule for computing tonnage arithmetically, based on principal dimensions, was not devised until 1582. Therefore it is important to remember that before that date, all figures for tonnages were estimates, as the only way of accurately ascertaining a ship's capacity seems to have been by actual trial (Salisbury, 1966: 43).

Third, the 1582 rule required different formulae for ships of different proportions, so that varying interpretations caused some discrepancies. As a result, tonnage measurements varied not only between nations, but within them as well. Even in the official lists of the Queen's ships, the tonnages of some individual vessels varied slightly from one year to another. Tonnage measurements must

therefore be considered approximate--not accurate--designations of hull size.

In this thesis I will use tonnage figures only for purposes of comparison, not to extrapolate quantitative data. When an Englishman has used the term "tons of burthen," even in reference to Spanish ships, I will assume that he was talking about English tons, and that he was using the figures to compare the Spanish ships to ones with which he and his audience were familiar. The converse would, of course, apply to a Spaniard writing of English ships.

The original English rule of 1582 was as follows:

> By the proportion of breadth, depth, and length of any ship to judge what burden she may be in merchant's goods... The Ascension of London being in breadth 24 feet, depth 12 feet from that breadth to the hold, and by the keel 54 feet in length doth carry in burden of merchants goods [in pipes of oil or Bordeaux wine] 160 tons...
>
> To find the burden of any ship proportionately to the Ascension before specified multiply the breadth of her by her depth, and the product by her length at the keel, the amounting sum you shall use as your divisor. If 15,552 [the product of the three dimensions of the Ascension], the solid cubical number for the Ascension do give 160 tons, her just burthen, what shall 8400, the solid number of a ship 20 feet broad, 10 feet deep, and 42 feet keel. Work and you shall find 84 34/81 tons of burden...(Oppenheim, 1896: 132).

This seems complicated but is not. Baker devised this rule to make the mathematically derived tonnage match the empirically observed "just burthen" as closely as possible. However, as previously mentioned, there are slightly different formulae for ships of different proportions. All of the formulae require that we

multiply the length of the keel times the beam times the depth of hold and divide by a number, the divisor, which varies according to the proportions of the ship in question. In order to compute the correct divisor, the user must have at least one ship whose tonnage is already known, like the Ascension. Baker instructs us to multiply the length of its keel times its beam times its depth of hold, which equals 15,552, the dividend (Baker has misused "divisor" in the above quote: it is clear that he meant dividend). Then the user must compute the divisor that, when divided into 15,552, will produce the known burthen of 160 tons. That is $15,552 \div x = 160$. In this equation, $x = 97.2$. Therefore, to find the tonnage of any vessel that is proportionally similar to the Ascension, multiply the keel times the depth times the beam and divide by 97.2. If you wish to compute the tonnage of a differently-proportioned ship, it is first necessary to calculate the correct divisor by performing the above computations for a similar ship whose tonnage is known. To further complicate matters, the majority of worked tonnage examples in Fragments, although not all of them, use an approximated divisor of 100 (Barker, 1983: 4). It is not difficult to see how there would be some discrepancies, although later the value of the divisor was mandated by law, starting with 100 and getting lower through the years . Lowering the divisor yielded higher tonnage figures, enabling the government to collect more taxes from merchant vessels.

The Spanish system of measurement in 1590 was to multiply half the breadth by the depth of hold, and the result by the length overall. From this 5% was

deducted for the entry and run of the hull, and the remainder divided by eight gave the net tonnage (Oppenheim, 1896: 133-34). The Spanish shipping ton, or tonelada, smaller than the English ton, was about 1.5 cubic meters. The measurement by tonelada was Sevillian, or South Spanish, and was the one most often referred to by the Spaniards. The Biscayan builders calculated by the tonél, ten of which equalled 12 toneladas, so that one tonél displaced about 1.8 cubic meters (Oppenheim, 1896: 53).

BEFORE HENRY VIII

Before one can properly evaluate the changes that took place in English ship design during the 16th century, one must first have an idea of what types of ships were being used up until that point. By the reign of Henry III (1216-72) the Navy was already made up mostly of sailing vessels. Although royal ships existed, they were supplemented with converted merchantmen that had been fitted with temporary fore- and aftercastles for fighting.

Also by the reign of Henry III, the royal ships were large enough to become attractive to merchants, who hired them from the crown. This evidently became a common practice, and Oppenheim states that there was hardly a reign, down to and including that of Elizabeth, where men-of-war were not hired by merchants for freight. He further states that nearly all of the voyages to Italy and the Levant during the last quarter of the 15th century were carried out in men-of-war leased for the voyage (Oppenheim,1896: 4).

However, the royal ships of Henry III were, strictly speaking, troop transport vehicles, of much greater use in an era when all fighting of consequence took place on land. Henry V (1413-22) was ahead of his time in being the first monarch to begin to appreciate the special place a navy should have in an island nation. Under his rule the Navy was increased to a degree unprecedented in English history, and the records of ships bought or built seem to indicate that they were for seagoing

purposes, rather than for troop transport or escort (Oppenheim, 1896: 12).

A relatively complete list of Henry's ships, compiled by Oppenheim (1896: 12,15) from the accounts of Catton and Sopor, successive keepers of the ships, shows an increase not only in the numbers of ships, but also in their individual tonnages (see Table 1). Oppenheim found the tonnage of the Grace Dieu mentioned twice, once as 1400 tons and once as 400. He had a hard time accepting the larger figure, and even went so far as to say that the tonnage of the Jesus of the Tower was suspect at 1000 tons, even though its largest anchor weighed a considerable 2224 pounds. McKee agrees with the larger figure, and cites the Grace Dieu's large retinue of two balingers of 100 tons, three "Cok-boats" and two boats as evidence (Bass, 1972: 227). But most importantly, W.J. Turner (1954: 55) located a third contemporaneous source which listed her tonnage as 1400. Therefore, we can say with a certain amount of security that the Grace Dieu was a 1400-ton vessel, though we can just as safely conclude that such a size was in no way typical. In any case there were nine ships ranging in burthen from 400 to1000 or more tons, out of a total of thirty-eight ships. This represented a total tonnage equal to that of the navy of Elizabeth I (1558-1603) during the first dozen years of her reign (Oppenheim,1902: 5).

It is also important to take note of the classification system used in the accounts. The classes are 'ships,' 'carracks,' 'barges' and 'balingers.' Practically every one contains the phrase "of the Tower", which was the man-of-war mark,

Table 1. The navy of Henry V

		built	prize	tons
SHIPS	Jesus of the Tower	----	----	1000
	Grace Dieu of the Tower	1418	----	1400
	Holigost of the Tower	1414	----	760
	Trinity Royal of the Tower	1416	----	540
	Thomas of the Tower (rebuilt)	1420	----	180
	Grande Marie of the Tower	----	1416	420
	Little Marie of the Tower	----	----	140
	Katrine of the Tower	----	----	---
	Christopher Spayne of the Tower	----	1417	600
	Marie Spayne of the Tower	----	1417	----
	Holigost Spayne of the Tower	----	1417	290
	Philip of the Tower	----	----	---
	LittleTrinity of the Tower	----	----	120
	Great Gabriel of the Tower	----	----	----
	Cog John of the Tower	----	----	----
	Red Cog of the Tower	----	----	----
	Margaret of the Tower	----	----	----
CARRACKS	Marie Hampton	----	1416	500
	Marie Sandwich	----	1416	550
	George of the Tower	----	1416	600
	Agase of the Tower	----	1416	----
	Peter of the Tower	----	1417	---
	Paul of the Tower	----	1417	----
	Andrew of the Tower	----	1417	----
BARGES	Valentine of the Tower	1418	----	100
	Marie Bretton of the Tower	----	----	----
BALINGERS	Katrine Breton of the Tower	----	1416	---
	James of the Tower	1417	----	----
	Ane of the Tower	1417	----	120
	Swan of the Tower	1417	----	20
	Nicholas of the Tower	1418	----	120
	George of the Tower	----	----	120
	Gabriel of the Tower	----	----	----
	Gabriel de Harfleur of the Tower	----	----	----
	Little John of the Tower	----	----	----
	Fawcon of the Tower	----	----	80
	Roos	----	----	30
	Cracchere of the Tower	----	----	56

and of those vessels, only the Nicholas of the Tower has ever been found on the lists of merchantmen of the century (Oppenheim, 1896: 25), indicating a practical distinction between the King's ships and merchant vessels.

What were the characteristics of each of these classes? The balinger, Spanish ballanere, is identified by Fernandez Duro as a long, low vessel for oars and sails introduced by the Biscayans in the 14th century (Oppenheim, 1896: 13). Corbett (1899a: 18) agrees that this was probably the origin of the word, but feels that the type was almost certainly of North Sea ancestry, and of high antiquity. In any case, according to Oppenheim (1896: 13) the usual tonnage for a balinger in the 15th century was about forty tons, although a man-of-war balinger could clearly be quite a bit larger. The same thing seems to have been true about the man-of-war barges, whose usual tonnage ran from sixty to eighty tons.

The carracks were all prizes, of Spanish and Genoese origin, taken while in French pay in 1416 and 1417 (Oppenheim, 1896: 13). The tonnages of the carracks compare favorably with those categorized as 'ships,' but they have definitely been classed separately from one another. Therefore we can safely say that a Mediterranean-style carrack of the early 15th century was something noticeably different than a typical English ship-of-war from the same period.

Our picture of an English man-of-war from the reign of Henry V is somewhat incomplete, but a few patterns can be observed or inferred.

First, English vessels of the 15th century were, for the most part, smaller than Italian, Spanish or German vessels. There is no record of any of Henry V's ships having had more than two masts, but if there were any, they were certainly the first of their class in the English service . Even the inventory of the Grace Dieu, the largest ship in the fleet, only mentions two masts, the "great mast" and the "mesan," plus two bowsprits. Oppenheim (1896: 13, 14) takes the mesan (literally "middle") to mean foremast, from the French mât de misaine. McKee and Prynne have taken it in its literal English as "mizen", or aftermast (Bass, 1972: 227,228). Although there are published examples of carracks with only main- and foremasts, and others with only main- and aftermasts (Nance, 1955: 192), the foremast (arbor de prora or artimon) was longer and heavier than the middle-mast (arbor de medio) on a typical medieval Mediterranean roundship (Pryor, 1984b: 284-289), supporting McKee and Prynne's interpretation. The bowsprits of the Grace Dieu carried no sails, and may have been more in the nature of "bumpkins" than spars. The Grace Dieu carried six sails and eleven bonnets, but their positions when in use were not mentioned, and some of them were quite possibly spares (Oppenheim, 1896: 14).

English ships of this period were typically clinker-built, or lap-straked. The Burlesdon ship, discovered in the Hamble River between Portsmouth and Southampton (Anderson,1934: 158) in 1859, was dated by dendrochronology as having been built of timbers felled "early in the 15th century" (Bass ed., 1972: 228). It had a keel length of at least 38.1 meters and a beam in excess of 14.6 meters, and

was characterized by triple-skin clinker construction, each overlap being five skins thick and attached to the frames by trenails 2.03cm in diameter (Fig. 1). This wreck has been tentatively identified by some as the Grace Dieu, but there is not enough evidence to know for certain. Suffice it to say that it was a very large vessel, too large to have been from much earlier than the early 15th-century. On the other hand, there is no record of any really large clinker-built ship after the great galley of 1515 which was described in 1523 as "the most dangeroust ship under water that ever man sailed in," so that the shipwright had to "break her up and make her carvel" (Anderson, 1934: 160). Therefore, it is almost certainly a vessel from the days preceding the reign of Henry VIII and perhaps from before Henry VII or even Henry VI.

Permanent castles began to appear on English ships in the early 15th century. L.G. Carr Laughton states (1925: 31) that throughout the 15th century, great ships (both ships and carracks) had (beyond the stem head) a projection of the forecastle which was said to be "carrack-fashion." We also have records of two "somerhuches" (derived from old English Somer (sic), a bedstead, and old French huche, making it, originally, a sleeping place) being built on the early 15th-century Holigost and Trinity Royal, and construction costs suggest more than simple timber stagings.

These somerhuches became the summercastles, or poops of the early 16th century (Oppenheim, 1896: 15).

The tactical necessity for such structures is easily understood. Until well into

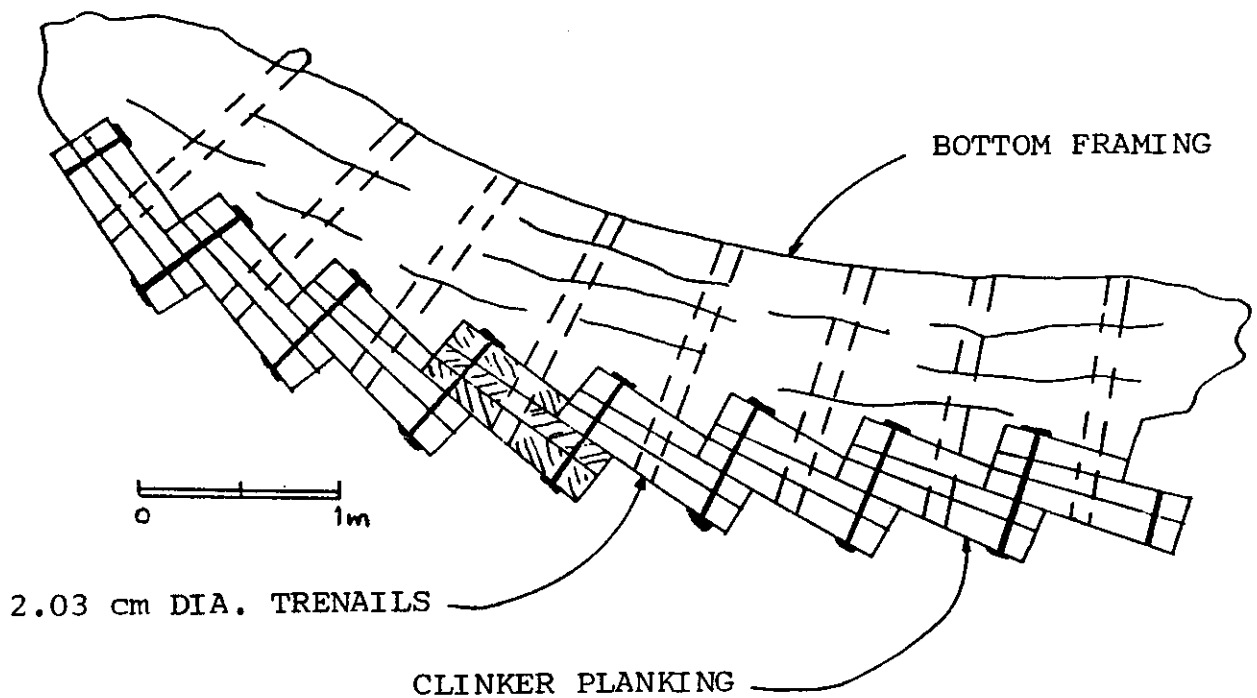

Figure 1. A section through the planking of the Burlesdon ship. After Prynne (Bass, 1972: 228).

the 16th century, boarding was the chief method of warfare at sea. From these structures, as mentioned in the introduction, the archers of the attacking ship would clear the decks of their enemy, after which the armored infantry would enter and capture the vessel. Since both firing and entering are facilitated by height, the distinctive structural feature of a warship was a tall fighting platform forward, projecting over the bows (Bass, 1972: 227), plus a lower one at the stern. The forward fighting platform evolved directly into the modern forecastle and remained evident in some ships until the time of Elizabeth.

Apparently, the men-of-war were a good deal larger than the built-up merchantmen that were inevitably pressed into service in times of war. Oppenheim (1896:19,20) published two lists recording the home ports and tonnages of merchantmen impressed for expeditions to Aquitaine. The first, from 1439, shows only twelve ships 200 tons or larger, two of 300 or larger, and none greater than 360 tons. The second, from 1451, mentions twenty-four ships 200 tons or larger, seven of 300 tons or larger and none greater than 400 tons (Oppenheim, 1896: 19, 20). While the merchant fleet was more numerous (how much more we do not know, since the above figures do not represent the total reserves available to England), the warships had a decided size advantage.

After the death of Henry V, his personal possessions, at his bequest, were sold off to pay his debts. That these included the bulk of his men-of-war illustrates two points. The first is that the royal ships were, at that time, the personal possessions of

the king. This meant that he had total power over how they were to be used or disposed of, as long as he performed his duty to protect the shores. The second is that the Privy Council did not consider the ships important enough to invest in when they were compulsorily put up to auction (Oppenheim, 1896: 17). This led to a situation where an individual monarch's personal commitment to the navy was crucial to its success.

Although the royal ships were variously sold, hired out and allowed to rot during the reign of Henry VI (1422-61), the merchant fleet flourished. Where Henry V had apparently intended to increase the royal navy until it was large enough for him to be able to rely on it for everything but transport, his successor had a more old-fashioned approach. Henry VI did not maintain a royal force or keep impressed ships under crown officers. Instead, indentures were occasionally entered into with individuals who were supposed to be competent to provide, under their own command, an agreed number of ships and men to be kept at sea for a specific period of time. While seemingly inexpensive, there were innumerable problems with delays and with the inevitable conflicts of interest that went along with allowing merchants to command naval operations (Oppenheim, 1896: 20-25).

Henry VI also hired foreign vessels to make up for some of the shortcomings of his navy. In 1460 he wrote a directive instructing the officials of the Exchequer that "of suche money as is lent unto us by oure trewe subgittes for keping of the see and othire causes ye do paye to Julyan Cope capitaigne of a carake of Venise nowe

beinge in the Tamyse £100 for a moneth, and to Julyan Ffeso capitayne of a nother carrake of Jeane [Genoa] being at Sandwich £105 for a moneth the which two carrakes be entretid to doo us service" (Oppenheim, 1896: 28)." Note the continued reference to carracks within a Mediterranean context.

There is little specific information about any improvements in the form or equipment of ships during the reign of Henry VI, and even less about those of Edward IV (1461-1470, 1471-1483) and Richard II (1470-71, 1483-1485). One can only say that the considerable advances in rigging and construction made during the 15th century must have evolved slowly over the course of the century, leaving no specific traces in the records (Oppenheim, 1896: 29). Edward did reappoint a keeper of the ships, however, and there is every appearance that he made some effort to halt the reversal of the royal navy that had begun under Henry VI. One ship, purchased during his reign in 1478, was a Spanish vessel, the Carycon, which later became the Mary of the Tower. Carycon, or Carraquon (sic) was Old French for a large carrack, and the then largest ship in the French navy was named the Carraquon. The short reign of Richard II did not allow much time for naval development, but the crown service was not permitted to retrogress, and a few new ships were purchased (Oppenheim, 1896: 32-34).

After the end of the Hundred Years War, no warships were built in England until Henry VII's (1485-1509) rearmament program of 1486-87. He built two ships, the Sovereign, at 800 tons, and the Regent, at 1000 tons, and they were the only

new men-of-war in his entire navy (see Table 2). McKee describes them as carracks, but let us for the time being just say that they had many of the features associated with carracks, such as the high, overhanging forecastle and a lower "summer castle" at the stern (Bass, 1972: 229), both permanent fixtures of the ship. The sterncastles each had a poop and a poop royal. The Regent had four masts and the Sovereign three, and they both had fore and main topmasts. In addition,

Table 2. The Navy of Henry VII (from Oppenheim, 1896: 35).

Grace Dieu	Sovereign	Fawcon
Mary of the Tower	Regent	Trinity
Governor	Le Prise or Margaret of Dieppe	Sweepstake
Martin Garsya	Bonaventure	Mary Fortune
	Carvel of Ewe	

each had a bowsprit and spritsail with more or less modern-style standing and running gear (Oppenheim, 1896: 40). The term carrack still denoted a vessel of Mediterranean origin, although by this time the English had begun integrating some of the southern traditions into their designs. A 1487 Exchequer warrant for the paying out of construction funds for the Regent states that the money is "for the building of a ship of which he [Sir Richard Guldeford] has the oversight in the county of Kent of 600 tons, like unto a ship called the Columbe of France", which the King had seen while in Brittany (Oppenheim, 1896: 35, 36; Laughton, 1961: 101). Unfortunately, nothing is now known of the Columbe, but seven years earlier, the carrack the Carraquon was the largest ship in the French navy (see above), so it is

entirely possible that the Columbe, and therefore the Regent, was a carrack as well. Certainly by the middle of the reign of Henry VIII (1509-1547), there were several English ships designed "carrack-fashion."

The Regent and the Sovereign were the only ships built for the navy during the entire reign of Henry VII, except for two much smaller vessels, the Sweepstake and the Mary Fortune, both built at a total cost of only £231. They each had 3 masts with a main topmast, and were fitted out with eighty and sixty oars respectively. Although sometimes referred to as galleys, they were ordinary ships that were small enough to permit the use of sweeps if required. Of the thirteen ships in Henry VII's navy, six, the Grace Dieu (not the same as the ship of that name built by Henry V), Mary of the Tower, Governor, Martin Garsya, Fawcon and Trinity, were inherited by him. The Margaret was a prize from 1490, and the Carvel of Ewe was originally a hired ship bought sometime during the reign. The Bonaventure is only named once: "our ship the Bonaventure...William Nashe, yeoman of our crown hath in his rule and governance." This seems to indicate that she was a royal ship (Oppenhein, 1896: 35, 36, 41).

Although Henry VII did not add many ships to his navy, he did not leave it forsaken. Political conditions of the day were not such as required great fleets at sea, and when he did act abroad, the English ships were only engaged in the unopposed transfer of troops. Thus he was able to rely on the merchant marine to make up the bulk of his fleets. He also sometimes hired foreign, including Spanish,

ships. On a number of occasions he tried to buy Spanish ships, but Ferdinand and Isabela had set stringent restrictions against the sale abroad of ships owned by their subjects (Oppenheim, 1896: 37, 38).

The two achievements that stand out during the reign of Henry VII are the bounty system for the construction of large ships, and the construction of England's first dry-dock and dockyard at Portsmouth (Oppenheim, 1902: 5). The bounty system, which Henry may have imitated from the Spanish, provided that the builder of any new sea-going ship (usually a merchantman) was to be paid, by the crown, a certain amount per ton of burden. The actual amount varied from three to five shillings per ton. This policy, which remained customary for a century and a half, did much to encourage the production of vessels that were at least fit for war service (Oppenheim, 1896: 37).

The dry dock at Portsmouth paved the way for the establishment of a permanent facility for building and repairs that was the first of its kind in England. Until this time, docks were only temporary arrangements by which ships could be laid ashore in a suitable place. The word is derived from the Low Latin diga, or ditch, which perhaps more accurately portrayed its character. But the new dock, built during forty-six weeks of 1495-96, was a modern dry dock, fabricated of timber, stone and gravel, and capable of being emptied by one "ingyn." This facility, and the dockyard surrounding it, made Portsmouth the predominant port of England until the middle of the century, when Deptford, Woolwich and Chatham were founded

(Oppenheim, 1896: 29, 39, 40).

CHAPTER V

HENRY VIII

> "In former times, we finde that our kings have enlarged their dominions rather by land than by sea forces, whereat even strangers have marvelled, considering the many advantages of our seate for the seas; but since the change of weapons and fight, Henry the eighth, making use of Italian shipwrights, and encouraging his own people to build strong shipps of warr, to carry great ordnance, by that means establish a puissant navy..."
>
> From a report of the Commissioners appointed to enquire into the State of the Navy in 1618 (Charnock, 1801: 246).

Henry VIII (1509-47) had more impact, by far, than any of his predecessors on the development of the English navy as we know it. Aside from the historical circumstances mentioned in the introduction, he had a personal involvement and more than a passing interest in naval affairs. He often inquired into the merits of new types of ships and their sailing qualities in a way that implied some technical knowledge and showed more than a political interest (Oppenheim, 1896: 48). At least eighty-five ships were bought, built or captured during his reign, exclusive of galleys and small auxilliary ships, making his navy the strongest in the world. At the time of his death in 1547, England had twenty-eight warships of 100 tons or more. When Elizabeth died fifty-six years later, England had twenty-nine such ships. In addition he constituted the Admiralty Department, which formed the basis for the modern navy (Oppenheim, 1902: 6, 7).

Henry was also a ship designer, perhaps even to the extent of designing at least one entirely new ship type. There are two references that allow us to know this. The first is from Letters and Papers, in which we read that a prize was to be altered "so as she now shall be made in every point as your Grace devised." The second is taken from a 1541 letter from a Chapuys to the Holy Roman emperor, to the effect that "[t]he King has likewise sent to Italy for three shipwrights experienced in the art of constructing galleys, but I fancy that he will not make much use of their science as for some time back he has been building ships with oars according to a model of which he himself was the inventor" (Oppenheim, 1896: 59). Henry's use of Italian shipwrights will be discussed further in Chapter VI, "The galleon question."

There are two primary reasons we know so much about Henry's ships. The first is that his increased emphasis on shipbuilding and the navy led to a great deal more documentation on the subject than had previously been normal. The second is Anthony's A Declaration of the Royal Navy of England, discussed in the literature review.

The Anthony Roll has the vessels split up into three categories; shyppes, galliasses and pynnasses. For the purposes of this thesis I will use the modern spellings for these ship types. The pinnaces, being under 100 tons each, do not really concern us to the extent that the ships and galleasses do. The following list (Table 3) contains the names and tonnages of all the ships and galleasses as they appear on the Anthony Roll. Oppenheim (1896: 49-51) gives different tonnages for

a number of these vessels which he cites but does not explain.

Table 3. The ships and galleasses of the Anthony Roll.

SHIPS	TONNAGE	HOW ACQUIRED
Henry Grace a Dieu	1000	Built **1514**, rebuilt 1540
Mary Rose	1000	Built **1509**, rebuilt 1536
Peter	600	Built **1509**, rebuilt 1536
Matthew	600	Bought 1539, unk. origin
Greate Barke	500	Bought 1539, Hamburg
Jesus of Lubeke	700	Bought 1544, Lubeck
Pawncey	450	Built 1544
Murrian	500	Bought 1545, Danzig
Struse	450	Bought 1544, Danzig
Mary-Hanbrough	400	Bought 1544, Hamburg
Xpoffer of Bream	400 [1]	Bought 1546, Bremen
Trinity-Harry	250	?
Smaell Barcke	400	Bought 1539, Hamburg
Swypstake	300	Built 1539
Mynnyon	300	Built **1523**
Lartyque	100	Prize, 1545, France [2]
Mary-Thomas	90	Prize, 1545, unk. origin
Hoye-Barcke	80	?
George	60	Bought 1546, England (merchant)
Mary-Iamys	60	Prize, 1545, unk. origin
GALLEASSES		
Graund Masterys	450	Built 1545
Anne Gallante	450	Built 1545
Harte	300	Built 1546
Antelop	300	Built 1546
Tiger	200	Built 1546
Bulle	200	Built 1546
Salamander	300	Prize, **1544**, Scotland,French
Unicorne	240	Prize, **1544**, Scotland, Scottish [3]
Swallowe	240	Built 1544
Galie Subtille	200	Built **1544**
Newe Barke	200	Built **1523**
Greyhounde	200	Built 1545
Jennet	180	Built 1539
Lyon	140	Built 1536
Dragon	140	Built 1544

Therefore, since the tonnages are primarily important for comparing one ship to another, I have chosen to give the tonnages as they are listed in the Anthony Roll. The data for the "HOW ACQUIRED" column are primarily from Oppenheim's notes on pages 49-51. Of them, Oppenheim (1896: 48) says:

> The records are not sufficiently complete or detailed to enable the inquirer to be certain in all cases of the exact year of building, rebuilding or purchase, and a further element of uncertainty is introduced by the changes of names which occurred, and continuity of name in what may be supposed to be new ships, but of whose building there is no distinct evidence. The dates printed in heavier type may be taken as exact; the others can only be regarded as likely to be correct, and the tonnage varies at different times in nearly every ship.

By the time of the Anthony Roll, coincident with the last full year of Henry's reign, at most eight out of the twenty ships (shyppes) were English-made. Of these, the three largest, the Henry Grace a Dieu, the Mary Rose and the Peter (Figs. 2, 3, 4), had had their keels laid during the early years of the reign, although they were all rebuilt between 1536-40. Even after rebuilding they show themselves to be part of a sort of "old-school" of shipbuilding in virtually every way. They had tall, overhanging carrack-fashion forecastles and only slightly shorter sterncastles. They are the only three ships where artillery is pictured in the forecastle. Two other ships, the Matthew and the Pawncey (Figs. 5,6), had similar, though less massive, forecastles, with no artillery there. All of the other ships had a much reduced version of the forecastle, where the first one or two decks were preserved intact, with a top deck that consisted of only what fit behind the foremast, eg. Jesus of Lubeke, Swypstake and

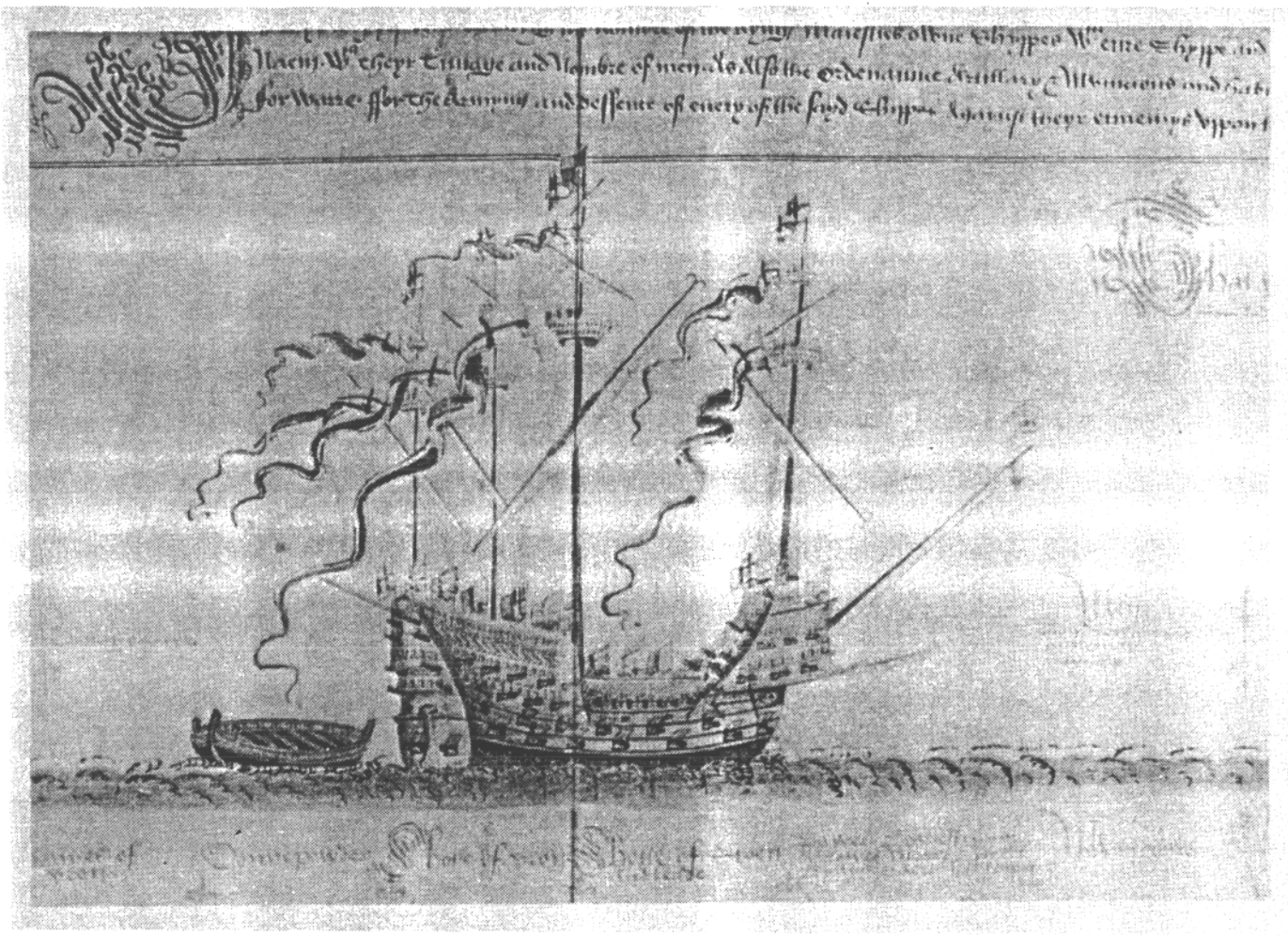

Figure 2. The Henry Grace a Dieu. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

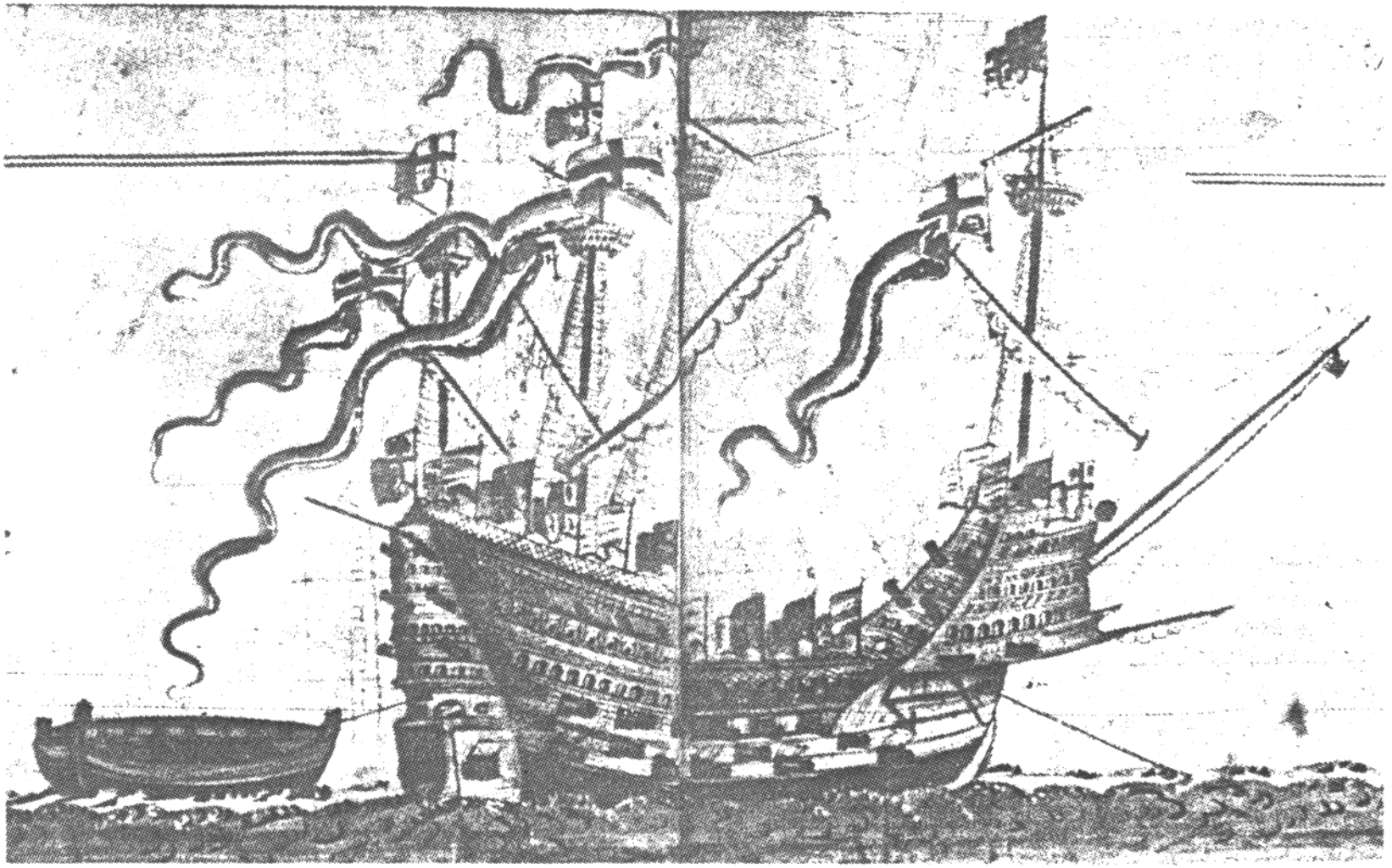

Figure 3. The Mary Rose. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

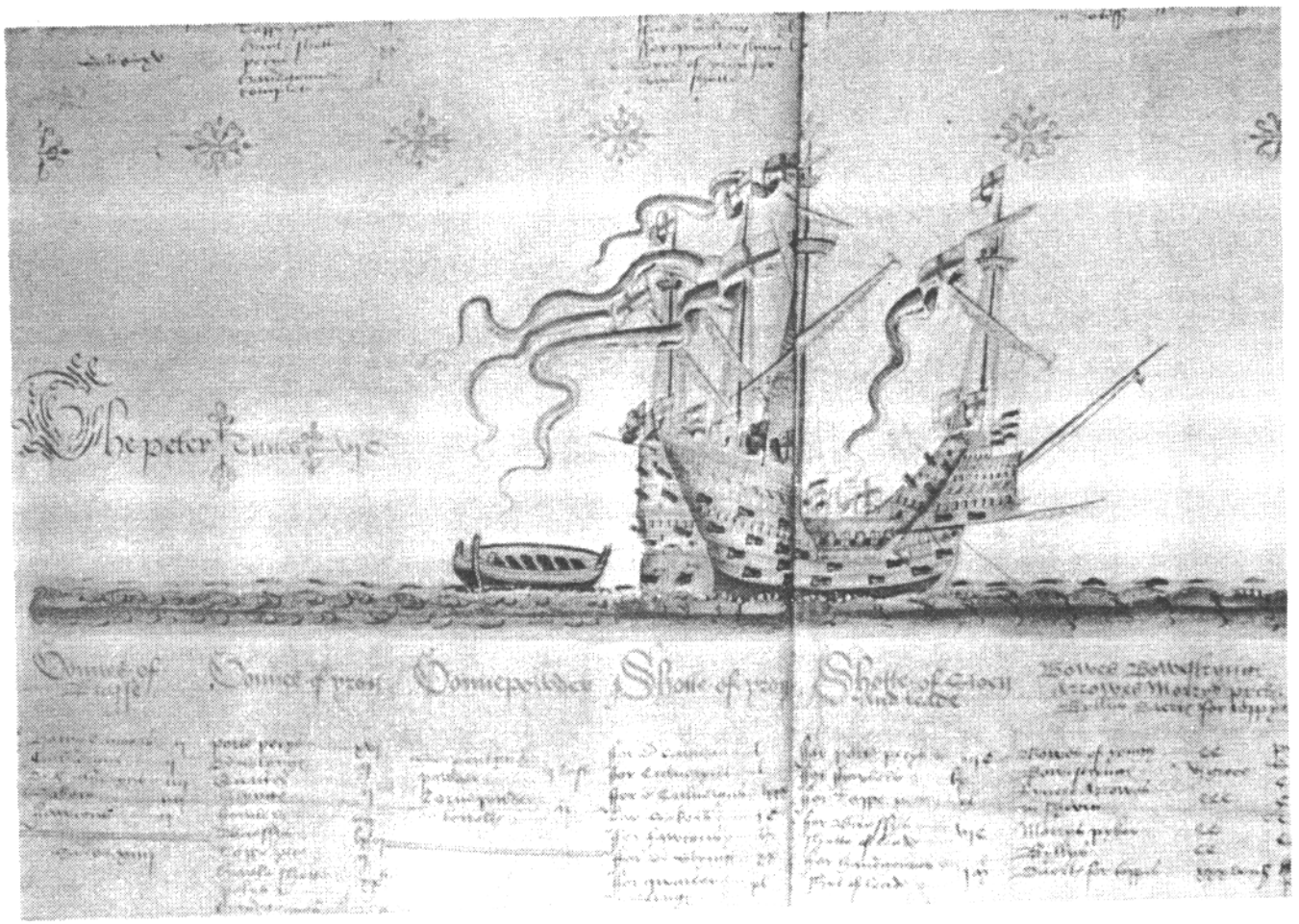

Figure 4. The Peter. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

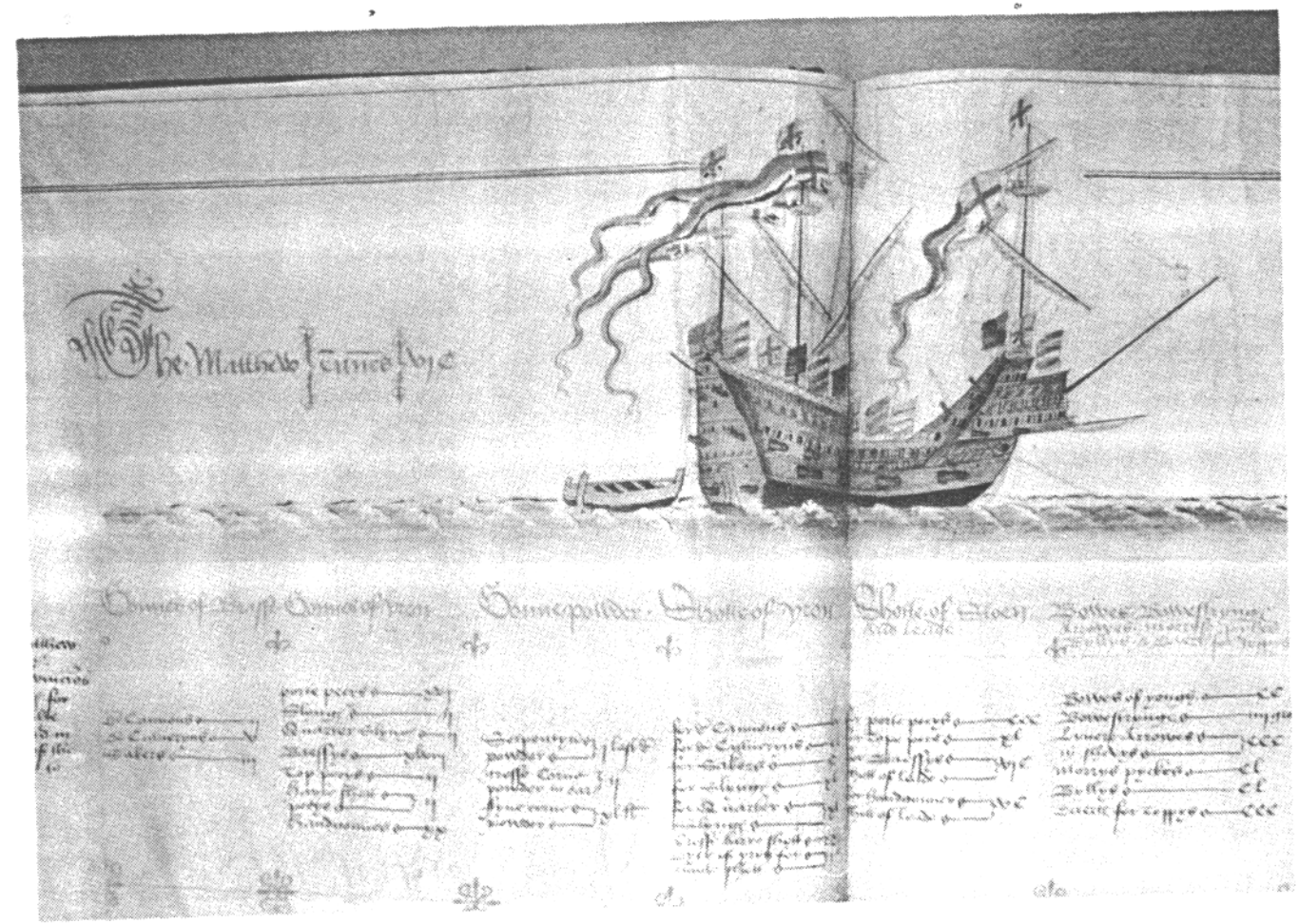

Figure 5. The Matthew. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

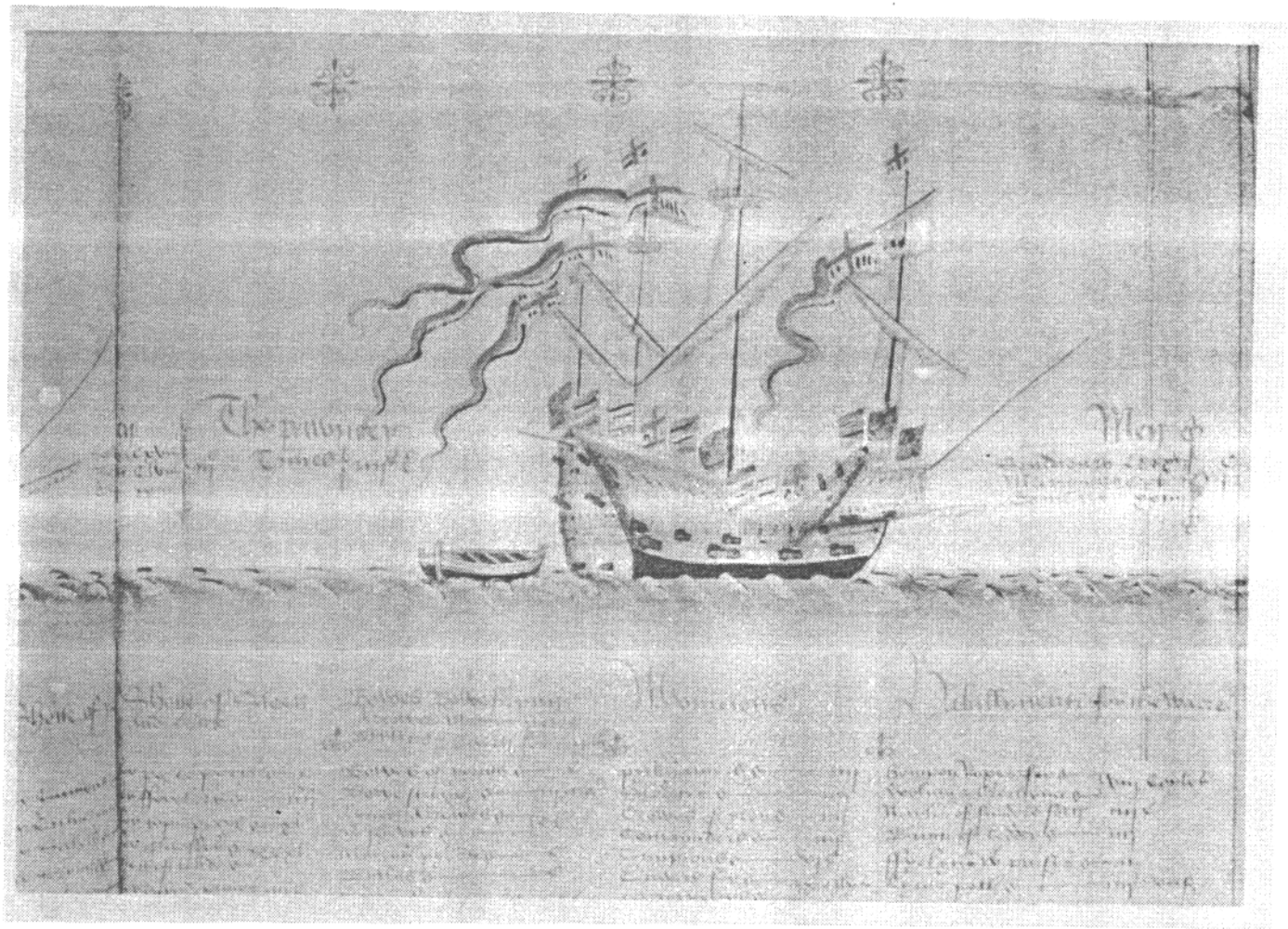

Figure 6. The Pawncey. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

Mary-Hanbrough (Figs. 7, 8, 9). All of the ships had square-tuck sterns, but those of the Henry Grace a Dieu, the Mary Rose and the Peter are the only three that had noticeable, and somewhat ornate, stern tiers. All the rest are pictured with much starker, flatter sterns, though still with considerable rake. All of the ships by this time had carvel, or edge-to-edge planking (Howard, 1979: 45) and four masts, except the Mary-Iamys which had three. I was unable to locate any additional information about the Trinity-Harry or the Hoye-Barcke. But besides those two, of all the ships in the Roll, only one was built in England after 1540, and that was the Pawncey, a 450-tonner built in 1544.

It should be noted that the English-built ships with reduced-style forecastles bore no noticeable distinctions from similarly-sized ships bought from the Hanse regions (Danzig, Hamburg and Lubeck), except for perhaps, a shorter stern. During the early years of his reign, Henry had captured or bought a number of carracks from Genoa and Venice (Oppenheim, 1896: 49-51), but none of them show up in the 1546 list. Only three, or perhaps five, ships that could even correctly be called carracks can be seen there. It seems that Henry got what he wanted from the Mediterranean carrack technology, hull forms perhaps, and then used them to his own ends. The term carrack continued to be applied more or less exclusively to large Mediterranean and French ships.

As far as the individual sailing qualities of these ships, we know very little. In the early part of the reign, the Mary Rose was thought to be the fairest sailor of them

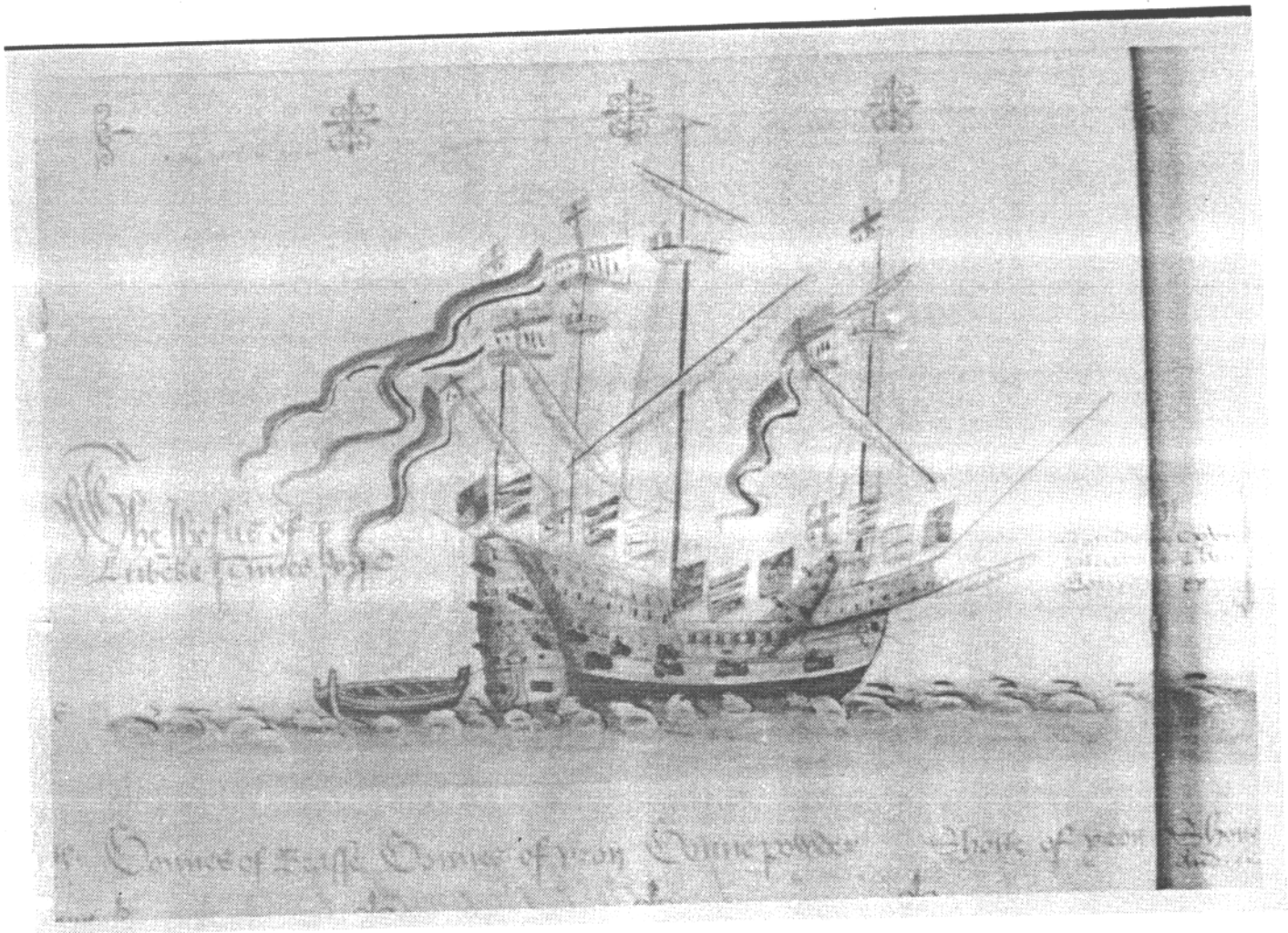

Figure 7. The Jesus of Lubeck. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

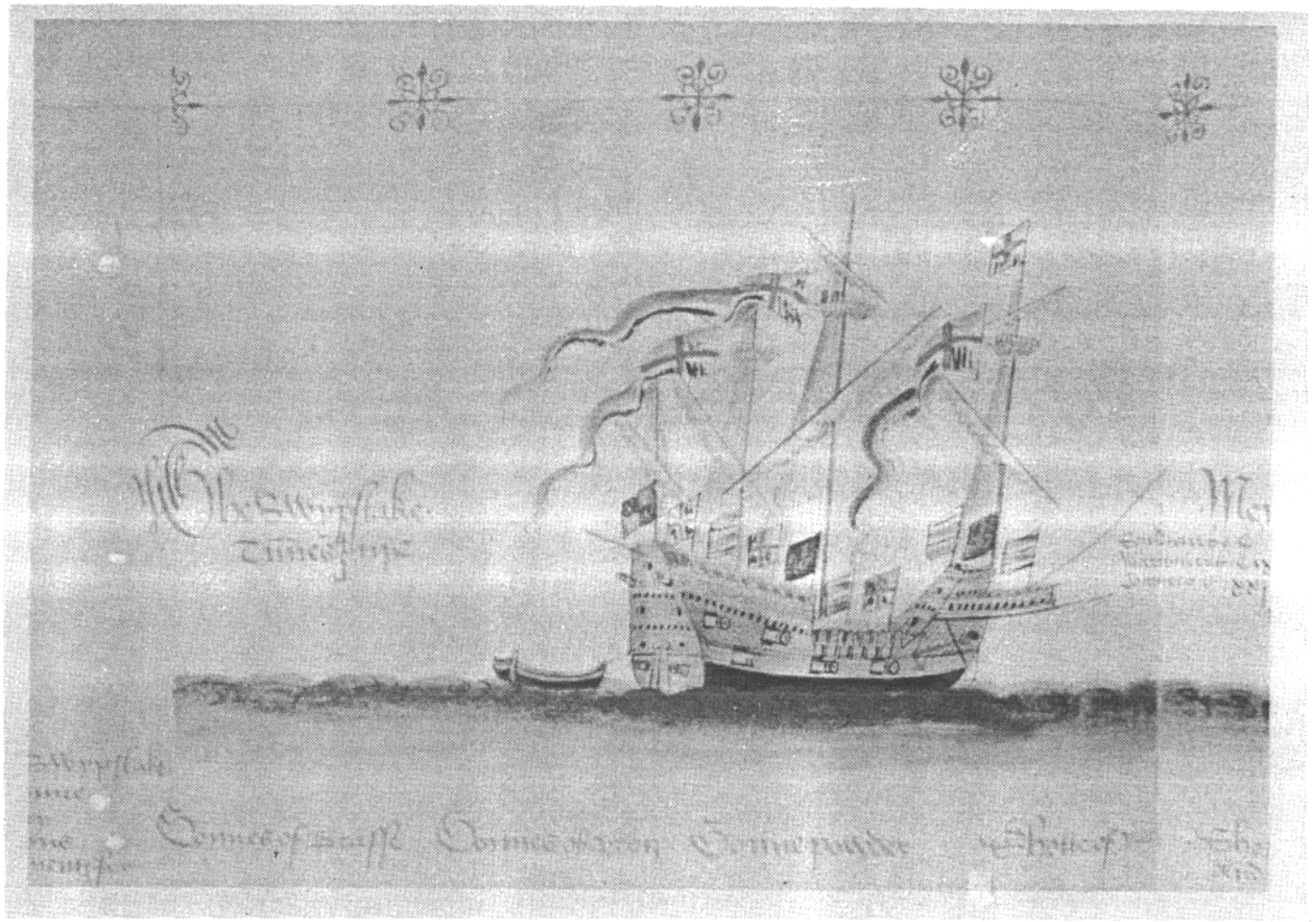

Figure 8. The Swypstake. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

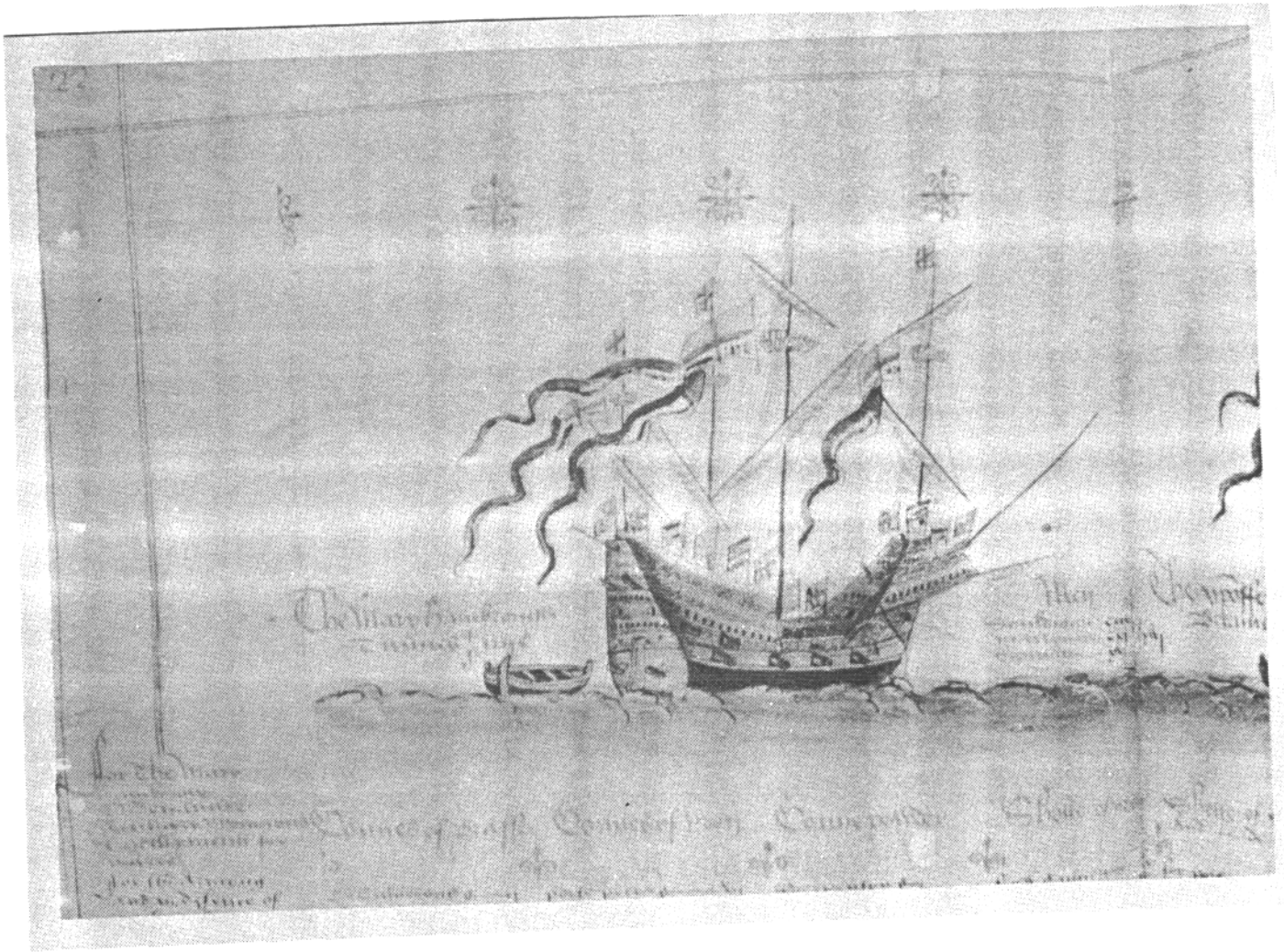

Figure 9. The Mary Hanbrough. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

all (Oppenheim, 1896: 61), but we know that by 1567, John Hawkins was quite unhappy with the design of the Jeus of Lubeke, preferring something smaller and lower. The Minion emerged "battered but whole from many a disastrous voyage, but she killed her crews with terrible regularity" (Williamson, 1927: 341, 355).

In a paper read to the Institution of Naval Architects, G.S. Laird-Clowes (1927:1) claims that the ships, "despite their lofty fore- and after-castles, did not really stand out of the water to the extent shown by Anthony Anthony and some other contemporary artists." As evidence he mentions two 1545 manuscript drawings of the harbor at Calais, by Thomas Pettyt, preserved in the British Library. Some of the ships from these drawings can be found in Howard (fig. 10), but to me their freeboards look no different than those of the small ships in the Anthony Roll.

As previously mentioned, only eight out of the twenty vessels classed as 'ships' were built in England. In contrast, thirteen of the fifteen vessels classed as 'galleasses' were English-built, ten of them after 1544. There can be no doubt, therefore, that this is the direction towards which Henry's naval energies were directed in the later years of his reign.

The galleasses can be separated into three types based on their design. Type 1 is exemplified by the Anne Gallante (fig. 11) and is characterized by a ram-like beak, complete with beak-knee, projecting from the bow. The lower edge of the beak is approximately level with the waist of the vessel, and the vestigial forecastle is but a modest rise in the hull above that waist. There is a bowsprit, but no visible

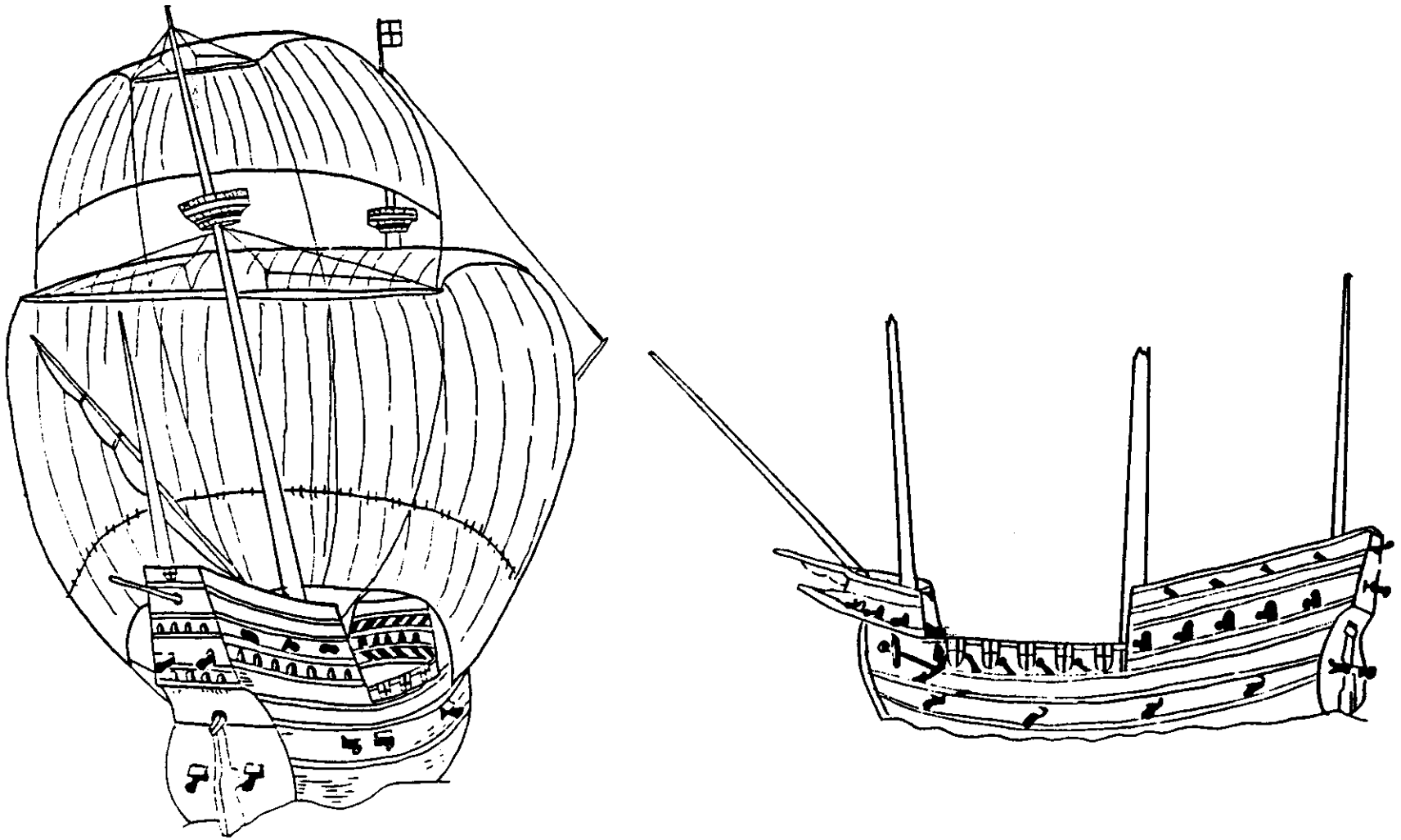

Figure 10. Some ship drawings by Thomas Pettyt, ca. 1540. (After Pettyt; Howard, 1979: 46-47).

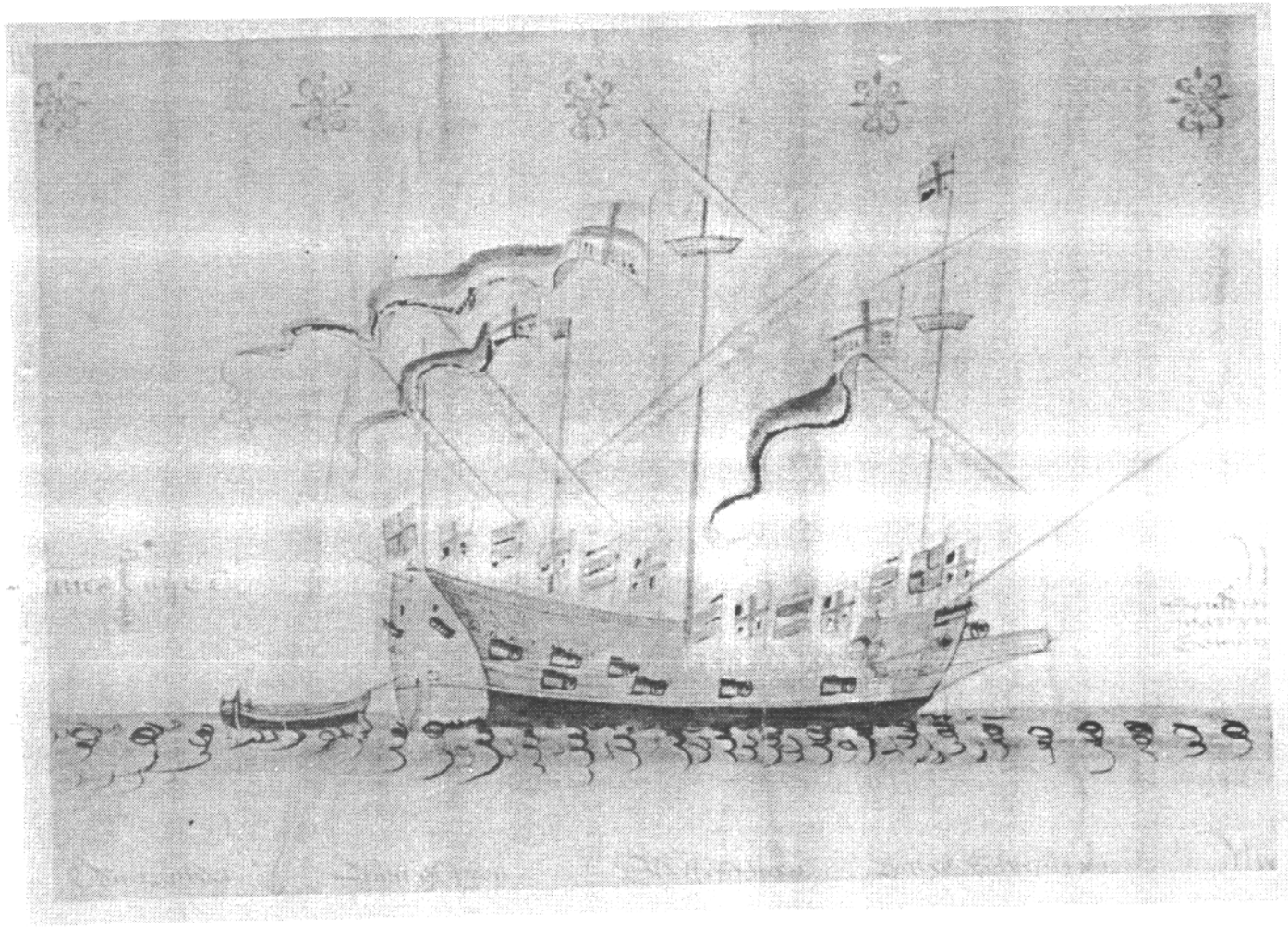

Figure 11. The Anne Gallante. From Anthony, 1546 (Admiralty MS 22047).
By permission of the British Library.

over the beak. A comparison of the Anne Gallante, one of the two largest galleasses at 450 tons, with an English-built **ship** of 450 tons, the Pawncey (Fig. 6) well illustrates their differences. The Pawncey had a large forecastle, at least one extra deck on the sterncastle, and no beak. The forecastle of the Anne Gallante is, more or less, what would be left if you were to remove the entire forward superstructure of the Pawncey. The other galleasses which fall within the parameters of type 1 are the Graund Masterys, Salamander, Unicorne, Greyhound, Jennet, Lyon and Dragon. This list includes the two largest, four smallest and both prize galleasses, and two of the three that were built before 1544. These, like all of the galleasses, had four masts, with square sails on the main- and foremasts and lateen sails on the mizzen and bonaventure mizzen.

The type-2 galleass is exemplified by the Harte (Fig. 12). It is characterized by no visible castles or waist. Instead, it is as though somebody took the Anne Gallante, and filled in the area between the two castles. This had the effect of making a single superstructure, which was then extended over the bow to compliment the beak, which appears slightly lower than that of the type-1 Anne Gallante. In the picture of the Harte there appears to be a bow chaser between the bow superstructure and the beak. The superstructure is undoubtedly for protection while in battle, and also appears to allow the Harte to mount all of its guns on the main deck without being too exposed to enemy fire.

This type is unlike any of the 'ships' in the Roll in any way. It can be compared,

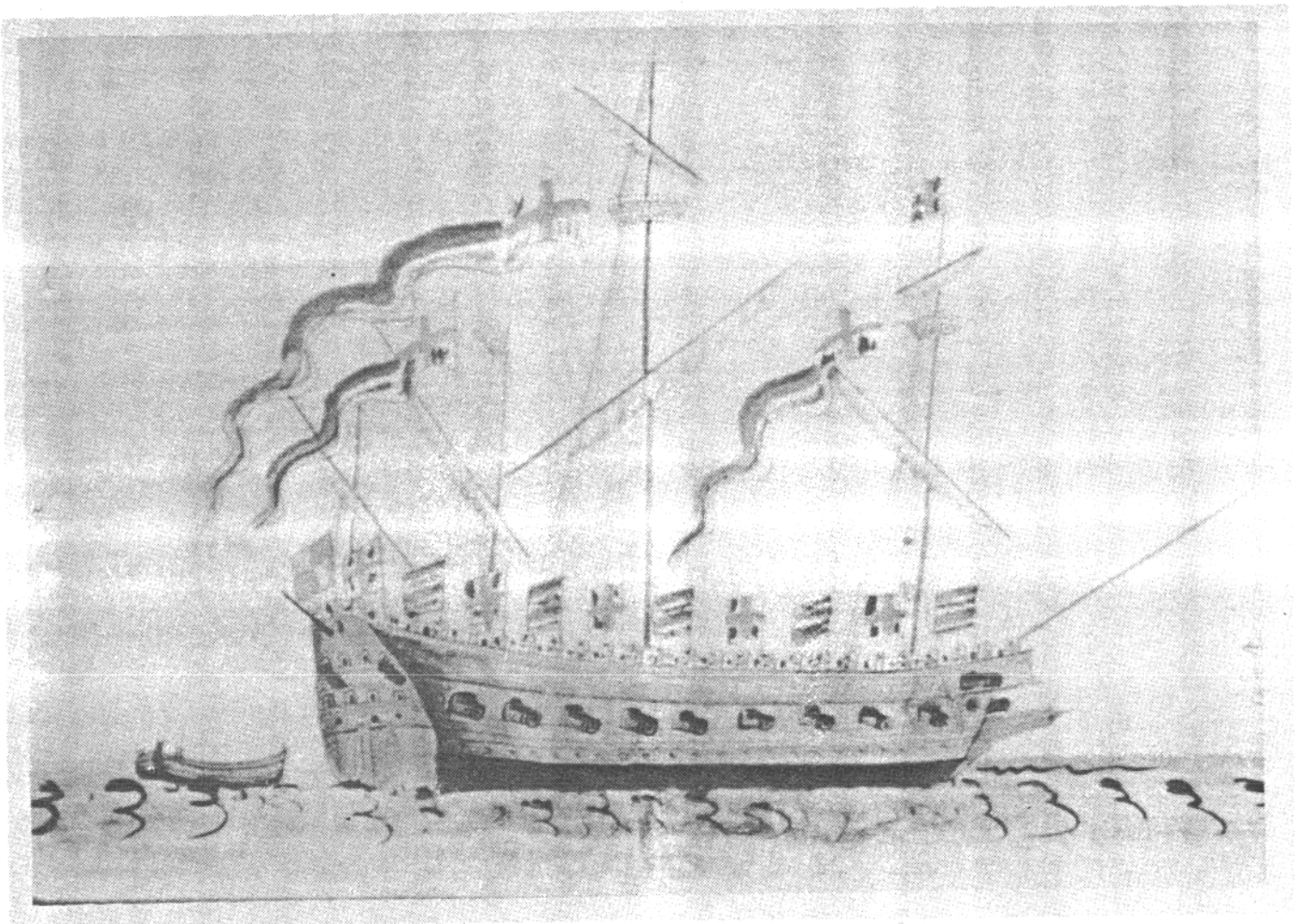

Figure 12. The Harte. From Anthony, 1546 (Admiralty MS 22047). By permission of the British Library.

for example, with the Swypstake (Fig. 8), a ship of the same tonnage and built only a few years earlier. One glance will tell you that this is an entirely different concept in ship design. The other galleasses that fall into the parameters of type 2 are the Antelop, Tiger, and Bulle. These four galleasses represent all of the vessels larger than 100 tons built by the English in 1546, the year of the Anthony Roll, and it has been hypothesized that all of them were designed by a Venetian known as Levello (Armstrong, 1973: 10). One of the advantages of this type appears to have been the ability to carry a greater number of large guns. The type-2 galleasses Harte, Antelop and Tiger, at 300, 300 and 200 tons respectively, each carried about twenty-four guns, while the type-1 Graund Masterys and Anne Gallante, at 450 tons apiece, could carry only about twenty, and the Swypstake, a **ship** of 300 tons, is shown with only fourteen large guns. Although we have no dimensions for these ships, the Bulle was rebuilt in 1570, where it was reported that she had a rather high keel/beam ratio of 3.64 (Glasgow, 1964: 184), and a letter of 1588 refers to the original dimensions of the 1545 galleasses as having produced keel/beam ratios of 4.00 (Barker, 1983: 6).

The type-3 galleass is the one that most resembles a cut-down version of one of the ships, and is exemplified by the Swallowe (Fig. 13). It had a sterncastle just like the type-1 galleass, and a forecastle not unlike the smaller English and Hanse ships. The lowest guns appear through ports, apparently from the orlop, and the beak, shown at approximately the same height as that of the Anne Gallante, is less

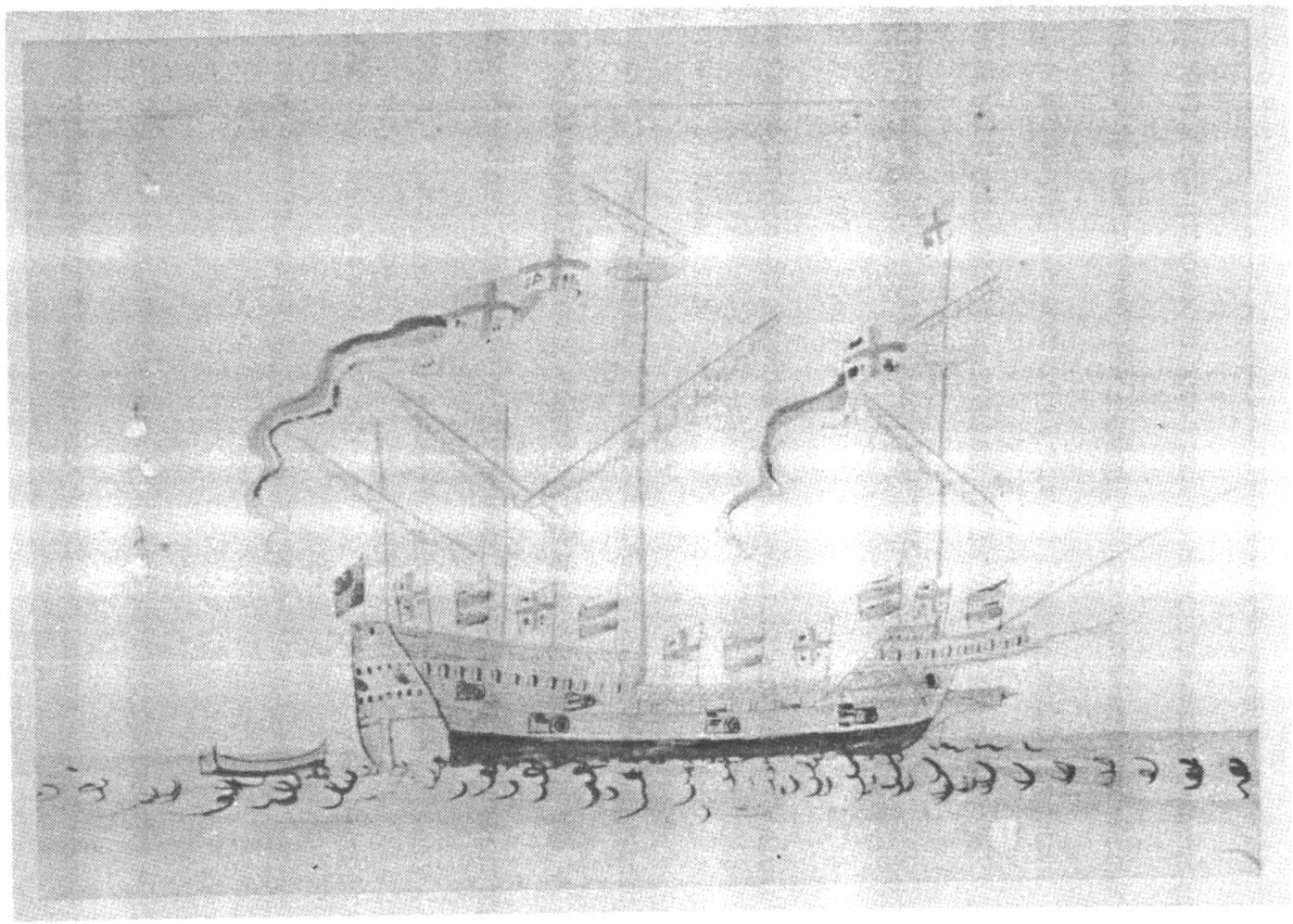

Figure 13. The Swallowe. From Anthony, 1546 (Admiralty MS 22047). By permission of the British Library.

inclined than the beaks of the other two types. There is no bow chaser, and very few guns overall, suggesting lighter construction than the type-1 and type-2 examples. Aside from the Swallowe, there is only one other type-3 galleass, and that is the Newe Barcke, the oldest galleass still in service in 1546. Its name and slightly primitive design (compared to types 1 and 2) lead me to believe that it was an early model of the new ship type. The Swallowe was one of only two galleasses built in 1544, and the only other ones that are older are the Jennet and the Lyon, both small, type-1 galleasses. It would appear that the business of building large galleasses was begun in earnest only after 1544.

The last vessel listed as a galleasse was the Gallie Subtille (Fig. 14), a Mediterranean-style light galley built in 1544. It was built by imported Venetian shipwrights and was completely different from the other galleasses. Instead of four masts it had only one with a large lateen sail. It had an entirely Mediterranean-style stern superstructure, and no bow superstructure at all. And importantly, it is depicted with oars. The subject of oars has been greatly debated, but this tells me that types 1, 2 and 3 were primarily sailing vessels, or oars would have been shown by Anthony. This opinion is borne out by the Roll of Pynnasses, which shows some pinnaces with oars, like the Harpe (Fig. 15) and some without, like the Brygendyn (Fig. 16).

There are several other reasons for believing that the galleasses were mainly sailing vessels. For one thing, rowed craft require calm water, a rare occurrence

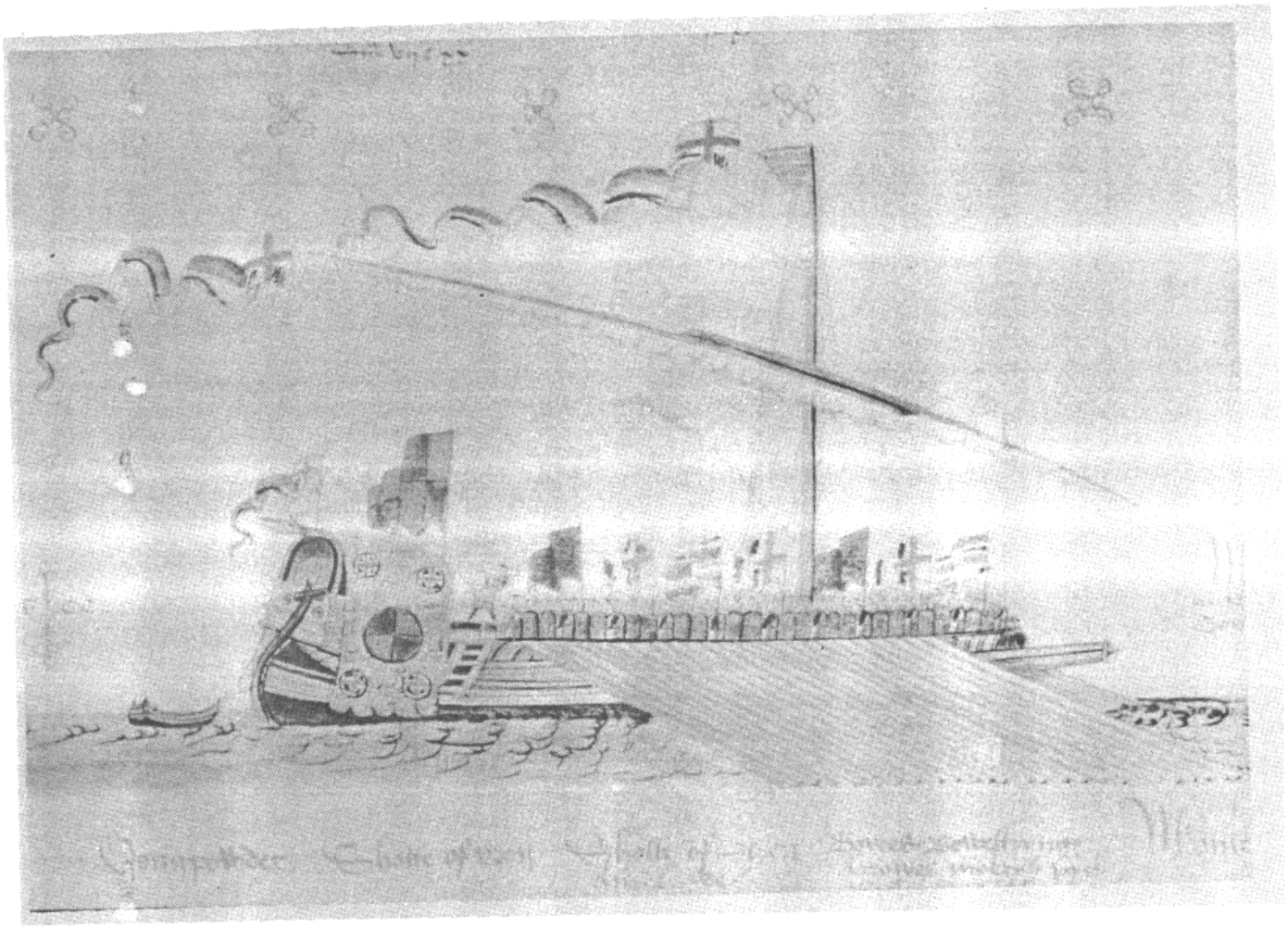

Figure 14. The Gallie Subtille. From Anthony, 1546 (Admiralty MS 22047).
By permission of the British Library.

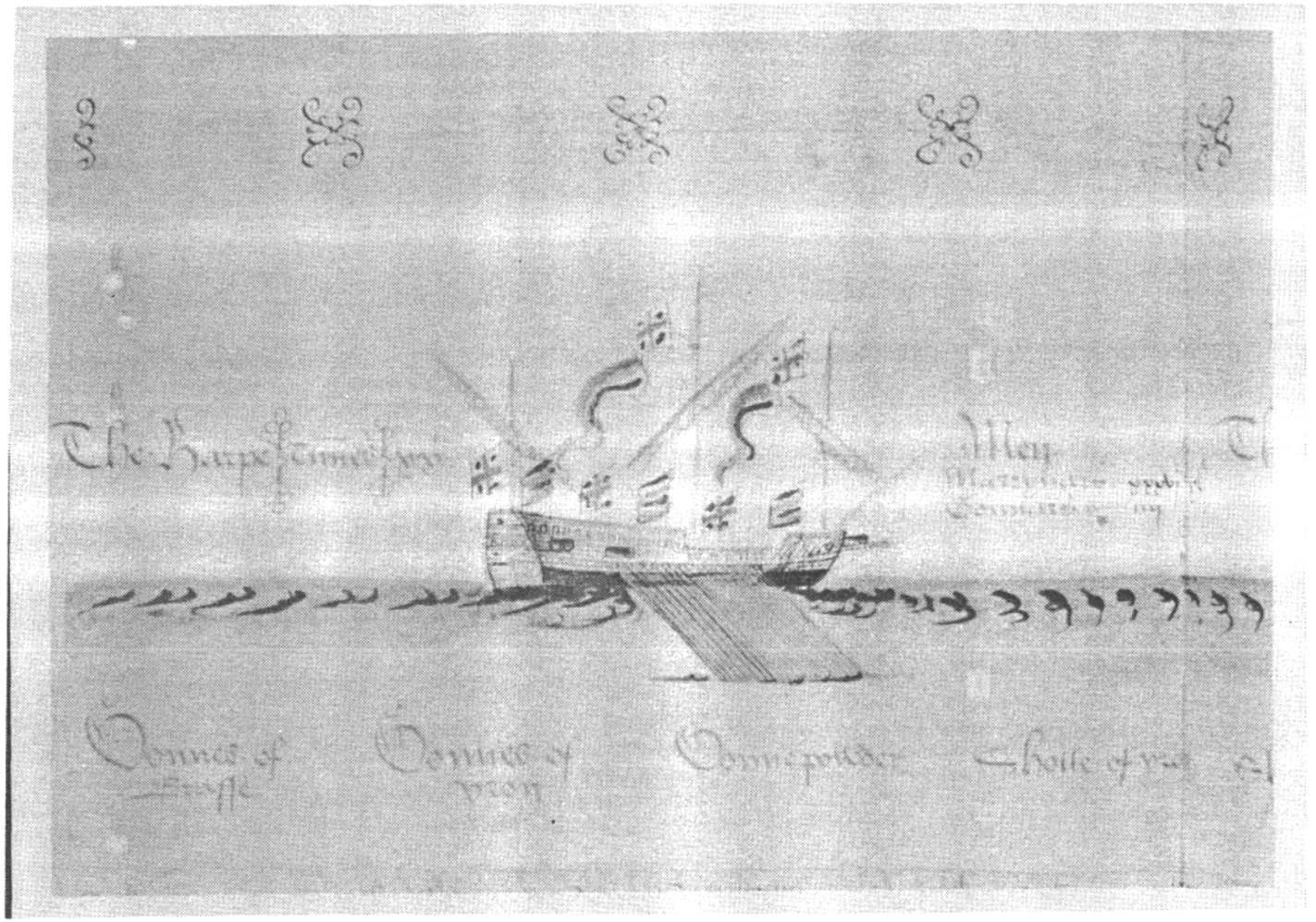

Figure 15. The Harpe. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

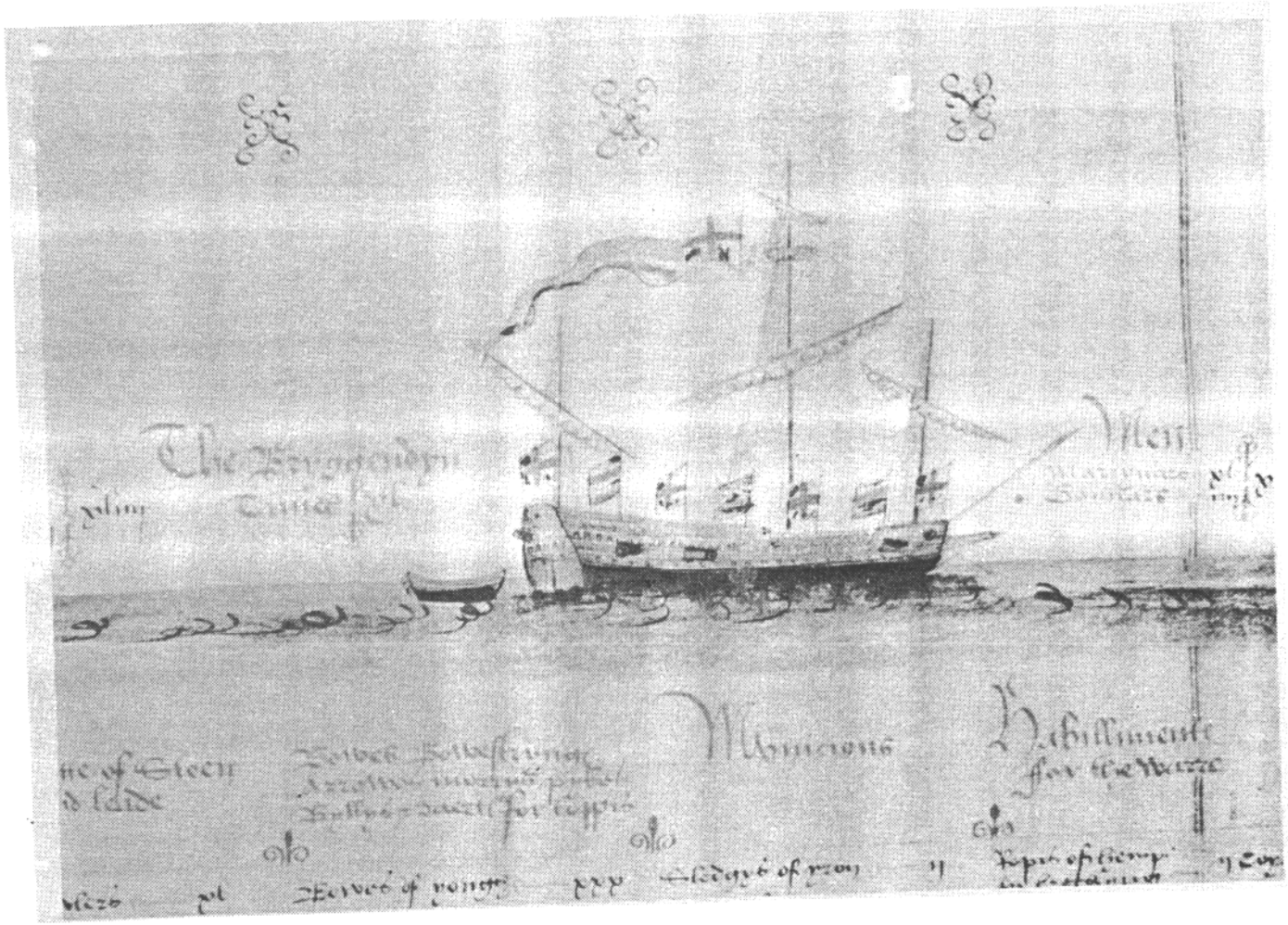

Figure 16. The Brygendyn. From Anthony, 1546 (Pepys Library MS 2991). Courtesy of the Master and Fellows, Magdalene College, Cambridge).

indeed in English seas. There was also the problem of manning the oars. Aside from the question of skill, "condemning prisoners to the galleys" was a concept that did not exist in England, and it was difficult to attract free men to such a distasteful task (Armstrong, 1973: 10).

The most noteworthy features of these galleasses are the ram/beak that appears on all of them and the dramatic lowering of the castle superstructures, especially the flush-decked appearance of the type-2 galleasses. One obvious question is, what was the beak for? There does not appear to be any rigging attached to it, although soon afterwards there would be. This was probably just an afterthought, as a well-stayed spar would have done the job just as efficiently (Vaughan, 1914: 40). Laughton (1925: 31) supposes "that this beak was adopted by sailing ships so they might be able to meet oared galleys with their own weapon." More than likely they were, like the galley rams, combination bumpers/boarding ramps, since boarding had not yet been made a totally obsolete method of warfare at sea. The spur at the tip of each one lends weight to this supposition.

One way or the other, the galleasses of Henry VIII were a brand new concept in English naval warfare. This leads us to the next chapter, where the question of their origins and ancestry is discussed.

CHAPTER VI

THE GALLEON QUESTION

The earliest instance I have been able to find of an English ship being called a galleon by an Englishman dates to the reign of Henry VIII. It is from Letters and Papers, 19th April, 1545, and in it, the author writes of a "great galleon" and a "second galleon" under construction at Smalhithe (Oppenheim, 1896: 51). Oppenheim has tentatively identified those two vessels as the Graund Masterys and the Anne Gallante, both large, type 1 galleasses. Whether or not this was truly the first instance is unimportant. What is important is the fact that these vessels were called galleons, as later in the century this term would become synonomous with state-of-the-art naval architecture throughout Europe.

The origin of the galleon and how it came to England is not altogether clear. In 1927 Williamson (413) wrote: "After the work of Sir J.S. Corbett and Mr. Oppenheim some thirty years ago, it should hardly be necessary at this date to labour the point that the galleon [of 16th century England] represented the new and not the antiquated type of vessel." While he was correct that the new galleon was a different type of craft than the first vessels of that name from some 100 years earlier, the galleon of the last quarter of the 16th century did not just "become" a new type of vessel. It evolved directly, and through demonstrable channels, from a technological "gene-pool" of characteristics available to Elizabethan shipwrights. Certainly, the topic can benefit from some discussion after a fifty year hiatus.

Oppenheim traces the origin of the term to the galeonus of the 13th-century Mediterranean. This was , he says, a small and especially fast galley, common for the time (Oppenheim, 1903: 320). Unfortunately, he does not cite his source.

The next references to galioni occur in the first half of the 15th century, at Venice. The Venetians are generally recognized as the originators of the galleon, and in in the 15th and 16th centuries, three different types of ships were called galionus by them: oared galleons, warships for use on rivers; great galleons, the large roundships designed especially for military use; and a certain unrevolutionary type of Cretan merchant ship.

The first of these to be documented were the oared galleons used on the rivers during the Italian wars involving Venice in the early 15th century. Although great numbers of these ships were built at that time for the Venetian arsenal, there is very little mention of their construction there only a century later (Lane, 1934: 38).

The oared galleon probably possessed characteristics similar to those of one described in Theodoro's Instructione, a Venetian document of the mid-16th century. The measurements given are Venetian and have the following values (Lane, 1934: 33):

1 pace = 5 Venetian feet
1 Venetian foot = 16 Venetian inches (deda).

For a modern reference, one Venetian foot equals .34 meters.

The instructions begin with the statement "Measures of a galleon (galion)

rowed by oars" and go on to describe a vessel that had a "length from rudder to beak" of 20 paces, a beam of 21 feet, with a stem rake of 10 feet, a stern rake of 7 feet and a depth of 6.5 feet (Lane, 1934: 38).

Lane interprets "from rudder to beak" as length on deck, and the evidence seems to bear this out. Given the rakes, this would yield a keel/beam ratio of approximately 3.95. Lane does not mention whether or not these were sailing vessels, but the deck-length/beam ratio of a galley was about 8.00 (Bass ed., 1972: 211) and that of a great galley was, by definition (Lane,1934: 33), 6.00: "I remind you that great galleys are derived by design from the beam. Six times 23 [feet, the beam] they know will make 27 paces and 3 feet, so much should be the length of the galley." This translates to a keel/beam ratio of approximately 5.00. This sizable difference would have put the galioni at a great disadvantage against the galleys if they could not have utilized sail power as well as oars. These may have been the vessels that Simoneta referred to in 1447, in describing galleons used on the Po, "Sunt autem galeones triremibus breviores sed latiores et sublimiores" (Galleons are shorter than galleys, but broader of beam and higher free-board). He went on to say that they had a superstructure fore and aft and were sailing vessels (Corbett, 1898: 338).

Galleons were mentioned again in 1495 by a Frenchman, Du Parc, who described those that were in the service of Charles VIII as "a kind of vessel bearing some resemblance to a small merchant ship or to a high and broad galley, which

uses sails and sometimes oars" (Corbett, 1898: 338). It seems that by this time the galleon had become primarily a sailing vessel.

In 1526, another Frenchman, Lazare Baïf, wrote of vessels which he called galleasses, but which Corbett (1898: 39) believes were galleons: "Forma erat mixta ex nave oneraria et longa triremi," that is, they were a combination of the "round" or merchant ship and the "long" or war ship. This characterization could have described either the galleon or the merchant galleass (galeazza di mercantia) of that time. However, it would not really describe the war galleasses of the 16th century,which have been described (Bass ed., 1972: 211) as "nothing more than a large galley, with certain improvements and better armament..." Olesa Muñido (1971: 269) basically agrees, stating that each galleass had a permanent and numerous crew of oarsmen, and that although they lacked the lightness of the galleys, they could propel themselves independently of the wind. Corbett (1899a: 4, 11) explains war galleasses as an attempt to reconcile broadside fire with oar propulsion, the smaller, lighter galleys not having the strength or the freeboard to fire anywhere besides end-on or forwards. The larger galleasses could mount a few broadside guns and cause some aggravation to enemy sailing ships of war, and in their favor, it can be said that they lasted in the Mediterranean until the end of the 16th century, and even were part of the Spanish Armada of 1588. While it is true that Mediterranean war galleasses throughout the century had sails and mariners to handle them, they were primarily oared vessels (Bass ed., 1972: 211). If

navigation was required, they could use sail power or travel under tow (Olesa Munido, 1971: 269).

The first "great galleon" built for the Signoria of Venice was completed in 1530. It was built by Matteo Bressan and may have been related to the barze, the large round-ships which Leonardo Bressan, foreman of the shipwrights of the arsenal, had been building for the past 30 or 40 years. In any case, Matteo's galleon was highly esteemed as a war ship, and when, in 1547, it was finally declared unseaworthy, the Senate gave orders for its measurments to be recorded so that its design might be repeated. It is unclear why, but no more were built in Venice until 1554, when one designed by Giovanni Maria Spuazza capsized on its maiden voyage while leaving port. Another, built by Vettore Fausto, was launched in 1570, but was hardly used after its first voyage for fear that it too would capsize. Apparently, the Venetians were initially unable to produce a vessel that would be fast under sail, but which could also carry a heavy load of ordnance on the upper deck and castles (Lane, 1934: 41, 42).

Theodoro gave a keel length of 20 paces, a beam of 33 feet, a stern rake of 11 feet, a stem rake of 24.5 feet, and a depth of 11 feet as being among the characteristics of a great galleon of the middle of the 16th century. Translated to metric, this yields a vessel that is over 36.6 meters long, with a keel/beam ratio of 3.03. It also had tumble-home construction, two decks, and a forecastle that projected 16 feet (Lane, 1934: 43-45). This contrasted with a merchant galleon of

the time, which, for a keel of 10 paces had a beam of 20 feet, or a ratio of 2.50; the sternpost raked 6.5 feet, the stempost 15 feet and the depth was 6.5 feet. The merchant galleon also had tumble-home construction, although the sides were much rounder than those of the great galleons. These large round-ships were commonly referred to as naves (Lane, 1934: 46-49). The Venetian galleon of 1564 shown in Charnock (with questionable accuracy) is undoubtedly one of these two galleon types (Charnock, 1801: 24). The guns and high superstructure suggest it is a great galleon (Fig. 17).

The 16th century marks the period when Venice started losing her influence as a great maritime power, and by the middle of the century, she lagged behind much of Europe in warship technology. With the recent discovery of the New World, the Mediterranean basin lost much of its strategic importance, and the old maritime states were unequipped to produce vessels that could handle the rigorous transatlantic crossings. The early Venetian galleons, as we have seen, were not very seaworthy in storms or heavy seas. In the beginning, therefore, the nao (heir of the navis) and especially the caravel were preferred for trade and exploration (Bass, 1972: 216). However, once the Atlantic powers began concentrating on building bigger and better warships, the supremacy of sail over oar for warships would never again be questioned.

Although the Mediterranean maritime states lost their power, their influence would never be forgotten. They paved the way for the revolution in ship design that

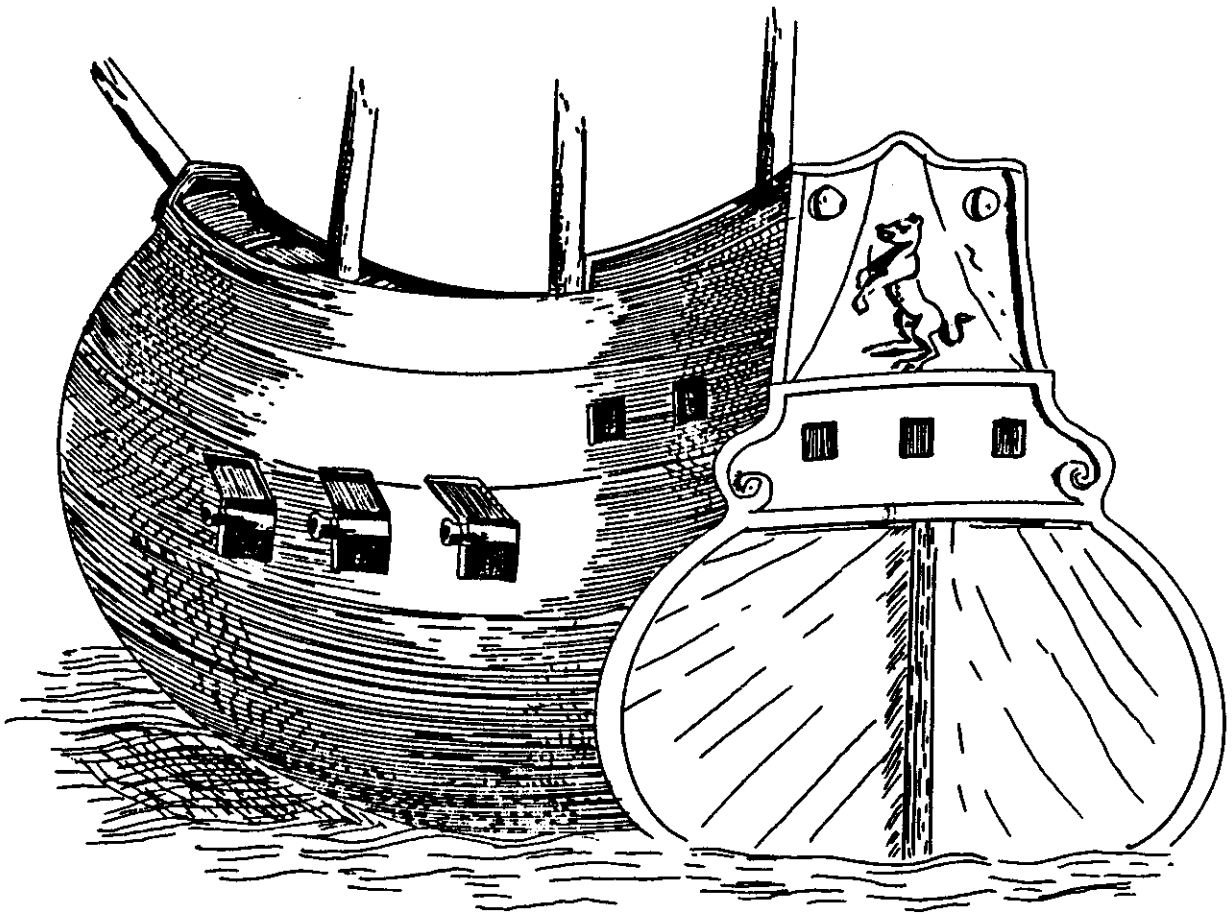

Figure 17. A Venetian galleon of 1564. After Charnock (1800: 24).

was on the horizon in the early 1500's. By the end of the 16th century no navy in Europe was free from Venetian influences. John Charnock (1801: 73) explained it this way:

> The cause is obvious and the effect natural. The states of Genoa and Venice, which proudly led the van both in respect to power and skill in naval tactics, were followed with avidity, as to their customs, by all nations which attempted to vie with them, or were ambitious of becoming their rivals... such were the means by which the Portuguese, the Spaniards and the English themselves, first acquired the knowledge of the different proportions of weapons, of stores and of men, in their different classes, whether rated as mariners, as soldiers or as gunners...

It was for these reasons that Henry VIII imported shipwrights from Venice, and Genoa as well, (Charnock, 1801: 39) to help him improve his navy. But more significantly, there was one Venetian vessel with which he had direct contact. That was the galeazza or galéa di mercantia, the merchant galleass that conducted trade between Venice and London. It was described by Corbett (1898: 339), citing Coronelli's Atlante Veneto, where Coronelli called it the galéa or galeazza di Londra, and he wrote that it was generally along the lines of a war galleass, but with a length/beam ratio of 3.60. It carried three masts, with the foremast flying square sails, and the main- and mizzenmasts flying lateen sails. In order for them to work in and out of confined waters and rivers, they were equipped with oars, but only as an auxilliary means of propulsion.

Unfortunately, Corbett does not quote the passage or even say whether the

figure he gives for the length/beam ratio represents the keel length or the length on deck, and either can be inferred. For any kind of quantitative analysis, this data is critical.

However, for the kind of qualitative analysis being done here, it will suffice to say that these merchant galleasses had a keel/beam ratio of between 3.00 and 3.60, probably the latter. A vessel with either ratio would have been considered too wide to be a good rower, and yet less beamy than most pure sailors. It has been mentioned previously that the keel/beam ratio of the Bulle, one of Henry VIII's galleasses, was 3.64, and this is highly suggestive. Though the galeazzi di Londra were undoubtedly coasters, they must have been built with more strength than would normally have been necessary in the Mediterranean so that they could safely navigate the Iberian coastline and the English channel. The fact that Coronelli described this vessel by comparing it to a war galleass places it closer to the oared galleon than to the great galleon, both of which had fore and aft superstructures. However, its length/beam ratio indicates more of a sailing vessel, like a great galleon. It should be remembered that the galeazza di Londra was a merchant ship on a fairly long voyage, so it must have had ample cargo space.

The pattern that stands out in all of this confusion is that in the early 16th century, sailing ships were just beginning to challenge the supremacy of the galleys that had been the centerpiece of naval warfare in the Mediterranean for more than two millennia. The harbinger of this change was the advent of gunpowder

weaponry at sea, which allowed sailing ships to stand off from attacking galleys and thus keep themselves from being boarded. No longer faced with the certainty of a boarding attempt by the enemy, a ship with a small crew and gunpowder weapons was able to provide a successful defense against one or more war galleys. Even armed galleys, which carried main centerline bow guns, had to turn head on to an opponent to deliver or receive an attack, just as they had had to do during boarding operations, whereas the armed sailing ships were capable of delivering multiple broadsides (Guilmartin, 1980: 257, 266). Out of necessity, the Mediterranean maritime powers began to try to combine the positive attributes of both the fast, maneuverable, galley-type vessel and the sturdy, economical sailing, or round, ship. Out of all of this technology several new ship types appeared. When ships started carrying big guns in their castles, the original oared galleons just didn't have the strength, stability or freeboard to carry guns enough to compete. One compromise was to increase the freeboard so that broadside guns could be mounted, while at the same time decreasing the keel/beam ratio to compensate for the loss of stability that resulted. This, more or less, would describe the so-called great galleons of the mid-16th century reported by Lane.

The Venetians never solved the stability problem, but the English did. They took what was basically a Venetian vessel, probably the galeazza di mercantia, and put guns on it. But the revolutionary improvement that they made was to put the guns below, rather than above, the main deck.

Without getting into a discussion of who invented or introduced hinged gun-port lids, it was in the navy of Henry VIII where the idea was best put to use. By cutting the gun-ports directly into the (now) carvel-built hulls, the English were able to get a greater number of large artillery pieces below the waist of a ship, lowering its center of gravity while, at the same time, making it possible to increase the total number of guns on board.

Therefore, when Henry and his ship-builders first decided to experiment with a galeazza di Londra- styled craft, their first impulse was not to raise its sides, but to lower its gun-deck. This is the chief reason that the English were able to make the long, low sailing craft work and the Venetians were not.

We can see this improvement in the types-1 and -3 galleasses, where the lowest level of guns is quite clearly below the main deck. In the type-2 galleass, the guns appear to be all at main-deck level, although, for what it is worth, the type-2, 300-ton Harte (Fig. 12) seems to have been a beamier vessel than the type-1, 450-ton Anne Gallante (Fig. 11), with a higher freeboard normally associated in the Mediterranean with the great galleon. The galleasses were generally outfitted with sweeps for auxilliary propulsion only, and the row of circles below the guns in the Harte has been interpreted by some as oar ports. The same features can be seen on many of the pinnaces that are shown without oars, and it was from such ports in the hulls of rowed pinnaces like the Harpe (Fig. 15) that the oars emanated. Certainly, it would have been difficult to row the Harte from way up on the

superstructure. Notice also, that even small vessels like the 40-ton Bryggendyn (Fig. 16) carried a small amount of broadside artillery, although on or above the main deck level.

CHAPTER VII

AFTER HENRY VIII

The death of Henry VIII led to a period of indecisiveness in ship design. Henry had left the navy with two basic strategies for ships of war, the great-ship design exemplified by the Henry Grace a Dieu and the Jesus of Lubeke, and the galleass design, exemplified by the Anne Gallante and the Harte. The high-charged great-ships followed a long medieval tradition of manning navies with the largest ships that could be obtained. The new galleass-style vessels relied more upon nimbleness, allowing them to gain tactically superior positions from which to release their broadsides. Without Henry to dictate which direction to take, there was naturally a great deal of debate on the subject within the Admiralty Department.

In addition, the factious struggles of the reign of Edward IV (1547-53) and the religious difficulties of the reign of Mary I (1553-58) were not at all conducive to a settlement on any particular design. That would have to wait for Elizabeth. However, certain activities did take place which advanced the cause of the navy. Even though very little construction or rebuilding of ships took place during Edward's rule, two important steps in the development of naval policy were taken. The first was the commencement of the great Gillingham (Chatham) yard, which helped to alleviate the limited anchorage space afforded by Woolwich and Deptford and was closer than Portsmouth to the center of government and the merchants supplying stores. The second step was the formation of a separate and responsible

victualling department. Previously, victualling had been performed by a dozen or so independent agents with no central authority to control them. This was probably an idea planned by Henry VIII which he himself had not had a chance to implement (Oppenheim, 1896: 100-103).

During Mary's reign, many of the ships acquired by Henry VIII began to require rebuilding, and towards the end of her rule, she spent more per year for the care and building of the fleet than Elizabeth spent in any single year of her reign (Glasgow, 1964: 180). It is true that by the time Elizabeth took the crown, Henry VIII's fleet of 28 ships of 100 tons burden or more had been reduced to twenty, some of them unserviceable . However, Elizabeth inherited two large, new ships in the making, Elizabeth Jonas at 1000 tons and Hope at 600 tons (Oppenheim, 1896: 120, 121, 124), and eight galleasses and pinnaces had been rebuilt. The galleasses were the Harte, Antelop, Swallowe, Newe Barke, Jennet and Greyhounde, and the pinnaces were Phoenix and Sacar (Oppenheim, 1896: 110).

CHAPTER VIII

ELIZABETH

The accession of Elizabeth I (1558-1603) began another great period of experimentation. Armed with new technology and a young monarch, and facing a growing Spanish threat, the English aggressively pursued designs that would give them incontestable command of the sea.

The evolution of the hull forms of the ships of that period can be followed both by pictorial, documentary and descriptive evidence. At first, the pattern was quite clear, and ships related to both the great-ship and the galleass were produced, the former getting a little smaller, and the latter getting a little larger. This trend led to a situation where, for the first time, the word ship came to be used generically to describe any vessel over about 100 tons.

The 'long-and-low' versus 'tall-and-strong' ship debate continued well into Elizabeth's reign. In a mid-16th century context, the debate was quite reasonable. The broadside was still a relatively new and untried method of naval warfare. The tactics were just being worked out, and ships were still being taken on a regular basis by boarding. Oppenheim (1896: 122) claims that the Admiralty did not like the larger ships, being too big, too unhandy and too expensive, and that they were never used unless a fleet of great strength was required, but this is a simplification. Sir William Monson distinguished between two classes of ships by referring to the low type as "flush-decked ships," which he said were better sailing machines that

could get within pistol-shot of the "high-built ships" and shoot them below the water line without the enemies' guns being able to touch her. On the other hand,he continued, they were highly indefensible from boarders and afforded little cover for the deck hands (Oppenheim, 1913: 92; Corbett, 1899a: 356-57). However, for fighting against galleys he wrote, "If it were my choice I would rather have two ships of 200 tons each to encounter six galleys, than one ship of 1000 tons to fight two galleys..." (Oppenheim, 1913: 105), and he categorically condemned ships of three decks as being always overgunned and unhandy (Corbett, 1899a: 357).

Many actually preferred the old style of great-ship. Sir Richard Hawkins cites their virtues as being superior for boarding, able to carry heavier weight of artillery and stronger crew, but chiefly "for majesty and terror of the enemy." Apparently, some of the tactical advantage lost by the largest great-ships was made up for by their effect on morale (Corbett, 1899a: 352). Furthermore, in the tactical sense the superstructures truly were castles. In case of being boarded, the English sailors could bar themselves in the fore and aft superstructrues and fire down on the intruders within their ship. Thus a ship of the old English design could rarely be held by boarders unless her "cageworks" had been destroyed by gun-fire (Corbett, 1899a: 355).

Laughton (1961: 104) states that the carrack of Henry VIII was what eventually evolved into the post-Elizabethan ship-of-the-line, and Taylor (1950) has written an article where he traces the evolution from "carrack into galleon." Nance and Prynne

have gone so far as to draw up plans illustrating such an evolution (Nance, 1955b: 291; Bass ed., 1972:227). Nance was writing about Mediterranean and Spanish galleons in addition to those of the English, but the evolutionary process in the two areas was very different, and in the case of England, the weight of evidence points to a fairly clean line of evolution from, not the carrack, but the galleass of Henry VIII to the Elizabethan galleon. One must bear in mind, however, that the English had been building great-ships for more than a century, and that the technology they acquired in doing so was quickly exploited to increase the size of the new-proportioned ships.

English great-ships from the beginning of Elizabeth's reign are not difficult to document. We know from a Navy List of 1565 that the dockyards had built two more of these vessels, the Triumph at 1200 tons and the White Bear at 1000 tons. The 800 ton Victory had been purchased in 1560, and the 600-ton Hope and the 250-ton Aid were the only other new vessels with substantive fighting capability (Corbett, 1899a: 141; Oppenheim, 1902: 8). We also know that there were a few left over from previous reigns.

Pictures of such ships are scarce, but they do exist. One group of pictures based on drawings of ships embellishing a map of Ireland in 1567 by John Goghe (Fig. 18) show quite clearly the existence of the bulky, high-charged type of vessel. One of them even has a marine preparing to release a boarding grapnel from the bowsprit (Howard, 1979: 57). Another source is the atlas of sea charts by

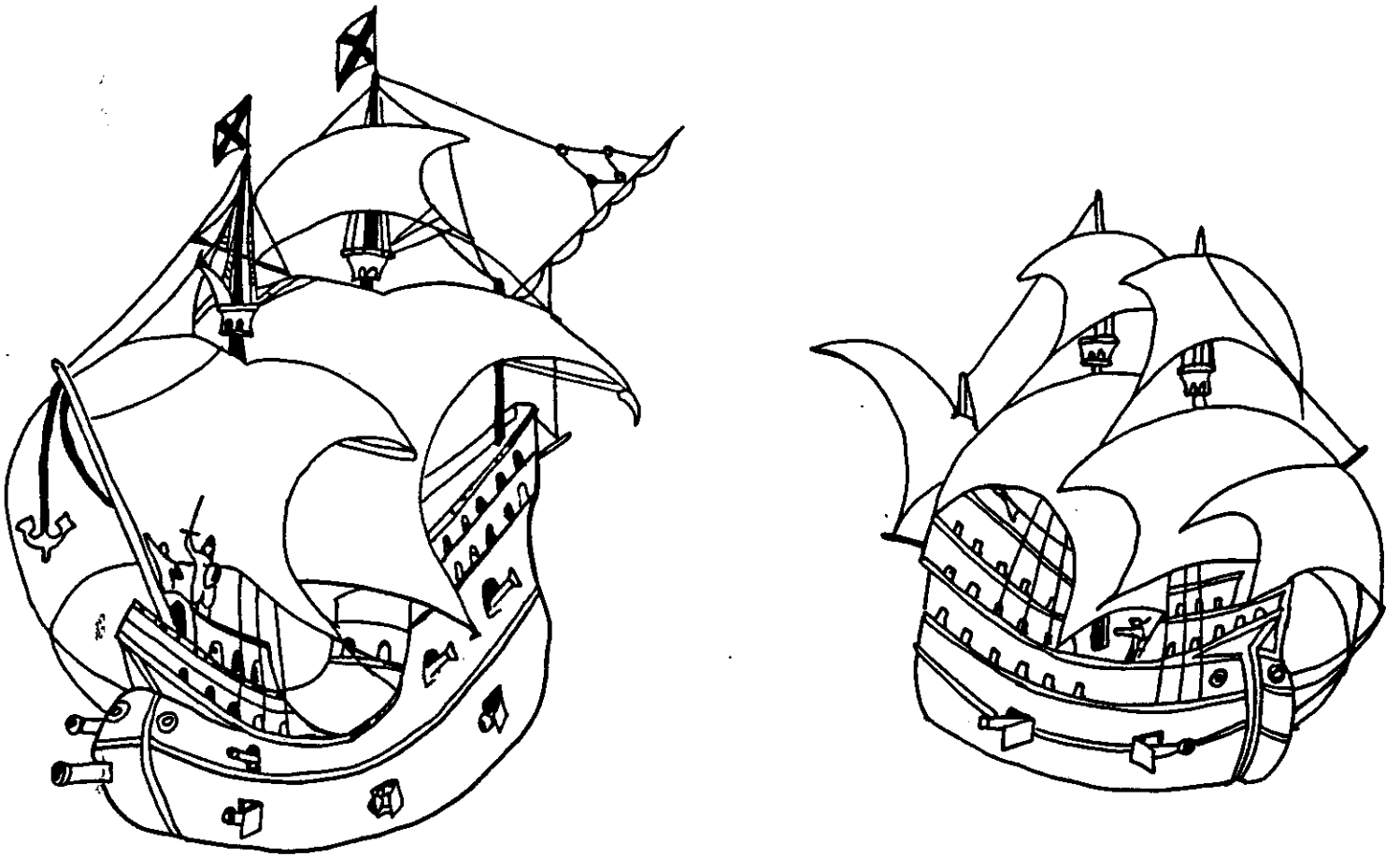

Figure 18. Some mid-16th-century ship drawings by John Goghe. (After Evans; Howard, 1979: 46-47).

Waegener; it was published in 1588 but was undoubtedly many years in the making. On a map on page 6 of the atlas labelled "A perfect description of the sea coasts between S. Malo, and beyond the porte of Roscow" (Fig. 19), we can see three great-ships sailing the coast of Brittany. And on the third page of Mathew Baker's famous manuscript, there is a sketch of a ship with an overhanging forecastle (Fig. 20), though this one seems almost "race-built" (as the low, flush-decked ships were called) compared to the huge floating fortresses of only fifty years earlier.

The above-mentioned manuscript by Mathew Baker, known as Fragments of Ancient English Shipwrightry, was written between 1570 and 1620 and is probably our most valuable document of the period. Mathew was the son of James Baker, shipwright to Henry VIII (Oppenheim, 1896: 132), and he was appointed a royal shipwright in addition to Peter Pett in 1572 (Glasgow, 1964: 183-84). Fragments was his legacy, an instruction manual and sketch book dealing with the design and construction of royal ships. It was added to after his death in 1613, possibly by John Wells of Deptford Dockyard (Barker, 1983: 1-2).

One thing that is immediately apparent in this manuscript is Baker's fascination with the Mediterranean oared ships. We know that he was sent to the Mediterraenean on a training voyage in about 1550, and perhaps he had the opportunity to record some of the foreign methods of ship design (Barker, 1983: 1, 1985: 13). On the second page of Fragments thereis a scene (Fig. 21) wherein

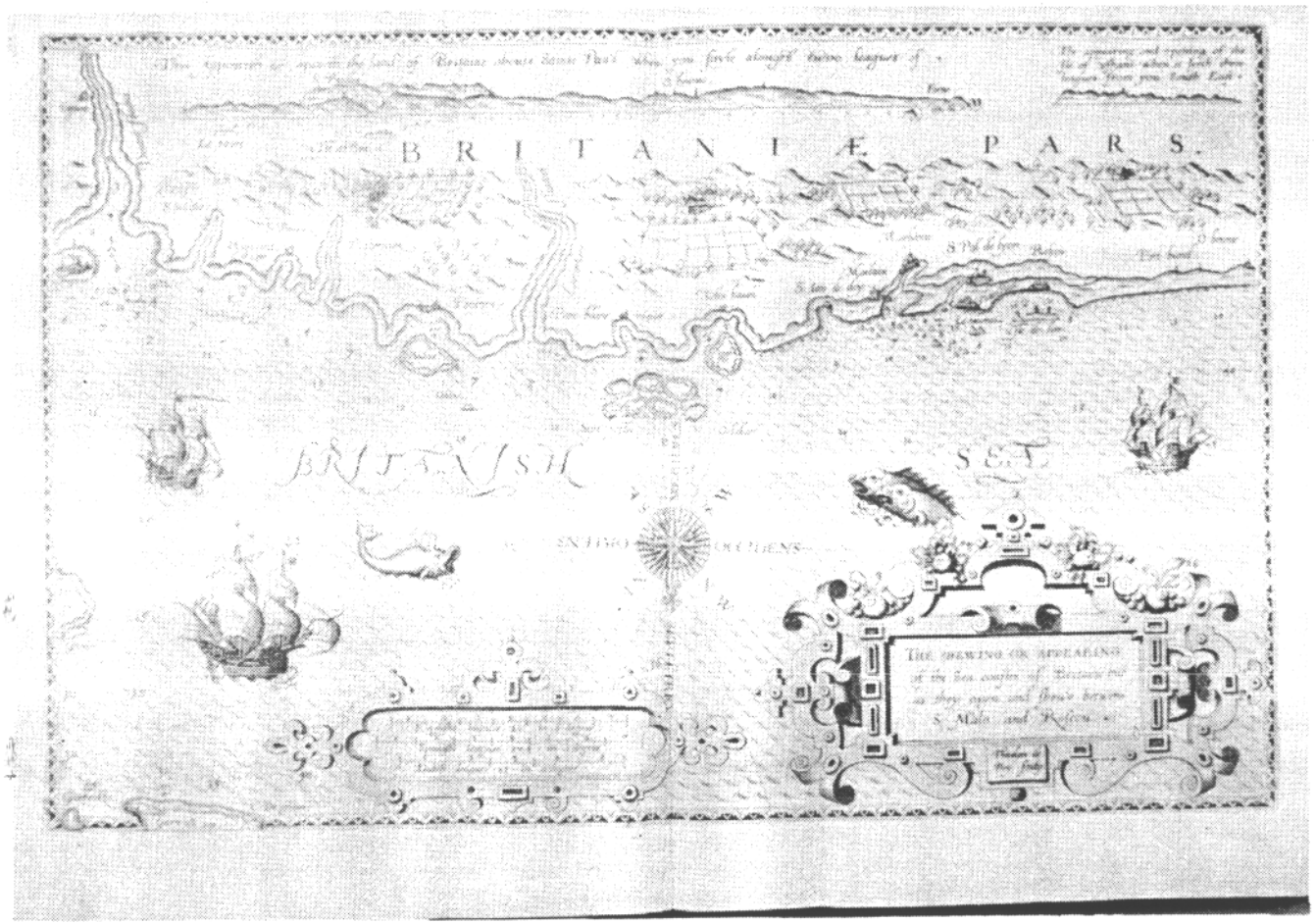

Figure 19. Map of the coast of Brittany. From Waegener, 1588. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

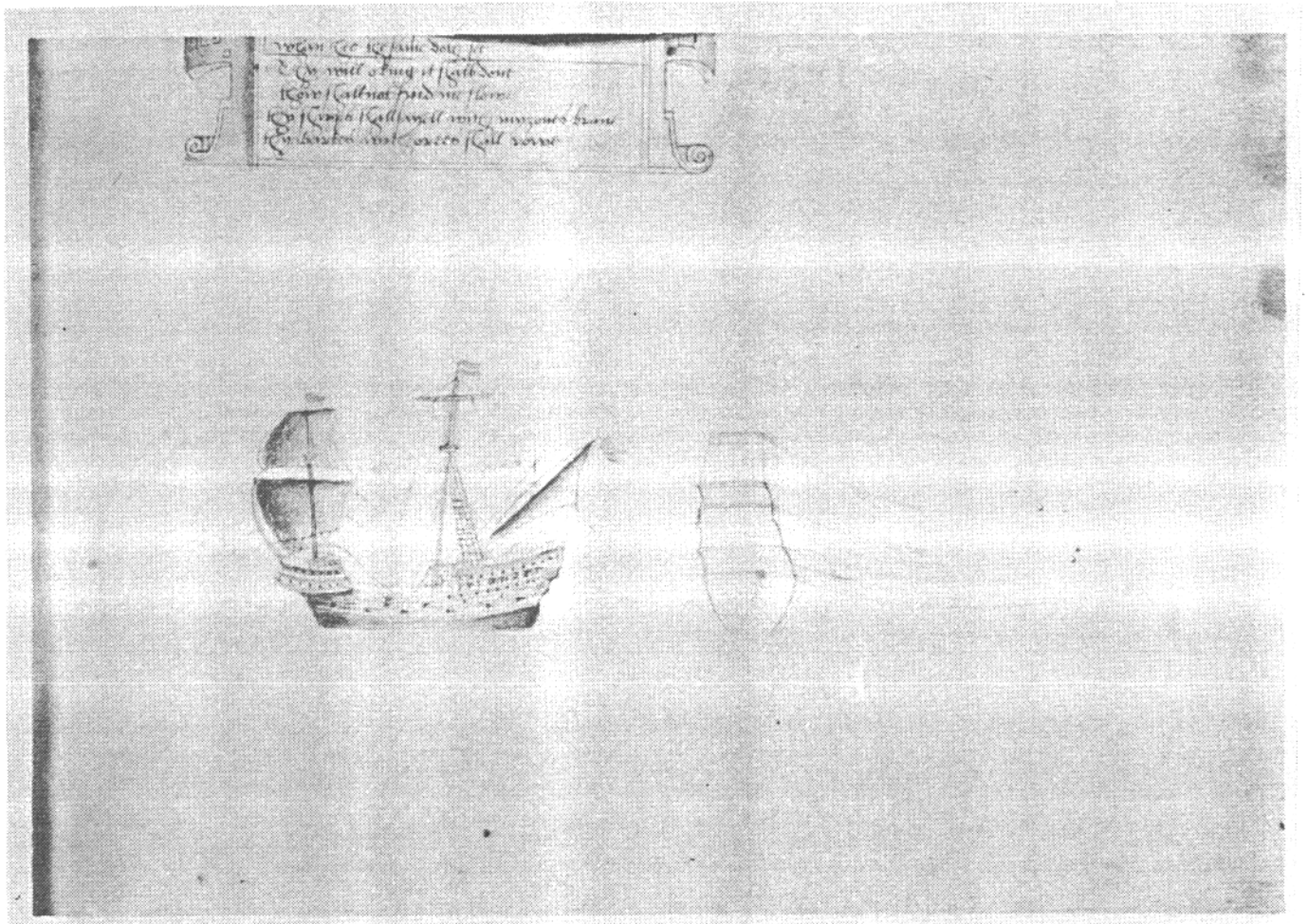

Figure 20. An Elizabethan ship with overhanging forecastle. From Baker, ca. 1570: 3. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

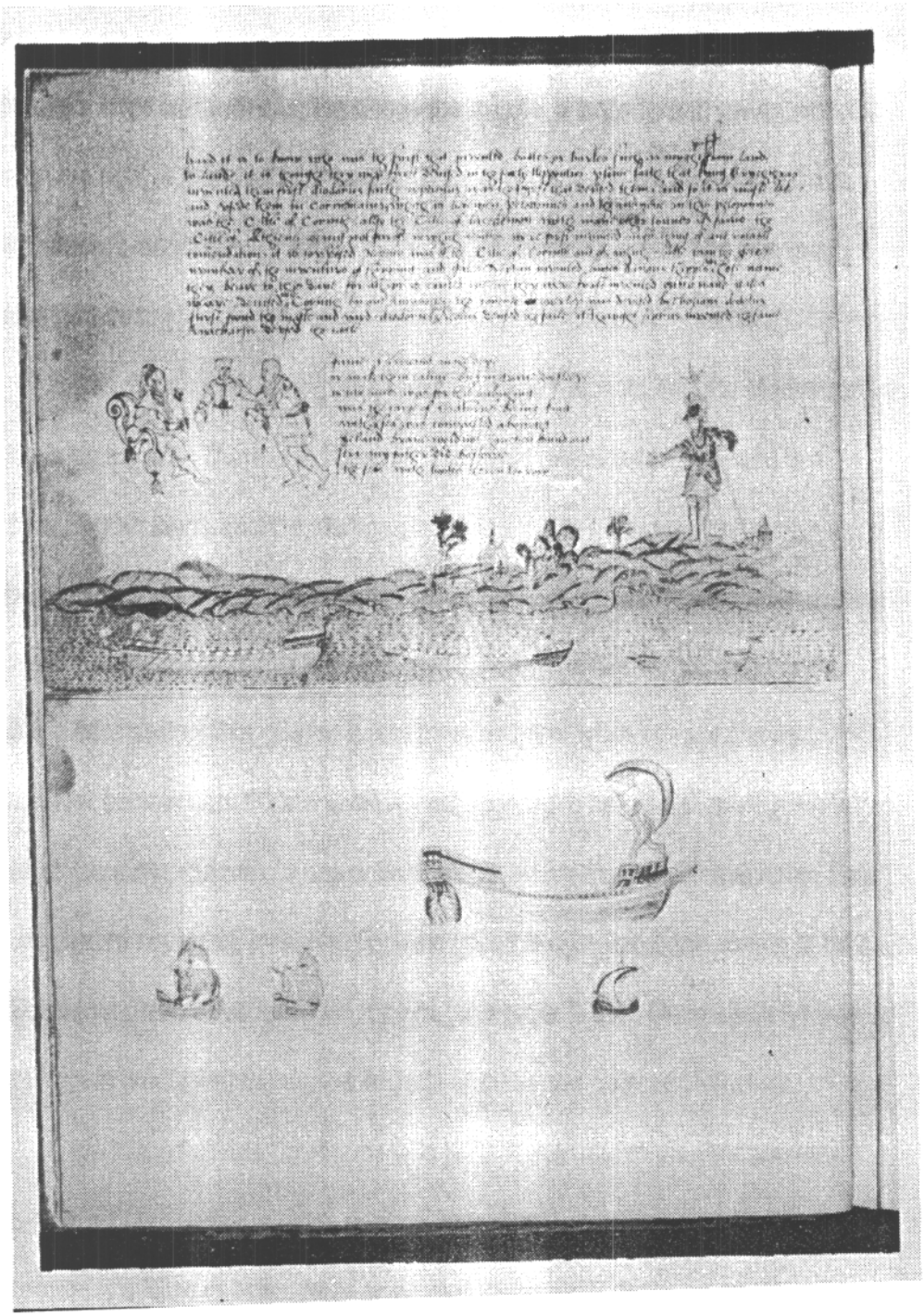

Figure 21. Some Mediterranean-style oared craft. From Baker, ca. 1570: 2. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

Neptune is shown observing a line of three, oared vessels. The vessel on the left is probably a large war galleass; the one in the middle, a large (great) galley; and the one on the right, a standard war galley. They all carry oars, and the masts have been struck, presumably for action. The galleass is the only one that shows any superstructures.

Below this scene is a ship that looks, in many respects, like the Mediterranean galleass on the left. There are, however, important differences. The stern is a modern English stern, and the sterncastle overhangs it. Likewise, the beak is a modern beak, higher on the hull than in the oared vessels, and not as pointed. And on the forecastle there stands a statue-like figure holding a sail, proclaiming this vessel to be a sailing ship. Below it are three different types of sailing ships, perhaps for comparison. The one on the left appears to be a small merchantman with a single mast, the middle one a smallish great-ship that could have come from any number of countries, including England, and the right-hand one seems to be a medieval roundship or carrack, with one huge (square?) sail. Once again we see an attempt at combining the desirable traits of these two classes of vessels.

Page four continues this theme (Fig. 22). It is a map of the Peloponnesian peninsula, and contains drawings of three oared and two sailing craft. In the foreground is a large galleass (with one furled lateen sail). No guns are shown, and the oars only cover about one half of its length, so perhaps it is a type of merchant galleass. Next to it is a war galley (flying its single lateen sail): it is difficult to say

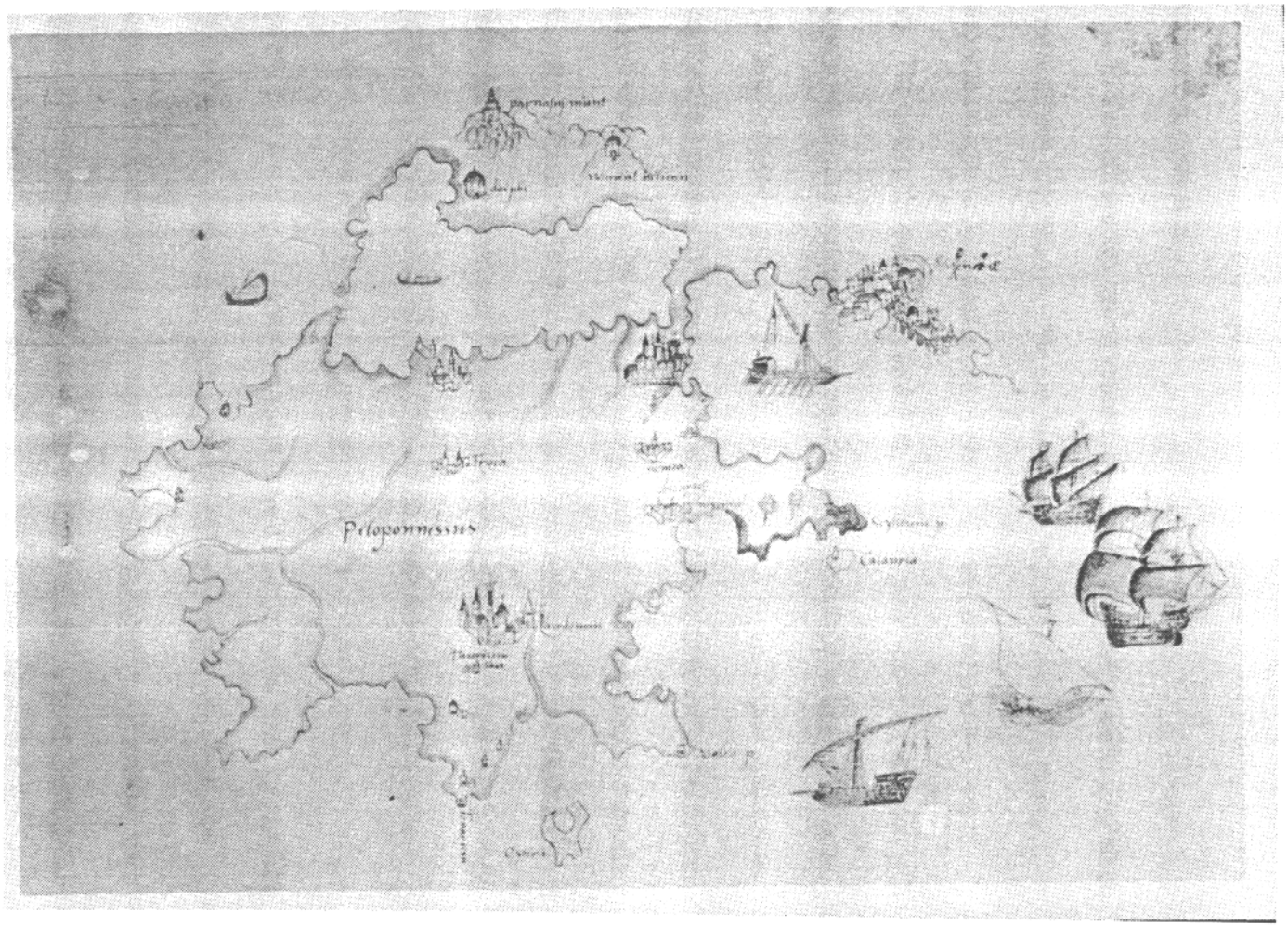

Figure 22. The Peloponnesian Peninsula. From Baker, ca. 1570: 4. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

anything more about it. And further up, in what is now known as the Saronic Gulf, is a third type, perhaps a war galleass, but again showing no guns. It has one furled lateen sail, only rudimentary superstructures, and oars throughout most of its length, grouped in six bunches.

To the right are two sailing vessels, both of which could be either English or, as we shall see later, Iberian. The one in the foreground is clearly of a typical great-ship design, with tall castles, three masts, high freeboard and two tiers of guns. The other ship also has three masts, but it is smaller, lower in the water, with only one tier of guns and greatly reduced castles. Particularly notable is the beak, which is at or below the level of the waist in the style of the old English galleasses. In contrast, the great-ship "beaks" were really overhanging forecastles, the bottom edges of which ranged with the level of the gunwale or the upper deck of the ship (Laughton, 1925: 31). All of the ships in this picture appear to be representations of existing contemporary designs. They show very eloquently the differences between the two types of sailing warships that England had been building until that time.

None of the other ships in Fragments are of the traditional great-ship design. They are all of the long, low style and seem to be divided into two basic types which I will refer to as styles A and B. Style A represents war ships whose keel/beam ratios cluster around 3.00. If you compare the Anne Gallant (Fig. 11) and the ships in figures 23 and 24 side by side, there can be little doubt that a close relationship exists between them. Note the single tier of guns below the main deck, with

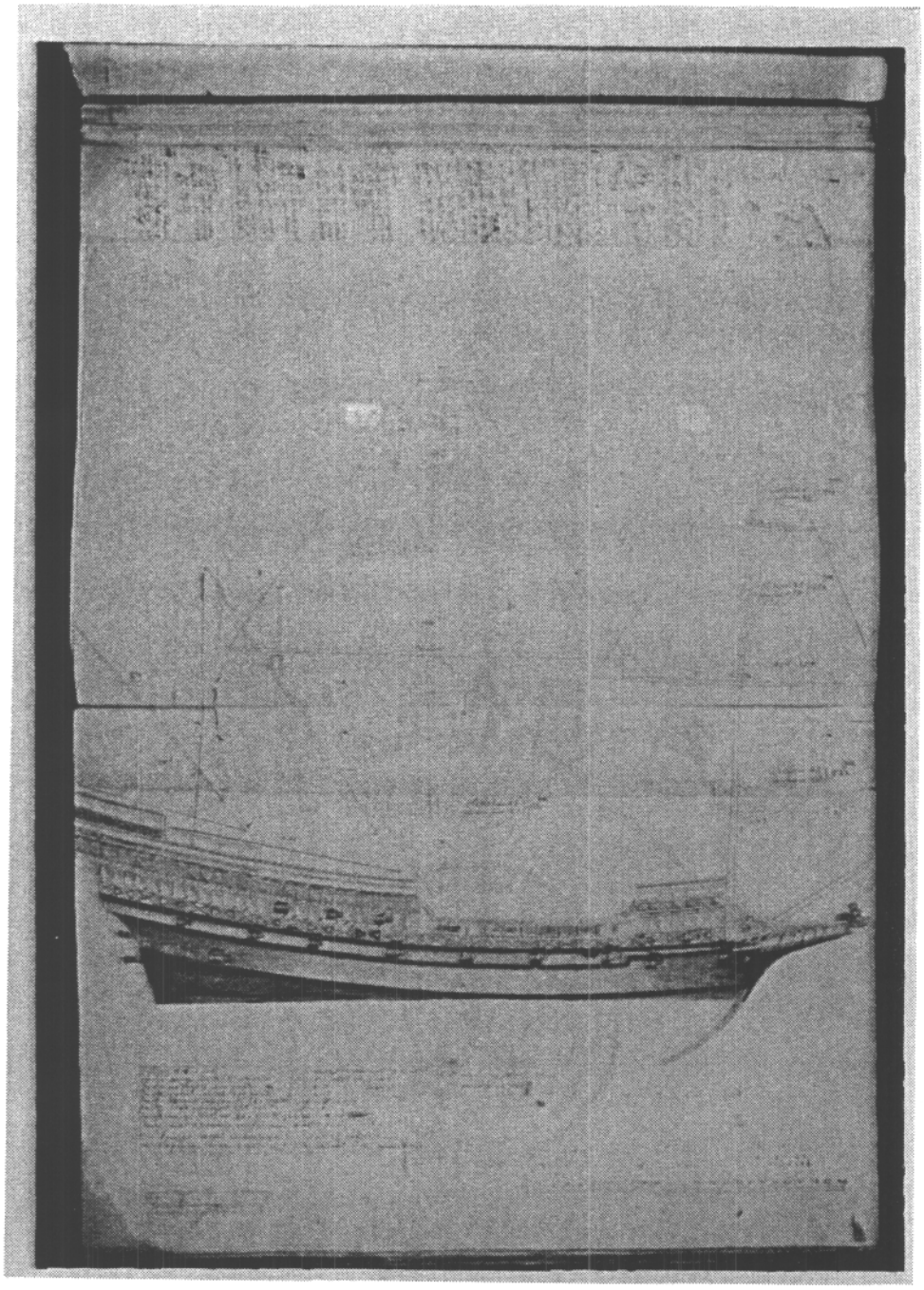

Figure 23. Elizabethan ship from page 115 of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

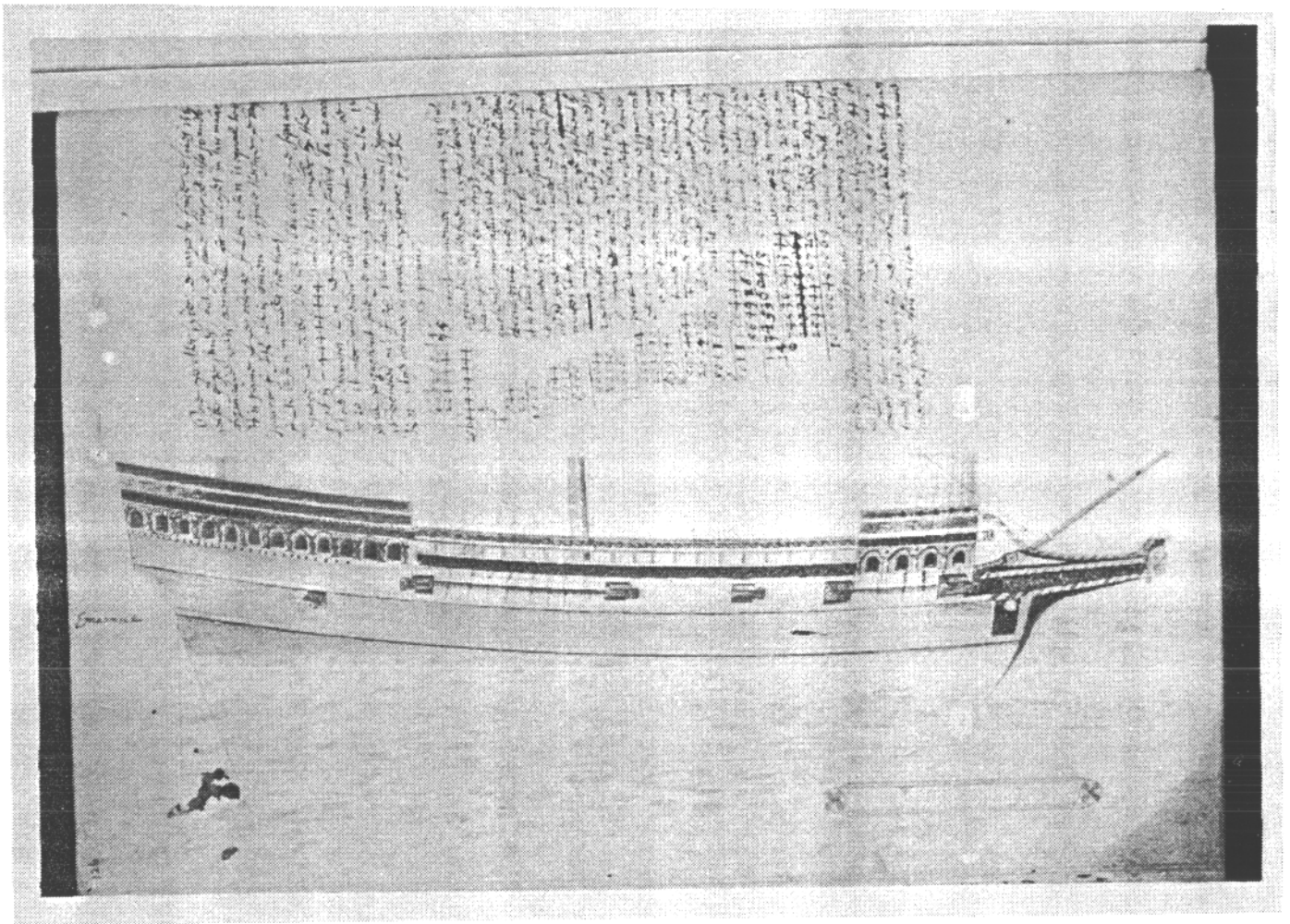

Figure 24. Emanuelle from page 126 of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

perhaps one or two guns a deck below at the stern and/or bow, where the freeboard is greater. Note also the steeved-up beak below the level of the gunwale, the height of the castles and the general similarity in profile. This is undoubtedly what Howard (1979: 48) meant when he said that the galleasses from the Anthony Roll "have the look of a mature design about them. The startling thing about these new ships is their close resemblance in appearance to the later Elizabethan warships--the affinities can be seen at once by comparing the various contemporary pictures."

For some of Baker's ships, enough information is given to figure out the vital proportions. The dimensions of the most famous of these ships, the so-called "fish-galleon" are noted in the text (Robinson,n.d.: 24; see Bass, 1972: 244 for illustration): "This shipp being 24 foot brod .60. bye the kell 12 foot [deep] dyed bere in goods 200 tons..." This yields a keel/beam ratio of 2.50 and a depth/beam ratio of .50. The former is quite a bit lower than the supposed ratio of 3.00 or more for the Henry VIII galleasses, and according to the guidelines given by Glasgow (1964: 184-85), the latter is about average for a ship of that period.

There are two other style-A ships whose proportions can be calculated, in this case by measuring the scale drawings. The first, from page 74 of the manuscript (Fig. 25), has a keel/beam ratio of approximately 3.10 and a depth/beam ratio of about .43. The second, from page 21 (Fig. 26), also has a keel/beam ratio of 3.10, and a depth/beam ratio of .38. These would both have been considered unusually slender and shallow by Elizabethan standards, though we will see that ships

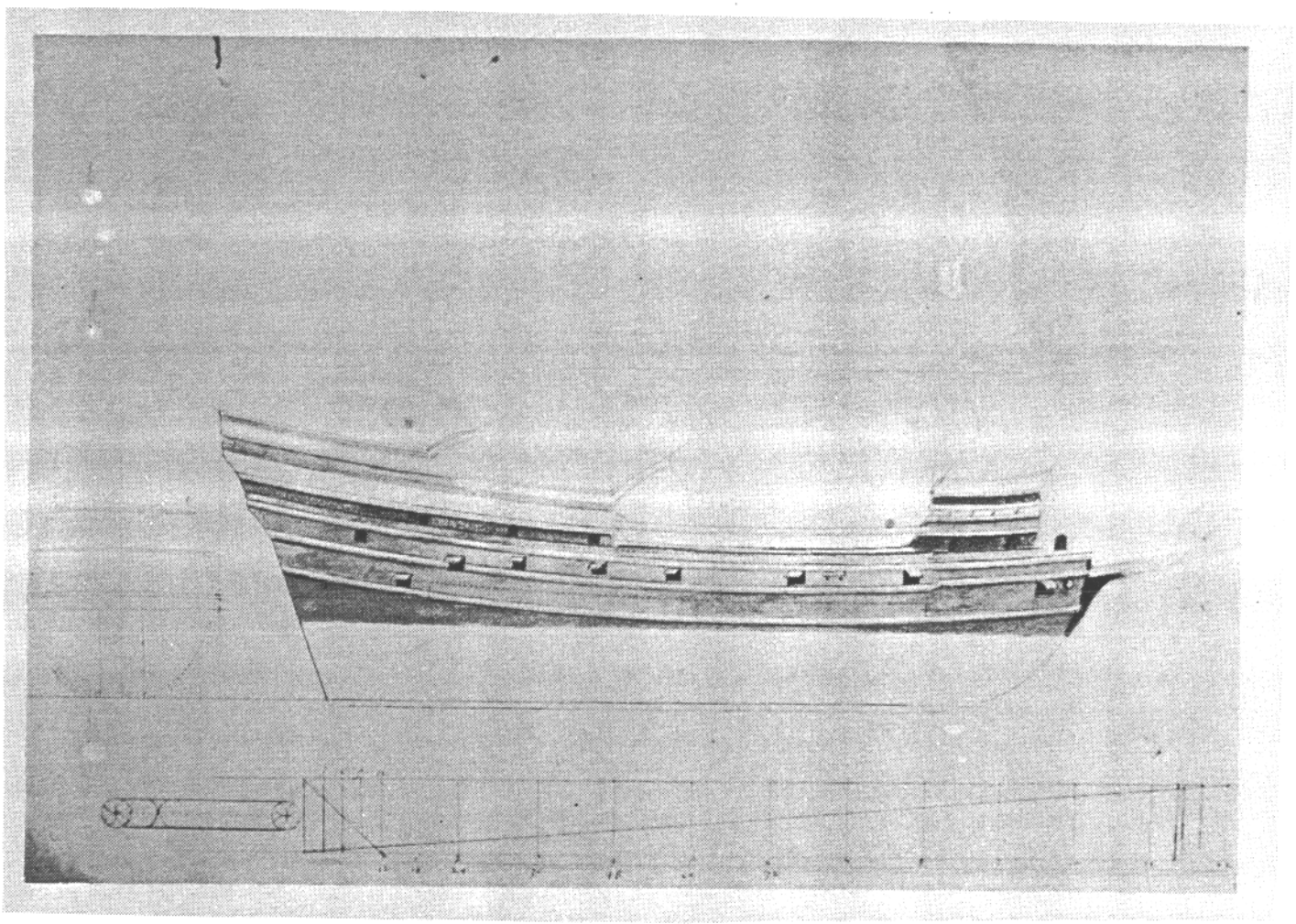

Figure 25. Elizabethan ship from page 74(?) of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

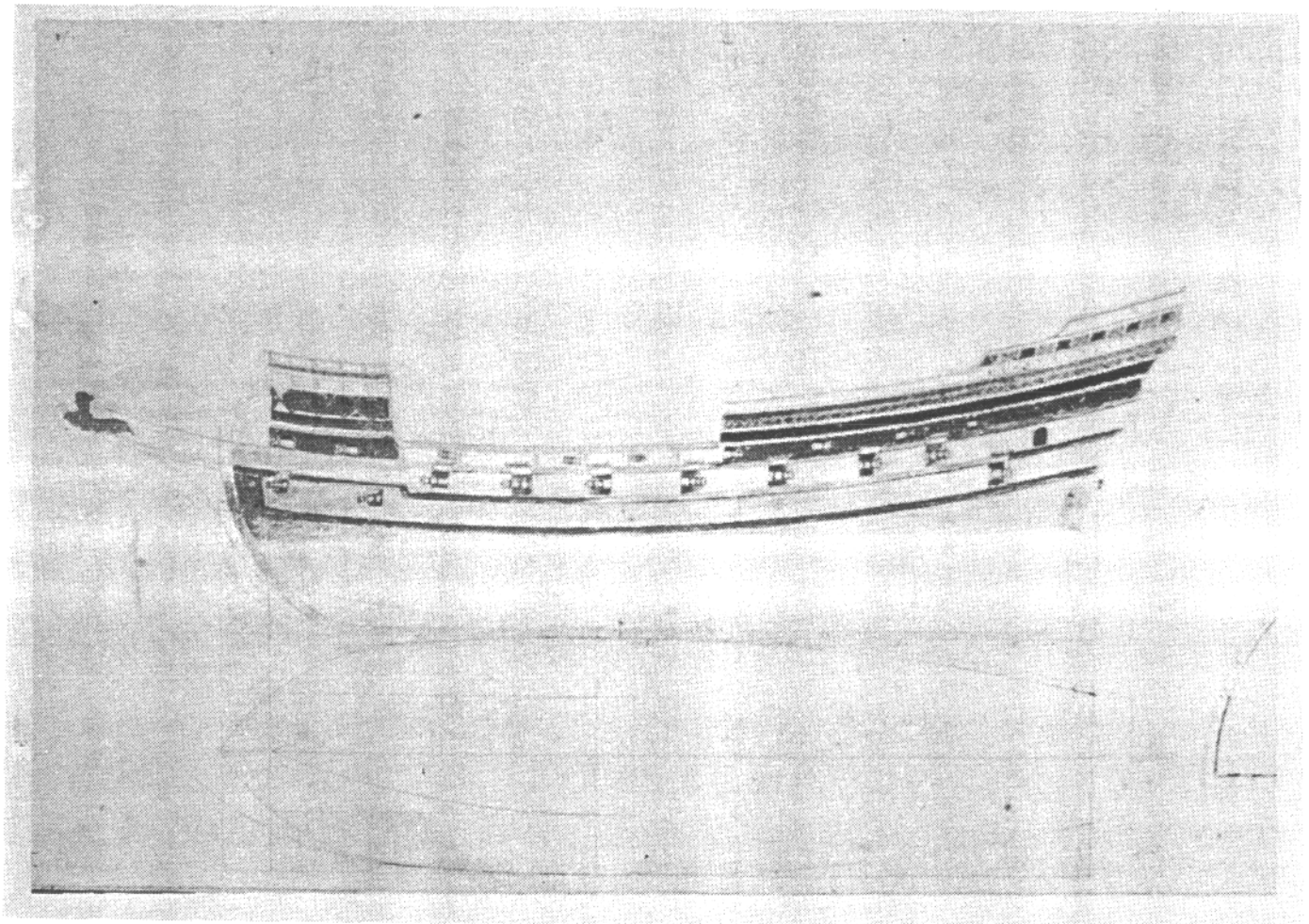

Figure 26. Elizabethan ship from page 21(?) of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

approaching and even surpassing these proportions were occasionally built by Baker and others.

The style-B ships of the Baker document are even longer, relative to their beams, and lower in freeboard. One from page 119 (Fig. 27) has its dimensions given in the text as having a keel length of 104 feet, a beam of 26 feet and a depth of 10 feet, four inches (Robinson, n.d.: 119). These figures, which can be checked by measuring the scale drawing, give a keel/beam ratio of 4.00 and a depth/beam ratio of .40. The keel/beam ratio is approximately that which would be expected of a large pinnace (Glasgow, 1964: 187), but Baker's tonnage rule yields a burden of almost 300 tons. Not only is this is much too large for an auxilliary craft, it actually indicates more carrying capacity than the beamier, deeper, but only 200-ton fish-galleon. Similar ships can be seen in figures 28 and 29, but since I have no proportions for them, further analysis would be purely speculative.

In spite of this evidence, there is no record of any ships of that size being built to those proportions in Elizabethan times (Barker, 1983: 6). The style-B ships must have been experimental drawings that Baker made in the hopes of someday building one. They were undoubtedly based on a wedding of English and Mediterranean technologies that Baker theorized would make a better fighting ship.

Baker and fellow royal shipwright Peter Pett did their best to bring the English navy around to this idea of abandoning the great-ship in favor of the "race-built" design. A famous story tells of an inceident in which William Borough was trying to

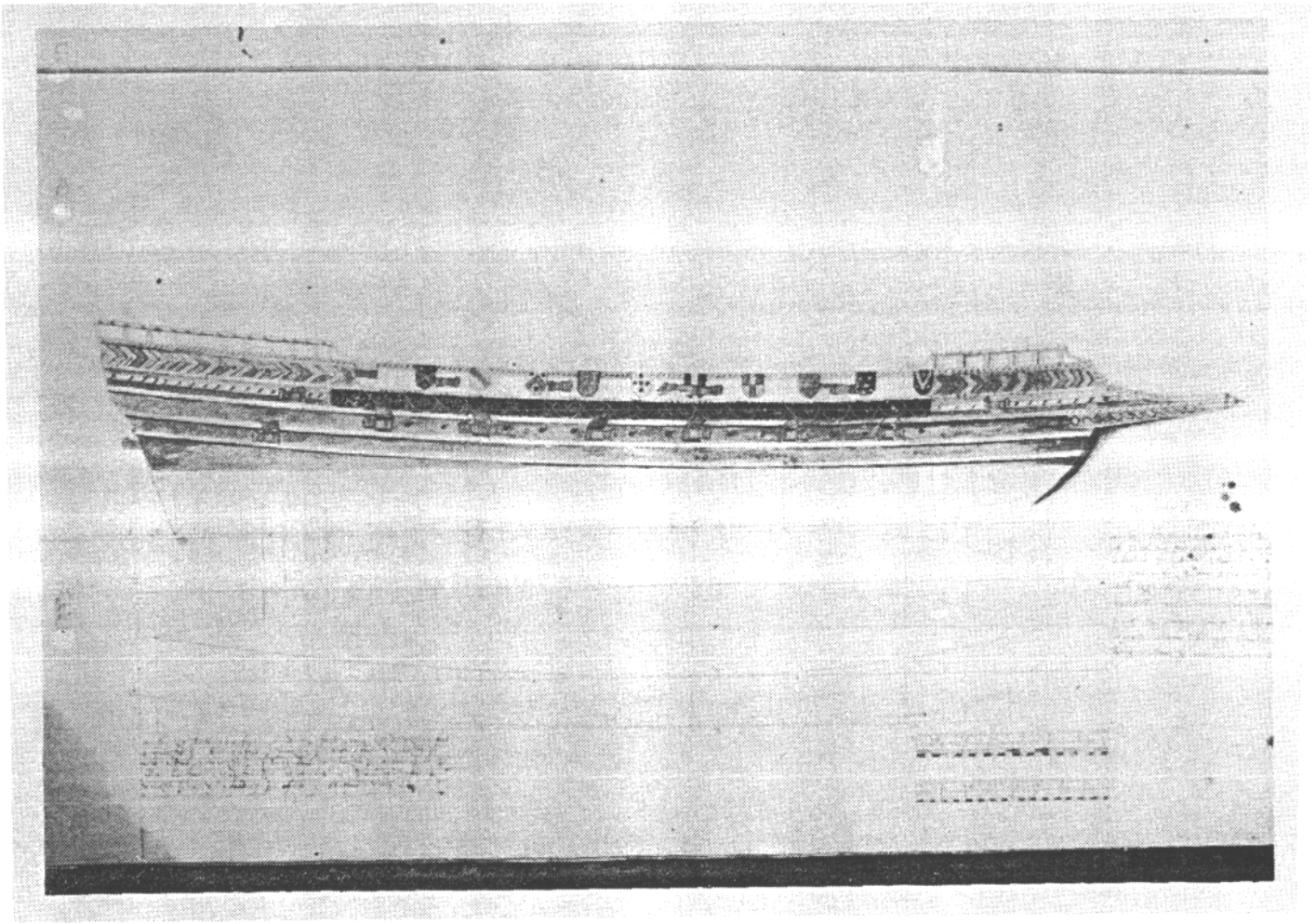

Figure 27. Elizabethan ship from page 119 of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

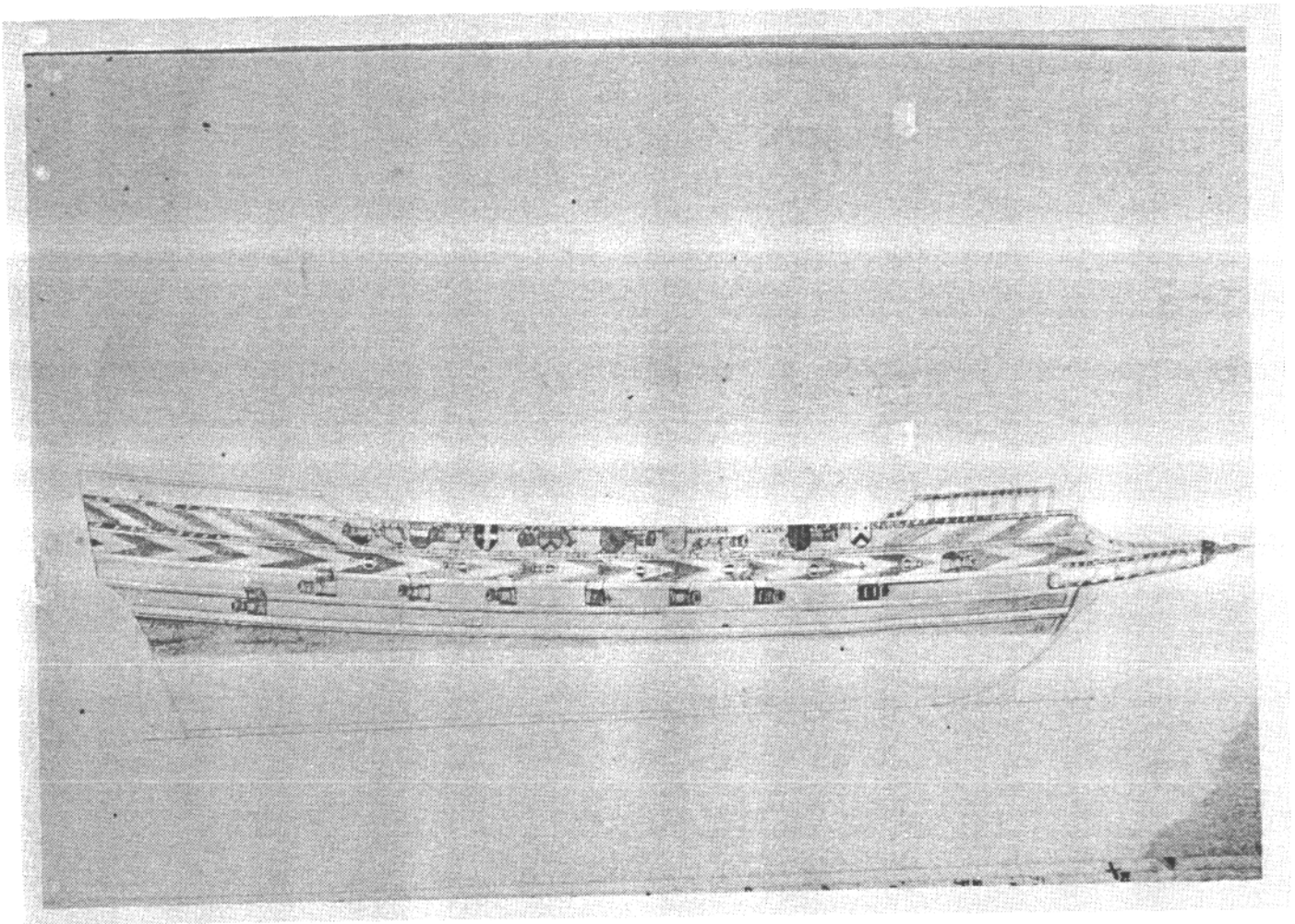

Figure 28. Elizabethan ship from page 113(?) of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

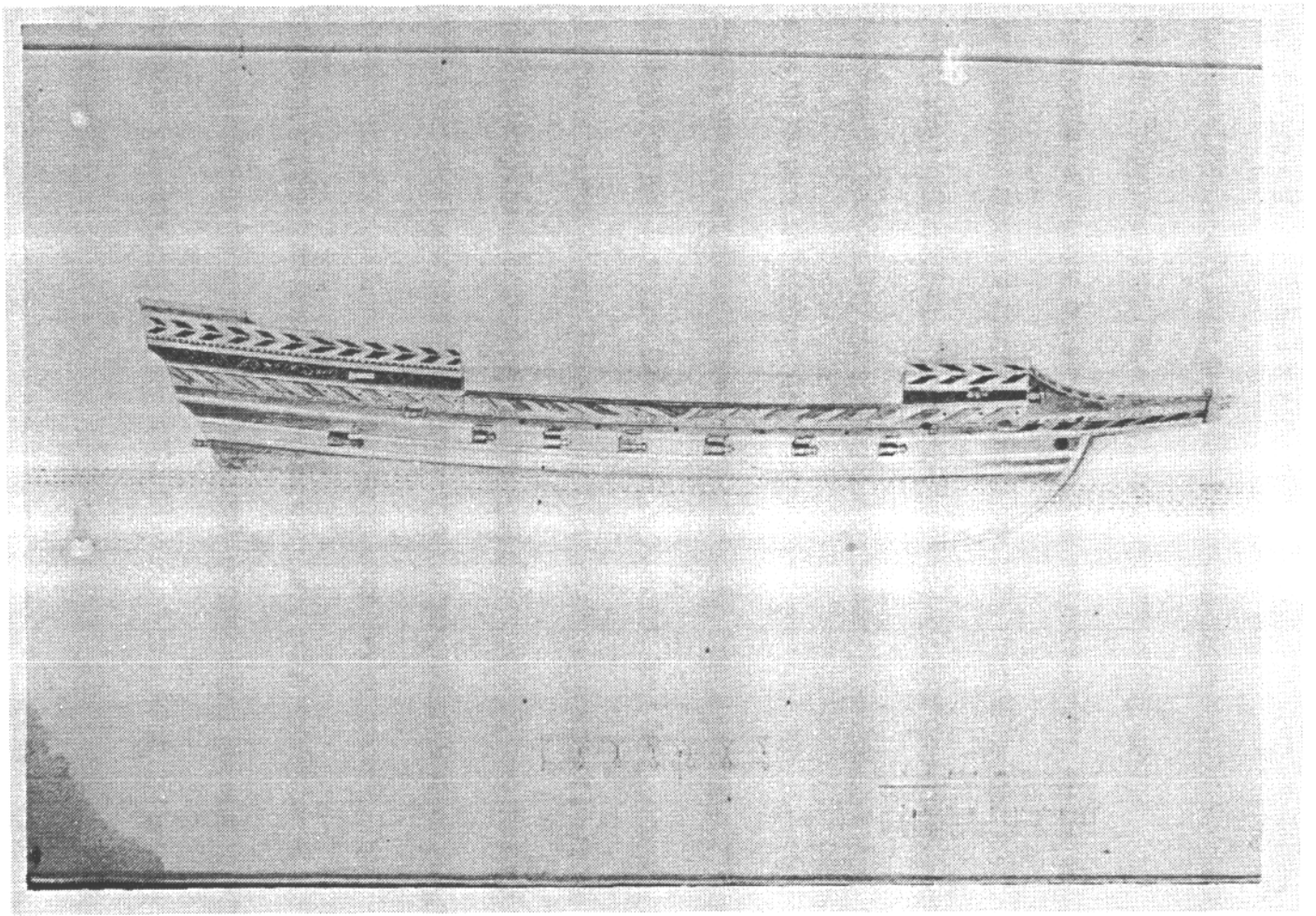

Figure 29. Elizabethan ship from page 121(?) of Fragments. From Baker, ca. 1570. Courtesy of the Master and Fellows, Magdalene College, Cambridge.

discredit Sir John Hawkins, an active promoter of the new design who was working with the two royal shipwrights at Deptford. After Hawkins' disastrous experiences with the Jesus of Lubeke, he was committed to the idea of improving the sailing qualities of the Queen's ships, and to him the obvious places to start were the lofty castles. Borough accused Pett of being dishonest, presumably with the collaboration of Hawkins, but allowed that Baker was more upright. He then went on to complain about the alteration in the design of the ships (Williamson, 1927: 355; Corbett,1899a: 356n.). "The cutting down and defacing of the romthes [rooms, here meaning deck-cabins] and commodious fights made in her majesty's royal ships for the wars and altering them to the manner of merchant ships, hulks and crayers must be accounted a transforming or reforming them to galleasses." That is, Hawkins, Pett and, I am sure, Baker as well, were tearing down the superstructures of some of the men-of-war. The reference to merchantmen refers to the fact that merchant ships used for short peaceful voyages did not generally have the large castles that were found on the larger great-ships. It was probably Borough's way of showing his opinion as to the type of service for which they were now fit. The reference to galleasses reveals that he was well aware of the motives behind this transformation, as the term at that time generally denoted a long, low warship with cut-down superstructures (Corbett, 1899a: 341-42), a type of which he obviously disapproved.

The experimentation that marked the Elizabethan era also led to a great deal

of confusion among contemporaries as well as among historians. During the reign of Henry VIII, large vessels had officially been called ships and galleasses, the smaller ones pinnaces, while those in the merchant service were generally referred to as simply merchantmen. However, even then there was a great deal of inconsistency in the nomenclature of ships, particularly in common usage. In a list of 1548, many of the ships called galleasses in the 1546 Anthony Roll were referred to as galleys. Both were official lists, and therefore we can infer that the two terms were not defined as rigidly as nautical archaeologists and naval historians would like them to have been (Oppenheim, 1896: 58).

There also seems to have been a good deal of flexibility between the terms galleass and ship. Though a great-ship would never have been called a galleass, galleasses with certain features were sometimes referred to as ships. Among all the vessels on the roll of galleasses, Anthony refers to the Greyhounde alone as a ship, although elsewhere it appears as both a galleass and a galley. Other galleasses that were called ships include the Lion, Jennet, and Dragon, presumably because they possessed stern and quarter galleries (Oppenheim, 1896: 58). They were all type-1 galleasses.

The word bark appears quite often in the records of Henry's rule, and this seems to have been just as vague as the word galley. Generally speaking, it seems to have meant a smaller, rather than a larger vessel, but it was a highly subjective judgement. The term could also be used to describe both high-charged and

galleass-fashion craft. Perhaps the best example are two Hamburg ships, the 500-ton Great Bark and the 400-ton Small Bark (modern spellings), which were also called, in official papers, the Great Galley and the Less Galley (Oppenheim, 1896: 50n.). Both appeared as ships (shyppes) in the Anthony Roll. The term galleon was used very rarely, and only to describe some of the galleasses.

After Henry's death, the use of the term galleass as an official class was dropped, and vessels were referred to as either ships or pinnaces. This system continued until the official Elizabethan classifications, ships, barks and pinnaces. The new class, barks, never became very well defined, sometimes including only small ships, and sometimes also the larger pinnaces. The main characteristic seems to have been a tonnage of between 50 and 150 tons, though this was not consistent (Corbett, 1899a: 340).

The new type of warships did not find a name right away, perhaps because of the fact that there were so many different variations on the theme. In any case, it took the nomenclature some time to be settled, and both the English and the Spanish called them, almost indifferently, galleon, galleass, galley, and galleot.

English seamen, though, never cared for the word galleon, and often confused the words galleon and galleass when describing foreign vessels. In contrast, they almost invariably used the term ship or man-of-war to describe any English sailing vessel fit to take its place in the line of battle.

Elizabethan shipwrights had a different perspective, and early in her reign

used the terms galleon, galleasse, bark and pinnace to describe specific ship types. It is difficult to say exactly what the characteristics were for each individual type, but a galleon seems to have been any vessel specifically constructed for war that had a keel/beam ratio close to 3.00. This distinguished it from the ordinary merchantman which had a keel of only twice its beam, or possibly a little longer (Corbett, 1896: 337-341). Corbett (1896: 338)explains that a galleass was probably even longer in relation to its beam than a galleon, and dimensions for Elizabethan ships given by Glasgow (1964) seem to confirm this. However, virtually all of Elizabeth's galleasses were heirlooms from Henry VIII, some of which she had to have rebuilt. 'Galleass' was also used indiscriminately by Elizabethans to refer to any ship that was considered by the observer to be unusually long in relation to its depth, and low to the water (Oppenheim, 1896: 128n.). However, the people involved in ship design and administration were well aware that a Mediterranean galleass was quite a different sort of vessel from an English one.

Barks included all sailing vessels of a lower degree, and pinnaces were all vessels specifically designed for oar propulsion as well as sailing. Vessels which were ordinarily called pinnaces have appeared variously as galleots, galleys, frigates and shallops. Brigandines were small vessels, rowed by their fighting crew, which were sometimes classed as pinnaces and sometimes as barks (Corbett, 1896: 340).

By the time of the Armada enterprise, most of the ships in the Royal Navy were

galleons, and were so described by foreigners, although, as previously mentioned, not by English mariners. Corbett cites an order made by the Officers of the Navy in 1586 in which the Queen's vessels were described as "ships, as well as barks, pinnaces, brigandines and frigates." At the same time, naval writers were calling them ships and pinnaces and the shipwrights were calling them galleons, barks and pinnaces, (Corbett, 1896: 340). There is also a figure in Baker's manuscript (Robinson, n.d: 33) which is captioned "A macanical demonstration devised or fyrist invented by Mathew Baker for the carpentor unlerned in arethmetke and jometre by which is found all cirqular devicions nedfull to the makeng of shipp, galowen, gale or whatsoever." So that, in at least one shipwright's mind, vessels were classified as being either ships, galleons or galleys. 'Ships' might here mean merchant ships.

The confusion was even greater when foreign vessels were involved. If any enemy ship with guns came to meet an English ship, the seamen could have called either or both a man-of-war, a galleon, a galley, a bark, or any number of other colloquialisms. If the ship was Spanish, they might call it an 'armatho,' an English corruption of the Spanish armado meaning a large, armed, man-of-war, although the term does not seem to have been commonly used in this sense by the Spaniards themselves (Corbett, 1896: 60, 65, 67). A French ship, man-of-war or merchant, was often just called a 'Frenchman' (Corbett, 1896: 3, 7); a Spanish, ship a 'Spaniard,' and so forth. The term bark was used very loosely by Elizabethan sailors as well as shipwrights, and its characteristic features cannot have been very

well marked among them (Corbett, 1896: 98).

Another factor which confused things were the merchant vessels and privateers. In many of the Elizabethan fleet lists, the ships were separated into the categories "Queen's ships" and "armed merchantmen." One such list for Drake's voyage to the West Indies in 1585 shows an armed merchantman of 400 tons named Galleon Leicester (Oppenheim, 1902: 124), and another for the Armada conflict has one of 150 tons named the Galleon Hutchins (Corbett, 1899b: 138). It would at first appear that there is some sort of contradiction going on, until we learn that 'armed merchants' is a somewhat misleading designation. In other lists, some of them are categorized as 'London ships,' or 'private men-of-war' (Corbett, 1896: 99). These were fighting ships commissioned by individual citizens and hired to the crown during times of war. At other times they were used either as protection for fleets of merchantmen, or were actively engaged in privateering against enemy shipping. They were probably called galleons to set them apart from the ordinary armed merchantmen.

By the early 1600's, any ship prepared especially for fighting, pirate or privateer, was called a man-of-war by the English. A royal man-of-war proper was spoken of as a 'King's ship' or a 'Queen's ship,' and later in the century a privateer was often called a 'private ship' (Oppenheim, 1913b: 63). If a ship was referred to in terms of its owner or home port, like the two galleons mentioned above, it was likely privately owned. For example, Corbett quotes a document which states that, "[t]he

man lost was the George Bonaventure, a ship of war of London [emphasis mine], whom we met on the coast." This particular vessel was owned by the Levant Company to protect its merchantmen, and she served against the Armada in 1588 (Corbett, 1896: 46).

The privateers were an important part of Elizabeth's total naval force, as evidenced by a document containing Martin Frobiser's position on the formation of a proposed Indies fleet to harass the Spanish. "My opinions is ther may be no less than 8 g[ood ships] of the Queen's majesty's and 12 good merchants, and all th[e private] men-of-war that may be gotten to accompany them..." (Oppenheim, 1902: 75; bracketed portions added by Oppenheim).

The fact that no reliable terms existed to describe the variable hull shapes makes the job of the chronicler more difficult. For the next section on the evolution of hull design during the Elizabethan period, I will use the terms 'ship' and 'man-of-war' to describe ships of war, 'merchantman' for merchant vessels, and 'pinnace' for oared auxilliary craft. In this way it will not seem inconsistent if I refer to a vessel as a 'ship,' even though it has been called a 'galleon' or a 'bark.'

The one feature that seems to have really given the English navy the edge over the Spanish Armada was the speed and maneuverability of their ships. By 1588, many exterior improvements can be seen in contemporaneous pictures. The disappearance of the low waists and high, heavy superstructures has already been discussed. In addition, the main mast appears to have shifted forward and carried

flatter sails, with an occasional reappearance of top gallants, which had been tried, then apparently discarded three quarters of a century before. However, the biggest factor in the success of these ships was the shapes of their hulls (Glasgow, 1964: 178).

The Elizabethans left a relatively complete record of the dimensions of the Queen's ships, as well as some parameters by which to evaluate them. Two separate treatises on ship design, one from around 1596 by William Borough, Comptroller on the Navy Board, and one by an anonymous shipwright from about 1620, have been passed on to tell us what proportions they considered to be optimal.

The Borough treatise states the following (Oppenheim, 1896: 126):

1. The shortest, broadest and deepest order.	To have the length by the keel double the breadth amidships and the depth in hold half that breadth.

This order is to be used in some merchant ships for most profit.

2. The mean and best proportion for for shipping for merchandise, likewise very serviceable for all purposes.	Length of keel two or two and a quarter that of the beam. Depth of hold eleven-twentyfourths that of beam.
3. The largest order for galleons or ships for the wars made for the most advantage of sailing.	Length of keel three times the beam. Depth of hold two-fifths of beam.

This gives the following proportions:

1. Merchant ships for most profit had a keel/beam of 2.00 and a depth/beam of .50.

2. Vessels best for shipping and all purposes had a keel/beam of 2.00-2.25 and a depth/beam of .46.

3. Galleons and ships for the wars had a keel/beam of 3.00 and a depth/beam of .40.

The anonymous author of the Treatise on Shipbuilding, written after twenty-five years of experience with essentially the same ships, agreed in general about the desired proportions of ships (Glasgow, 1964: 179), when he wrote (Salisbury and Anderson eds., 1958: 4): "The breadth is arbitrary, the depth must never be greater than half the breadth nor less [than] one third, and the length [of the keel] never less than double nor more than treble the breadth (Salisbury and Anderson eds., 1958: 4). However, for a warship in particular he stated (Glasgow, 1964: 179) that "...the best proportions of the breadth to the depth is as 7 to 3, of the

breadth to the length of 9 to 25." This yields a keel/beam of 2.78 and a depth/beam of .43.

Glasgow has done a thorough analysis of hull proportions during the Elizabethan period before the Armada campaign, and I reproduce his figures in Table 4. The tonnage figures have been computed using Baker's rule for tonnage measurement (see Chapter III on tonnages), presumably using a divisor of 100, which tends to give somewhat lower figures than the estimates of earlier years. A year followed by 'R' indicates a rebuild.

The ships from group I represent the earliest years of Elizabeth's reign. The Elizabeth Jonas and the White Bear, both built by Peter Pett, were very large ships indeed, as was the Triumph, perhaps also built by Pett. The Victory, as mentioned, was purchased from some merchants and was "altered into the fourme of a galleon" in 1586, probably by modifying her superstructures (Glasgow, 1964: 181).

A few patterns emerge from this information. The first is that the keel/beam ratios are widely scattered, from 2.28 to 2.92, but in no case do they achieve the level striven for in Borough's recommendations. The second is that they are approximately evenly divided on both sides of the figure given in the 1620 Treatise. The depth/beam ratios were all well above the recommended level in both documents, except for that of the Hope, which was slightly below the Borough figure.

Table 4. Hull proportions of Elizabeth's men-of-war (Glasgow, 1964).

SHIP	DATE	TONS	KEEL/BEAM	DEPTH/BEAM
Borough's man-of-war	1596	----	3.00	0.40
Treatise	ca. 1620	----	2.78	0.43
Mary Gonson	1514	256	2.35	0.30
GROUP I. 1558-69				
Elizabeth Jonas	1559	684	2.63	0.47
Hope	1559	403	2.85	0.39
Triumph	1560	741	2.53	0.49
Victory	1560	565	2.71	0.49
Aid	1562	255	2.92	0.56
White Bear	1564	729	2.88	0.48
Elizabeth Bonaventure	1567	448	2.28	0.46
GROUP II. 1577-79				
Foresight	1570	294	2.90	0.52
Bull	1570R	193	3.64	0.50
Tiger	1570R	149	2.17	0.57
Dreadnaught	1573	405	3.00	0.50
Swiftsure	1573	288	2.64	0.50
Revenge	1577	471	2.88	0.50
Scout	1577	132	3.00	0.55
GROUP III. 1580-85				
Swallow	1580R	332	3.26	0.52
Antelope	1581R	341	3.21	0.50
Golden Lion	1582R	421	2.94	0.44
Nonpareil	1584R	380	3.04	0.57
Achates	1585R	104	3.22	0.56
GROUP IV. 1586-87				
Vanguard	1586	449	3.38	0.41
Rainbow	1586	348	3.13	0.38
Tremontana	1586	138	2.61	0.44
Ark Royal	1587	540	2.78	0.42
Merhonour	1590	291	2.97	0.46
Garland	1590	516	2.88	0.47
Defiance	1590	417	2.88 [4]	0.47

Overall, though, English shipwrightry appears to have been well on its way to establishing the new hull form. The mean keel/beam ratio of the group-1 ships was 2.69, not far off of the supposed ideal of forty years later, and the mean depth/beam ratio was .46 (for all excluding the Aid, whose abnormally high ratio has led Glasgow to suggest that it was either an error in recording or that she must have been a particularly poor ship. If we include the Aid, the mean depth/beam ratio would equal .48), inexplicably higher than either of the recommended figures. Perhaps it was thought too risky from the standpoint of stability to reduce both the beam and the depth at the same time.

For comparative purposes, Glasgow has inserted the hull proportions of the Mary Gonson, one of the early ships of King Henry VIII. Unfortunately, we know very little about her , even whether she was originally intended for a merchant ship or a warship. If she was indeed a warship, as Glasgow suggests, then it is quite apparent that the changes in hull design between the early years of Henry VIII and those of Elizabeth were far more pronounced than the changes during the whole of Elizabeth's reign (Glasgow, 1964: 182). Very soon the dimensions of the Mary Rose, recently excavated by Margaret Rule and the Mary Rose Trust, should be

released to the scholarly community. When that occurs, her keel/beam ratio ought to be included in Table 4.

Group II, 1570-79, represented a period of new building brought on by the fact that the Queen's ships were beginning to deteriorate seriously (Glasgow, 1964: 182-83). The new ships were of a more mature design than their predecessors and more consistent in their proportions. Their tonnages were considerably lower than those of the last spate of building. At this time, the new hull form entered a maturing stage and was closing in on what twenty years later would be considered an ideal keel/beam ratio. Excluding the two rebuilds, which represent another period's designs, the mean keel/beam ratio was 2.88 and the mean depth/beam ratio was 0.514. The Bull was a galleass left over from Henry VIII's fleet, but the Tiger was not the Tiger from the Anthony Roll (Glasgow, 1964: 183). Where she was obtained is uncertain, but judging by her proportions she was originally a merchantman. The proportions of the Bull are also far out of the contemporaneous norm, although in the opposite direction.

The high depth/beam ratios of this period may have reflected the Englishmen's increased awareness of the Atlantic. The longer voyages required increased storage space to support them, and greater depth may have been the shipwright's answer. Over the course of the six years between the building of the White Bear in 1564 and the Foresight in 1570, the depth/beam ratio went from 0.48 to 0.52. During the interim, John Hawkins had completed his early voyages to the New

World and had become officially associated with the navy (Glasgow, 1964: 184).

The most famous ship to come out of this period was the Revenge. Although she proved to be an unlucky ship, she was considered by Sir Francis Drake to be a masterpiece of naval construction (Corbett, 1899a: 350), and was probably the prototype for many of the so-called galleons that were produced in the last few years before the Armada campaign. Williamson (1927: 342) writes that with the construction of the Revenge, the new rules for ship design became established for good. The ships of 1573, Swiftsure and Dreadnaught, he says, represented a last reactionary movement, and the Revenge, the triumph of the ocean-men's ideas.

This seems an odd statement to make about the Dreadnaught with its keel/beam ratio of 3.00. Corbett (1899a: 350) also called the Dreadnaught a 'great-ship' which he contrasted with the 'galleon' Revenge.

As usual, the solution to this seeming paradox creates more questions than it answers. For the most part, Glasgow (1964: 178, 186) took his figures from a Navy List of 1591-92, except for the last three on the list, Merhonour, Garland and Defiance, which he got from a 1602 List published by Oppenheim. He does not indicate why he prefers the 1591 list, although presumably it is because he wishes to weed out any possible unrecorded rebuildings that took place between 1592-1602. He also gives no reason for using the 1602 figures for the last three entries "in preference to" those from the 1591 list.

Although for the most part the two lists agree, there is one major discrepancy.

The 1602 list gives the dimensions of the Dreadnaught as keel = 80 feet, beam = 30 feet, depth = 15 feet. This yields the same depth/beam ratio as the 1591 List, but givesa keel/beam ratio of only 2.67, well below the 1591 figure of 3.00 for the same ship. There is no record of her having been rebuilt during that time, though she was dry-docked in 1593-94 (Oppenheim, 1896: 119). However, any major rebuild was unlikely. A Report of the Chief Shipwrights in 1587 (Corbett, 1898: 226-27) says of the Dreadnaught, "[t]he same ship we find by her decayed stern and many imperfect timbers, clamps, footwales, trenails, &c., that no less weakness appeareth to be in her than was reported, which cannot be well remedied to any purpose without dry-docking." In contrast, they report of the Antelope: "The same ship, although she hath been lately builded above water, yet is she a very old bottom, which in short time will require to be rebuilded." From these and other examples, it would seem that dry-docking was quite a bit less involved than a complete rebuild. Therefore, it comes to a question of which List to believe. Williamson and Corbett obviously used the 1602 list.

It has been mentioned before that Mathew Baker joined Peter Pett as Royal shipwright in 1572. Only two ships were built between then and the construction of the Revenge in 1577. They were the Swiftsure, built by Pett, and the Dreadnaught, by Baker. The stir caused by the Revenge, with its 2.88 keel/beam ratio suggests that 2.67 rather than 3.00 more accurately reflects the keel/beam ratio of the Dreadnaught.

The Revenge, however, was apparently more than just a slightly redesigned hull. It was a new achievement, the first one to combine successfully the low hull and superstructures of the 'galleass-built' ship, with the size of a great-ship. At 471 tons, the Revenge was the largest ship built between 1564 and 1587.

One glance at the 'date' column of Table 4 will explain why the years of group III (1580-1585) are called rebuilding years by Glasgow. All of the shipyard activity during those years was devoted to rebuilding the hulls of older vessels. Glasgow suggests that, with the exception of the Elizabeth Bonaventure (see Group I, rebuilt during this period) and the Golden Lion, the rest probably underwent noticeable alterations in dimensions. The Achates was likely lengthened, and the Nonpareil, originally named the Philip and Mary, had at least a 75% rebuild (Glasgow, 1964: 184-85). The other two, the Antelope and the Swallow, were, if anything, shortened. They were both galleasses in Henry VIII's navy, the Swallow a type-3 and the Antelope a type-2. The Bull, another type 2 galleass, was rebuilt in 1570 with a keel/beam ratio of 3.64, contrasting with the 3.21 ratio of the Antelope.

The depths of these ships continued to exceed the levels recommended by either the Borough document or the Treatise. This may have been at least partially due to the rebuilding program.

Finally, in about 1586, new building began again, and now the shipwrights were not restricted by having to use large portions of old ships as they probably had been during the previous six years. That year, Baker built the Vanguard, and Pett,

the Rainbow (Glasgow, 1964: 185), and both vessels were unlike anything that had ever been built in England. The keel/beam ratios were unusually high for ships of that size (both were commonly referred to as 500-tonners), and the depth/beam ratios were radically lower than any since records had been kept. Glasgow (1964: 185) suggests that neither Pett nor Baker had been pleased with the recent rebuilds and were experimenting with new proportions. Sir William Monson described the two ships as being "low and snug in the water like a galleasse" (Corbett, 1899a: 352), suggesting something quite unusual, different even from the Revenge.

Corbett (1899a: 352) tells us that no descriptive name for the new type had yet been agreed upon by 1586, even by the experts. That year William Wynter, in declaring the ordnance being prepared for ships new in building, made reference to the galleon P. Pett and the galleon Ma[thew] Baker, which were later christened the Rainbow and the Vanguard respectively (Corbett, 1898: 312-13). This is the earliest appearance of 'galleon' as an official shipwright's term that I have been able to locate.

Glasgow (1964: 186-87) feels that, in exceeding the level set for relative length in the Treatise thirty-five years later, the Vanguard and Rainbow also exceeded the "ideal" keel/beam proportions. He writes:

> During the Elizabethan years, they almost achieved the perfection they sought, but did not know it. So they continued changing until they were well past the ideal proportions. Then, in Chapman's Ark Royal, they found the shape they were seeking. Thereafter, to the end of the age, the keel/beam proportions remained below 3.00 and well within the limits set

> forth in the Treatise of ca. 1620. The depth/beam proportions continued to run deeper than recommended as ideal; but did not exceed 0.50. As already mentioned, this was not ignorance but an intentional compromise.

I agree with his statement about depth/beam proportions, but take exception to his observations concerning relative length. The keel/beam figures he gives for the Merhonour, Garland and Defiance are, for the most part, as close to 3.00 as they are to 2.78, and the figures given in the 1591 List, though a bit lower (see note [3]), are still not conclusive. And as we shall see, keel/beam ratios in the 17th century were higher even than that recommended in the Borough document.

The new warship design was well-represented in the 1588 Armada campaign, and a famous painting of one engagement, now residing in the National Maritime museum in Greenwich, shows many such ships. Details of that painting (Figs. 30, 31) contain a few particularly good representations of the Elizabethan "galleon." They compare very favorably in form with the galleasses of Henry VIII and the designs of Mathew Baker.

There is very little information on ship dimensions immediately after the Armada campaign, but experimentation did continue. By the 1620's England was lord of the sea, and by that time some sort of uniformity had finally been achieved with the categorizing of ships by rate, or basically by how many guns they could carry. By 1634 it was very difficult to find a ship with a keel/beam ratio of less than 2.90, and there were several higher than 3.00. In the years 1646 and 1647, not one ship was built with a keel/beam ratio of less than 3.20, and figures above 3.40 were

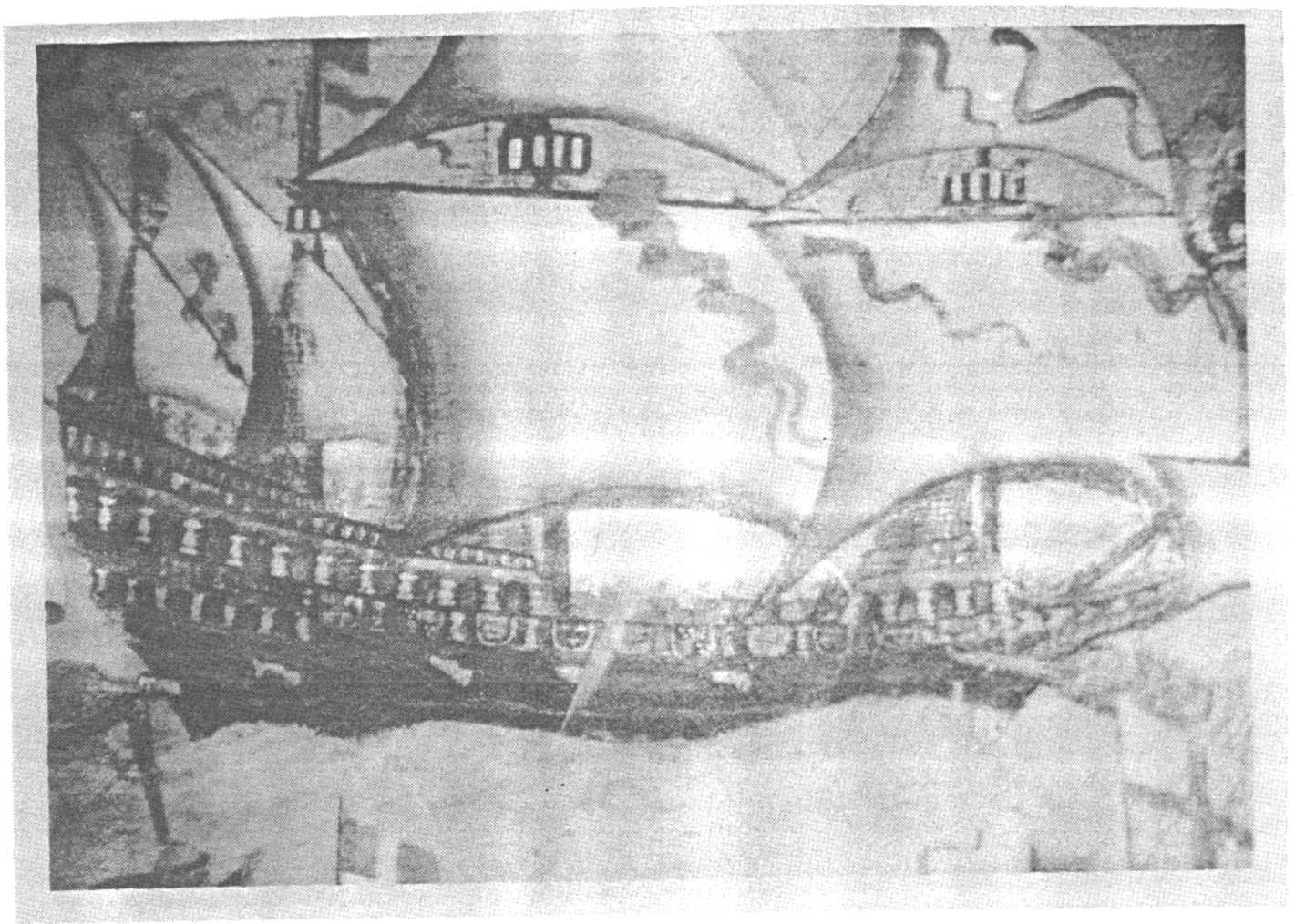

Figure 30. An English warship fighting the Spanish in 1588. From a tapestry study by an anonymous artist, National Maritime Museum, Greenwich. Photograph by the author.

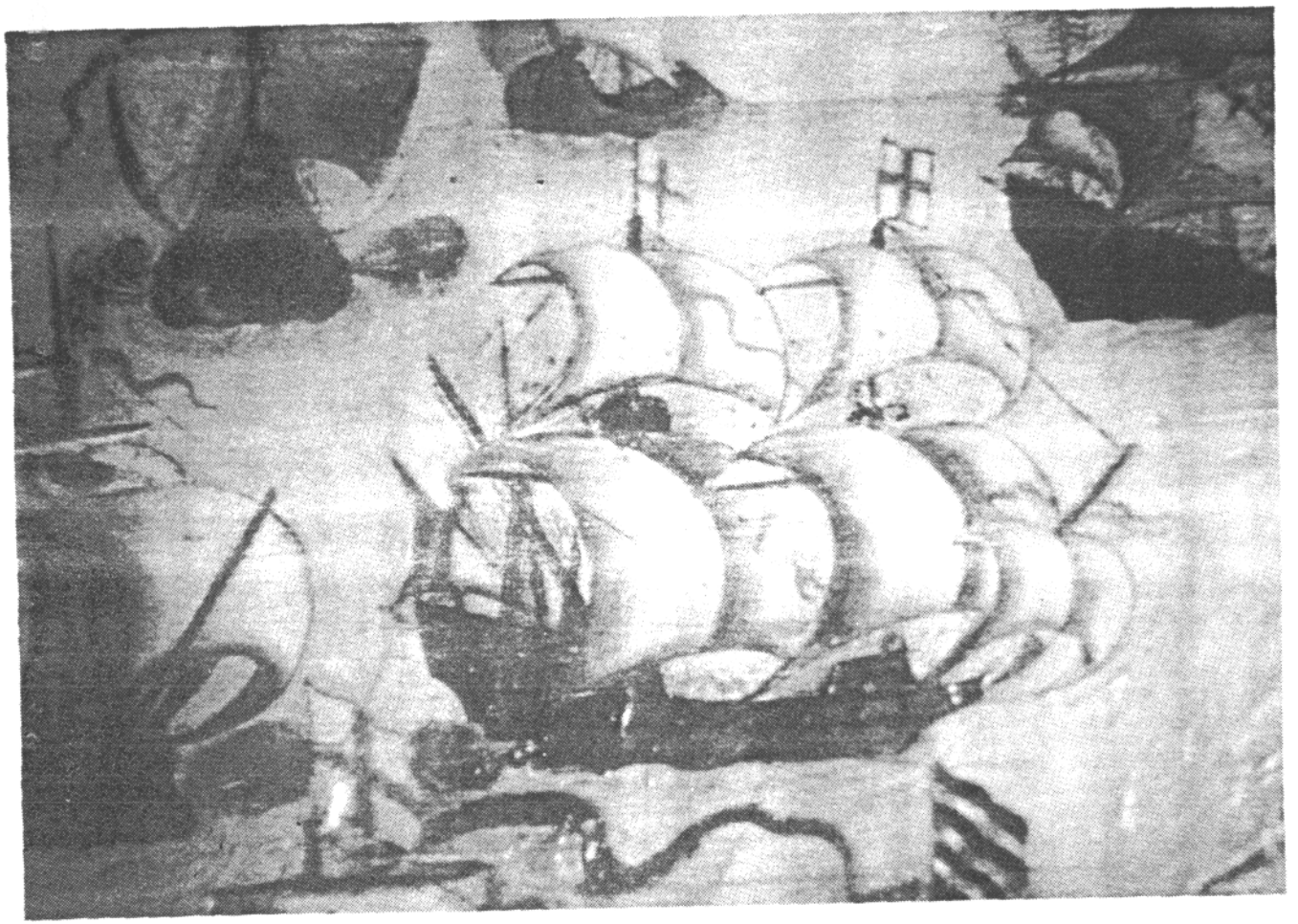

Figure 31. Detail of an English warship fighting the Spanish Armada. From a tapestry study by an anonymous artist, National Maritime Museum, Greenwich. Photograph by the author.

not unusual (Oppenheim, 1896: 254-55). The same can be said for the ships on the Navy List of 1660 (Oppenheim, 1896: 330-37). Therefore, even if keel/beam ratios did go down between the years 1588 and 1620, which may or may not be so, they went up again shortly thereafter, marking Peter Pett and Mathew Baker as the true conceivers of the design that made England "the team to beat" in international naval warfare.

However, it was not only the proportions of the principal dimensions that led to the superiority of Elizabethan ships, but also the manner in which the frames themselves were designed. In order to understand this it is necessary to go back to mid-fifteenth-century Venice.The Italian system of projecting the forms of moulds in 1445 was to measure offsets from a central line. According to Barker (1983: 3), by the 16th century a system of arcs, or sweeps, was being employed by the Venetians whereby the shape of the midship frame was projected using four sweeps with different centers. Mathew Baker demonstrated this method and identified it as Venetian. However, several of his mould drawings show an alternative, simpler form of the mould superimposed onto the original, this time using only two sweeps. In this system, the sweep closest to the floor (the wronghead sweep) remained as before, but the second sweep replaced the remaining three of the Venetian system. Barker states (1983: 3) that that this clearly had nothing to do with the Venetian method and that it is probably significant, though at present inexplicable.

He goes on to say that the majority of moulds attributable to Baker are of an

intermediate form utilizing three sweeps, which Baker himself claimed had been the Venetian method of choice for the past twenty years, that is, since about 1550 (Barker 1983: caption fig. 3). Unfortunately, it is not possible to figure out the sequences of construction of his moulds, since many of the lines and intersecting arcs used to define the sweeps have either faded away or have been erased.

We know very little about how frame moulds were designed up to this point in 16th-century England, as very few relevant texts survive, if indeed they were ever written, from that period (Barker, 1985: 6). Historians have presumed that traditions were passed on from shipwrights to their sons and/or apprentices, and that a technique now known as "whole-moulding" was applied in some form. This technique is defined by Barker (1985: 10) as a device for adjusting two simple frame patterns to form the floor and side of a hull over the slowly-varying central section of the hull. However, as midships sections involving more than one controlling arc began to be developed, this method became too restrictive.

The technique of using sweeps to define the shape of a frame had several advantages. It provided some semblance of consistency in design, since identical mid-ship frames could theoretically be derived over and over for ships of similar sizes and types. It also provided a means of evolution whereby the shape of a frame could be made more complex by using a greater number of arcs in its construction. In fact, by 1650, Anthony Deane's famous manuscript gave a rule for projecting a mould using **five** sweeps whose radii depended on the beam of the

ship being designed. Making all of the frames out of parts of circles also simplified the sawing of timber since all that was needed was a large pair of compasses or a string and a piece of chalk, to choose curved logs and to mark them out and saw them (Howarth, 1974: 115).

However, one should not assume that the system of using sweeps for determining frame shapes was used to the exclusion of all others. There were several problems involved, many of which were not solved until more than a century later, and all of which involved the reality of the shipyard.

First of all, although the methods described in England from about 1580 did attempt to define on paper the arc centers along the entire hull, it was generally acknowledged that this could not be completely successful at the the more complicated extremities of the vessel. After the frames for the central section of the hull had been fitted to the keel, ribbands were generally set up, and the forward and aft frames then adjusted by eye (Barker, 1985: 11-12).

Second, it was considered quite difficult, even during Deane's day, to accurately estimate the waterline at which a ship would float, which was then called the swimming line. Shipwrights would often have to correct their miscalculated swimming lines with ballast.

Third, there was a question of how closely the rules could be followed given that the carpenters were working with wood. English oak is known to warp somewhat unpredictably, and it was not always possible to find a naturally-curving

piece of wood exactly the right shape. Even into the 18th century it was thought wise to let the frames stand as long as the contract permitted before they were faired off and planked--Nelson's Victory stood a year in frame during 1759 and 1760.

Finally, there is the fact that shipwrights often ignored, or were ignorant of, modern design techniques. As late as 1620 there were complaints that shipwrights never succeeded in building two ships alike, and even later, Samuel Pepys said that most of them were gouty, illiterate, intemperate and ill-conditioned men who understood their craft so imperfectly that they could not explain it to anybody else (Howarth, 1974: 116).

These factors produce a picture of naval architecture as a nascent science in 16th-century England, coming into its own as an accepted practice only by the middle of the 17th century. Though many early shipwrights were employing sweeps to design the frames of their ships, there is some evidence that these rules may sometimes have been fudged, if not completely ignored, in the shipyards. However, there can be little question that the emergence of naval architecture as a science, rather than as an art, was one of the most important factors leading to England's dominance of the oceans through the 17th and 18th centuries.

CHAPTER IX

LA ARMADA ESPANOLA

By the middle of the 16th century, the two most powerful navies in Europe were those of Spain and England. Spain's expertise was derived mostly from the experience that the New World exploration, colonization and trade had given her officers, seamen and shipwrights. England's had come mostly from the personal prodding of Henry VIII, based upon his perception that England could not survive, much less become a major power in European politics, without a strong naval force.

Spain's naval needs were much different than those of England, and as such, were approached in different manner. England had built up her navy as a form of self-defense, so that ships-of-war were foremost on the minds of the architects of the plan. Spain, on the other hand, needed large merchant ships that could make the strenuous Atlantic crossings with regularity and safety, both to deliver colonists and supplies and to bring back hundreds of tons of booty from America. At first, having the largest naval reserve in Europe, they could do this relatively unmolested. Except for a few French and Dutch pirates, the Ocean Sea was theirs and war ships were little needed. However, once the English got into the fray in the second half of the century, and once the pirates became licensed privateers, a reaction was required. What happened greatly affected the history and naval

development of England, and must be discussed before one can gain a real understanding of the development of the English warship after about 1550.

But first some background: after Portugal's successful rounding of the Cape of Good Hope in 1488, Spain was desperate to find a route to the Indies. They were so desperate that they took a chance on a brilliant and obsessed man named Christopher Columbus, who erronneously claimed that Japan was less than a month's sail due west from Spain. The vessels that they chose were caravels, which the Portuguese had been slowly improving as they made their way around the coasts of Africa. These vessels were characterized by seaworthiness, low draft and maneuverability. The latter two characteristics were desirable for exploring rivers and reefs. Caravels were also known for their small size. Therefore, once trade with the New World looked like it was going to become an established network, larger ships were required.

The factor which seems to have had more of an effect on the development of ship design in Spain than any other was the lack of a royal navy as the English knew it until about the beginning of the 17th century (Oppenheim, 1896: 37n.). This cannot be stressed enough. In fact, except for the galley arsenals, there was not even a royal dockyard in Spain. Portsmouth dry-dock was built by Henry VII in 1496, but in 1596 there was still not a single dry-dock in Spain (Oppenheim, 1902: 30).

In the early days of New World trade, Ferdinand and Isabela had no shortage

of ships volunteering to make the highly profitable voyages to America. The trip was relatively safe, and once there, a man could make untold amounts of wealth with only one voyage. Shipbuilding prospered, and the King and Queen fueled this effort by offering a bounty on all newly-built Spanish hulls. A proscription on selling Spanish-owned vessels to foreign nationals kept the new ships in Spanish ports.

As more and more colonies were established, the ships got larger and larger. However, once the effects of piracy started to become a major loss of revenue to the crown, the inadequacies in their design became painfully apparent. The Spaniards had the monopoly on New World trade, and they guarded it very jealously. They began first by arming their ships more heavily, and then by grouping them into flotas, using the theory of strength in numbers. Finally, in the second half of the century, ships were designed whose specific function was to protect the flotas.

By the time Philip II (1556-98) acceded to the throne, there was not only the New World problem to drain his fleets, but the Turkish problem as well. His ships were obtained chiefly by the embargo of foreign vessels trading to his ports, or by hiring those built by Spaniards, to whom he also paid a bounty on the condition that the ships were kept at the disposal of the crown. Others were contracted for in Mediterranean ports (Oppenheim, 1902: 31).

In 1567, orders were issued that the flagship and vice-flagship (capitana and

almiranta) were to be equipped as men-of-war and to carry no cargo except treasure in order to leave them freer to fight. In addition, a squadron of twelve galleons (which were to form a permanent squadron for the protection of the Indies trade) was ordered to be built in the Biscay yards. These, the first members of the famed Indies Guard, will be discussed later. The important points are twofold. First, these vessels were being built specifically for protecting the merchants, and perhaps to carry treasure. Second, not only merchantmen, but warships were constructed and owned by the private sector. This particular squadron was built and maintained by a "general average" assessment levied by the Casa de Contratación, or House of Trade, on merchants trading to the Indies. It was a sort of private "insurance" squadron that was owned by the Casa de Contratación itself (Corbett, 1899a: 112).

As the embargoes began to severely deplete the merchant fleet, it was harder to convince investors that they could be guaranteed a good return on their money by building ships. In 1578, Sancho de Achiniega noted the falling off of the number of ships built as a result of the decay of trade and the embargoes for the royal service to which the ships were subjected. Since the ships of royal fleets were practically all armed merchantmen, the dropoff in shipbuilding greatly reduced the stock upon which the crown could draw (Oppenheim, 1902: 4).

Fernandez Duro tells us that by 1587 most of the ships in a Spanish port were of every flag but that of Spain. There could be found Genoese, Venetian, Ragusan,

Levantine, Dutch, Scottish, French, Hansa, and other ships among the vessels hired or embargoed for transport or for fighting purposes. Only seven out of the twenty-four that were destroyed or taken by Drake in a raid on the road of Cadiz that year were described by Fernandez Duro as being Spanish or Portuguese (Oppenheim, 1902: 145; Lakey, 1987: 28).

As for the famed Armada Invincible, Monson wrote that "[t]he chief ships that he [Philip] had in his expedition of 1588 belonged to the Portugal; most of the rest consisted of several nations, as Levantines, Bicainers [Biscayans], Flemings, and merchants of his own country (Oppenheim, 1913: 68)." The Portuguese ships had been acquired by Philip in 1580 when he usurped the throne of Portugal and were superior to anything that Spain was then producing (Waters, 1975: 20), with the possible exception of the Biscay galleons.

After the disastrous Armada campaign, the Spaniards started building ships with unprecedented energy, realizing that the only way that they could continue to reap the rewards of their New World possessions was to be able to meet the English, and other hostiles, at sea. The new ships were still not up to English standards of hull design, and this was largely due to the lack of central control that might have allowed a given shipwright to learn from the mistakes of many others.

The Ships

Throughout the 16th century, there were three ship categories that appeared more than any others in Spanish and Portugueses annals: the caravel, the nao (or nau) and the galleon. The caravel does not really concern us here, as it was primarily an exploratory vessel, not a warship. As previously mentioned, they were small but seaworthy craft with great maneuverability and low draft, and were more related to ancient coastal fishing vessels than to anything else. Recent archaeological evidence suggests that they carried a good amount of wrought-iron weaponry, though mostly it was anti-personnel in nature (Keith and Simmons, 1985: 415). Once larger ships started taking over the New World trade, caravels were once again used for fishing, coastal trade and, occasionally, as troop transports. One document published by Corbett (1898: 5) mentions a harbor in which the English found "a caravel laden with fish," and another (Corbett, 1898: 11) states: "We found in the [shipping] road seven caravels and one a building on the stocks. These ships had in them bread, wine, oil, sugar, marmalade, and suckets." In 1625, Sir William Monson wrote a criticism of the confession of a Dutch prisoner who had claimed to witness a plate fleet escorted by one hundred caravels that had been dispatched from Spain to do so (Oppenheim, 1913b: 171-72). While Monson is clearly skeptical about the quantity of the caravels, he never questioned the fact that this vessel type was being used for such a purpose.

The nao presents a bit more of a problem, but its origin seems clear. As

mentioned previously, the two main distinctions among medieval Mediterranean sea-going vessels were whether a vessel was a long ship or a round ship, the former being primarily an oared galley, an instrument of war, and the latter being a sailing ship and merchantman.

At that time, the principal freighter of the Mediterranean was a type of ship referred to in the Latin documents as a navis,. Naves could be quite large, up to 400 tons or more, but were also known to be as small as 70-75 tons. They had between one and three masts, but usually two, both carrying lateen sails. They always had a stern superstructure, and sometimes one on the bow as well. It is possible that the forecastles were only employed on the particularly large ships, or in case of hostile activity (Dotson, 1969: 96, 99, 101).

Several sets of dimensions exist for 13th century naves. One navis which the Genoese agreed to provide for the first crusade of Louis IX of France in 1264 had a keel/beam ratio of 2.23 and a depth/beam ratio of 0.43 (Dotson, 1969: 98). Another, the Venetian Roccafortis, from a document dated 1268, was larger than the Genoese vessel, and had a kee/beam ratio of 2.42 (Pryor, 1984a: 209). Two identical unnamed horse and troop transports for Louis IX were to have keel/beam ratios of 2.28 (Dotson, 1969: 325, 328). Several 13th-century naves for which Pryor (1884a: 203-204, 208-209) has been able to provide reliable dimensions show keel/beam ratios from 2.30 to 2.44. Therefore, we can conclude that the navis as a type in the early medieval period was rather beamy, with an

average keel/beam ratio of around 2.30.

Several variations on the name and design had appeared by the latter 16th century including nao, navio, nave and naveta (Corbett, 1989: 120), but throughout the medieval period the navis played an important role in Mediterranean trade without any great changes in design. However, some time between the 13th and the 15th century, a combination of northern and southern influences produced the carrack.

The carrack was, for the most part, the largest merchant ship of its time. It could have as few as three, or as many as five masts, with the main- and foremasts carrying square sails and the others lateen sails (Bass ed. 1972: 214).

In Spain, the terms nao and carraca were both used after the 15th century, but the differences were not at first clear, especially between "la nao gruesa o de alto bordo" and the carrack. Both had fore- and sterncastles, beamy hulls and round sterns. There were two principal masts with square sails, one or two mizzen-masts abaft with lateen sails, and a bowsprit with spritsail (Manera Regueyra et al., 1981: 144ff).

By the 16th century, however, the nao and the carrack had evolved into clearly separate types. At the beginning of the century, carracks were considered especially well-suited for long voyages. They were generally between 500 and 1000 tons and were heavily constructed with two or three decks. The forecastle overhung the bow considerably and was taller than the sterncastle, which was still

quite high and was sometimes surrounded by galleries. The carrack's masts consisted of the bowsprit, carrying a spritsail; foremast, carrying two square sails; main mast, also with two square sails; the mizzen, with a large lateen sail, and either a lateen or square topsail; and, in some cases, a second mizzen, the bonaventure mizzen, with a lateen sail. Smaller armament was carried in the castles; larger weaponry, on the main and lower decks.

The naos engaged in early 16th-century Atlantic trade had definite characteristics. The largest had tonnages of about 500 or 600 tons; the smallest, something more than 100. Those of Castillian construction were somewhat lightly built; their large masts and instability were said to be able to "undo the work of the caulker." The Flemish naos , on the other hand, were considered to be solidly built.

The Castillian nao ordinarily had an overhanging, upcurving forecastle and less full waterlines than the Flemish naos. Abaft there was a closed superstructure for the crew. The masts consisted of bowsprit and spritsail; foremast with two square sails; mainmast, also with two square sails; and one mizzen mast with a lateen sail. The artillery carried depended on whether the ship was armed "de mercancía" or "en guerra" (Manera Regueyra ed., 1981: 111).

Barkham points out, however, that even by the middle of the 16th century, the word nao was already being used as a generic term for 'sailing ship,' even for ships of under 200 tons. Although there was an overlap in the terms used for these ships, the smaller vessels like zabras and pataches were generally much narrower

in the beam in proportion to the keel than the larger naos and galeones (Barkham, 1984: 1). The naos that Barkham includes in his List II (1984: 3) all had keel/beam ratios of approximately 2.00. This is less than the supposedly ideal ratio of 2.31 for naos or navios given by Palacio (1944: 90; 1986: 114).

The Portuguese had a word for carrack, but themselves seldom or never used that term to describe their East-India ships, preferring "naus de carreira da India." These same naus were invariably called carracks in contemporary English and Dutch accounts (Boxer, 1984: 396), and this possibly reveals more about their appearance than anything else, for we know what an Englishman thought of when he thought about carracks. It was always used to describe the Mediterranean carrack as it is best remembered, high-charged, broad in the beam, and characterized by Boxer (1984: 396) as an indifferent sailor. Howard (1979: 48) is not so kind, and writes that ships of this sort in the early English navy "must have sailed like a haystack." Prior to 1622, Portuguese carracks usually had four decks, but smaller types with three or even two decks existed, and these were sometimes referred to as navetas. However, naveta was also used to refer to small, frigate-type India-built vessels which contemporary English and Dutch documents called 'yachts' or 'frigates' (Boxer, 1984: 396).

In any case, the Portuguese were little concerned over the below-average sailing qualities of their carracks, as I will call them, for two main reasons. First of all, in their voyages to the East Indies, the ships were rarely out of sight of land and

were usually never more than forty-eight hours away from a coastline. It is true that rounding the Cape of Good Hope is a difficult task even under the best circumstances. However there was never the problem of finding oneself in the middle of the Atlantic, a fortnight's sail to a landfall in either direction. The other reason is that, like the Spanish, the Portuguese enjoyed a monopoly over East-Indian trade for many decades, so that organized armed resistance on the sea was not generally a problem. Although she did not sail her ships in convoys, her carracks, some heavily armed, followed regular wind systems on non-competitive, bulk-carrying voyages. Therefore, her shipyards had no more incentive than those of the Spanish to design and produce weatherly ships of great burthen (Waters and Naish, 1975: 22).

English documents from the second half of the 16th century distinguish carracks as the largest ships on the sea and use the word mostly to describe Portuguese ships going to the Indies. One document (Oppenheim, 1903: 206) states: "My Lord's principal end in this voyage was to intercept those carracks, which for burthen exceed all other ships in Europe, and go full freighted with commodities for the East Indies, besides the abundance of money carried in them." Another (Oppenheim, 1903: 25) explains that "...those men advertised him of four sail of ships descried from the shore, and one of them, looming greater than the rest, seemed to be a carrack." And a paper of about 1586 (Oppenheim, 1902: 42), a contemporary translation of a Spanish original, tells us that there are in Lisbon:

> ...of great ships belonging to the King and merchants, called carracks, which go to the East Indies and are of burthen from 500 to 1300 tons, thirteen. There is, in Lisbon, for the wars, 26 caravels. There is in Lisbon of divers merchants [?] which go to the ports of Barbary, Africa, Venice, and other places, of the burthen from 100 to 400 tons, 37 ships. There is in the river of Lisbon of divers merchants [?] that are of burthen from 70 to 120 tons which go for the islands [Azores].

The carrack Madre de Dios, captured in 1592 and regarded as the largest ship afloat, had an overall length of 165 feet, a keel length of 100 feet and a beam of 46 feet 10 inches (Oppenheim, 1896: 125). The ratio of those respective dimensions comes very close to the 3:2:1 average cited by Scandurra (Bass ed., 216), which are further supported by the dimensions for naos da India given by Barros (Barros, 1933: 111). After the first quarter of the 17th century, the naos da India were phased out of existence by galleons and smaller naos (Boxer, 1984: 394).

Portugal's practice of using unwieldy ships travelling along regular routes had certain strategic flaws which their enemies did not fail to note. It was risky for a foreigner to be seen in Portuguese territory and be taken unawares, but the stakes were high. One Portuguese carrack named the San Felipe was taken in 1587 by Drake, and "[i]n her hold were hundreds of tons of spices and precious gems. Chests upon chests of costly china, bales of silk and velvets, and coffers of bullion and jewels." The total came to 114, 000 l. (Corbett does not explain the monetary unit which he abbreviates here), which Corbett (1898: xlii) calculated to be approximately one million pounds sterling in 1898, which works out to tens of

millions of 1987 U.S. dollars.

Until Philip claimed the crown of Portugal, Spain itself does not seem to have had a lot of carracks, and the word was used only rarely to describe Spanish ships until the 17th century. We can infer that the naos that Spain built in the first three quarters of the 16th century were simply beefed up versions of the old Mediterranean naos that they had used for trade up until the discovery of the New World. But the fact that they bought, borrowed and embargoed a large number of their ships from other countries confuses the situation.

After the turn of the 17th century, the word nao more and more became a generic word for 'large sailing vessel.' A similar word in English today would be ship, although, as we have seen, that word also once had a quite specific meaning. However, there are several instances from the 16th century where it is revealed to us that the term 'nao' once referred to something quite specific. Very often it is a question of a nao versus a galleon, as we shall see later, and this seems mostly to be a question of function, a nao in this case being a merchant, not a fighting vessel. And in the records of his first voyage, Christopher Columbus consistently referred to the Santa María as a nao, clearly setting it apart from the caravels Niña and Pinta.

But there is one list (Corbett, 1898: 120) that truly sets aside the naos as a quite specific type. It is a Spanish official report of their losses at Cádiz in 1587, and is given by Fernandez Duro in ducats as follows:

> Three hulks from Malaga [Mediterranean Spain] with 3,443 quintals of biscuit of his Majesty's. They burnt the one and carried off the other two with 2,000 quintals and her Flemish crew. Value, 10,000.
>
> Two hulks of 400 and 200 tons with 392 pipes of wine of his majesty's--burnt. Value, 15,000.
>
> A Portuguese ship (navio) with 3,288 bushels of wheat of his Majesty's--burnt. Value, 5,000.
>
> A Levant ship (nave) of 600 tons--sunk. She was taking in a cargo for Italy of cochineal, hides, wool, and other merchandise. Value, 40,000.
>
> A Biscay [north coast of Spain] ship (nao), new--burnt with more than 200 quintals of iron and other merchandise. Value, 20,000.
>
> The Marquess of Santa Cruz's galleon--burnt. Value, 18,000.
>
> Four ships (naos) of the New Spain Fleet-burnt. Value, having no cargo, 15,000.
>
> A Portuguese vessel (naveta), loading for Brazil with wine and other merchandise--burnt. Value, 6,000.

This list shows that, at least in the eyes of the Spanish officials, several different types of merchant ships existed, and that one type was the nao.

The one type that seems most clearly defined is the nave, as its route is spelled out for us. In this case it was a Mediterranean merchantman that made the run from the Levant to Spain, thence to Italy and back, undoubtedly stopping at many other ports along the way. The important points are its Mediterranean metier and the fact that it had a not unimpressive capacity of 600 tons. Therefore we can say that, in 1587 the word nave was used to describe a large, Mediterranean merchantman.

The naveta is another vessel for which a destination is mentioned: Brazil. We can combine this with the aforementioned information given by Boxer, and state

with some confidence that a naveta at this time was a relatively small, two- or three-decked Portuguese ship that was at least capable of making the transoceanic journey.

There is no clue to either the form or capabilities of the Portuguese navio. Neither its size, nor whether or not it was ocean-going, can be ascertained from this document alone. However, linguistically navio means small navis. Barros (1933) discusses Portuguese navios of 80, 150, 300, 400 and 500 tons, which he distinguishes from the naos da India, whose tonnages can range from a low of 100 tons all the way up to 1200 (1933: 111). And Barkham (1981: 1) classifies the 16th-century Spanish navio as a smaller vessel, usually under 180 tons.

The word that Corbett translated as hulk is urca (Lakey, 1987: 68, 69, 70), and little can be said about them from this list, other than that they could be fairly large, and were cargo carriers.

Of the five naos, four were of the New Spain fleet. More will be said about this fleet later, but for the time being we can say that those four were certainly of ocean-going quality and large, as were most of the merchant ships that made the New World circuit. The Biscay ship, though a destination has not been given, probably was transoceanic as well. For one thing, the only place to which the Spaniards were likely to be sending iron, which they did not mine or smelt themselves in any great quantities, was America. For another thing, the Biscayans were some of the finest shipbuilders in Europe and were situated on the Atlantic, so

that most of their craft were of ocean-going quality. However, this was not always true. One of the known wrecks from the 1588 Armada invasion, the Santa María de la Rosa, was built in San Sebastián on the Biscay coast. It was solidly framed, but the individual frames were quite light for a ship of 945 tons. Every other frame was 20 cm sided and 30 cm molded, and the intermediate ones were 15 cm sided and 25 cm molded (Muckelroy, 1978: 100). As a point of comparison, the Cattewater wreck, an early 16th-century English armed merchantman of only 200-300 tons, had floor timbers which averaged about 20 cm sided by 20 cm molded (Redknap, 1984: 95). Therefore it seems likely that some ships were built in the Biscay region for the Mediterranean, as well as the Atlantic, trade.

There is another document (Oppenheim, 1914: 50) which appears to distinguish between carracks and other merchant ships. It is "A Project on how to make War upon Spain..." written by Sir William Monson in 1603. In it Monson discusses strategies of attacking the various flotas as they leave or enter port.

> And if by consent [between England and Holland] we agree together we must resolve on the emplyment of two several fleets; the number, the time, and manner how to employ them, with the hopes of what we are to make of them are as follows:
>
> The carracks outward: the Plate fleet homeward.
> The Tierra-firme and New Spain fleets outward.
> The carracks and New Spain fleets homeward.

The carracks are identified as Portuguese. Ships from the other fleets have not been categorized, but there seems a clear distinction in the Englishman's eye

between the carracks of Portugal and the naos of Spain. The Plate-fleet was just the English name for the Tierra-firme fleet after it had loaded up with precious metals in the New World.

To summarize briefly, it would appear that several different types of merchant craft were known on the Iberian peninsula. The Portuguese carrack, called carracas by the Spanish and naus da carreira da India by the Portuguese, were the largest of the lot, and were used primarily to make the East Indies trading voyages. Naos were Spanish, trans-oceanic merchantmen which were probably sturdier versions of the Mediterranean naos with which they had been long familiar. Both of these ship types had tall superstructures, overhanging forecastles, and three or more masts, the forward two carrying square sails. The naveta seems to have been the Portuguese version of the Spanish nao. Most of the other ships whose names are derived from the root navis were probably Mediterranean merchants, of lighter build than the ocean transports, but not necessarily smaller.

But the biggest distinction that seems to have been made among ship types in Spain was the old Mediterranean distinction between long ship and round ship. Although this was theoretically a functional distinction between warships and merchant ships, the Spaniards confused the issue by frequently combining the two functions.

The first distinction was between the galley and the sailing ship, and later in the 16th century, between the galleon and the nao, or the galleon and the carrack.

At first the differences between galleons, naos and carracks were quite clear, at least to the English. However, by the 17th century, galleons had gotten bigger and carracks smaller, causing confusion to the extent that the same ship might be called a a galleon upon leaving port and a nao, or even a carrack, upon returning, sometimes by the very seamen who sailed in her (Boxer, 1984: 34, 394, 396).

Although the term 'galleon' is associated with Spain more than almost any other country, the Spanish were actually one of the last powers in Europe to acquire this ship type. However, it appears that the word entered their language quickly and, in contrast to English usage, was the word of choice to describe certain kinds of ships.

The allusions in Spanish manuscripts and books to galleons or ships of the 'new invention' actually refer to two designs. The first appearance of a galleon in Spain seems to have been in 1540, when Don Alvaro de Bazan, Marquis of Santa Cruz, offered to police the Straits of Gibraltar with two galleasses and two galleons. These ships were described as "los grandes galeones de que fue inventor," (the great galleons of which he was inventor), and in 1550 he received a patent for their design and an order to construct three of them. They were immediately incorporated into the Flotas (Oppenheim, 1903: 319; Corbett, 1898: 29; Manera Regueyra et al., 1981: 122). Corbett (1899a: 29) expresses the opinion that these galleons were probably little more than modified war galleasses, but that does not seem to have been the case. Later in the century, galleons that evolved from de

Bazan's galleons were oft times so large that they were confused with carracks. The name "grandes galeones" suggests an imitation or modification of the 1526 Venetian great galleon that was discussed earlier.

The second new ship was designed by Pedro Menendez de Avilés in 1573. These were long, low-flying, flush-decked ships without a forecastle or poop and could use sweeps as well as sails (Oppenheim, 1903: 319). They were not cargo-, but treasure-carriers, and had been developed specifically to accompany the Tierra Firme treasure fleets, which had come to supercede the New Spain fleets in richness and importance (Waters, 1975: 15). The new ships were considered well-suited for their job, and ships departing from other regions used to wait for the Plate Fleet in Havana. There they would put their gold into the said bullion carriers before leaving for Spain under the protection of the flota (Oppenheim, 1914: 49). These ships soon evolved into the gallizabras, invented by Alonso de Bazan, Alvaro's brother (Oppenheim, 1903: 319). This is a very descriptive term, alluding to a hybrid between a galley and a zabra or pinnace (Corbett, 1899a: 196). Soon the references to gallizabras all but disappeared, but in 1591, the same Alonso de Bazan (with a fleet of galleons) captured the Revenge, and the next year he was to set out in 23 galleons to Flores Island, off Portugal, to await the coming of the carracks (Oppenheim, 1902: 279). Monson described the 1591 action as being "the first time the [Spanish] King shewed himself strong at sea..." (Oppenheim, 1913: 68). Therefore it is quite certain that one type of Spanish ship that the

Spaniards and English referred to as galleons was small and nimble, and apparently quite successful.

Although these 'new' galleons appear to have had Mediterranean antecedents, there was probably some English influence too. There are many references in Elizabethan and Spanish papers to ships being built for Philip II on the English model. A William or John Lambert, of Liverpool or Chichester, was in Philip's employ for some time and designed some vessels for him (Oppenheim, 1903: 319), and in the early 1570s, it was reported that the renegade Thomas Stucley was teaching the Spaniards "to frame their ships after our [English] manner...which will in time annoy us greatly" (Glasgow, 1964: 182).

The Spaniards' penchants for large, profitable ships could not be overidden so easily, though, and it was not until their defeat at the hands of the English that any sort of program for the construction of quick, weatherly craft was begun in earnest.

The fact that galleons in 16th-century Spain sprang from so many separate antecedents makes the picture a little confusing, but three kinds seem to dominate the contemporary documents. :

1. The Biscayan galleon, similar to the great galleons designed by Alvaro de Bazan in 1550.

2. The Portuguese galleon, also relatively large, not used by Spain until after

1580.

3. The gallizabra-style galleon, invented in the 1570's to carry bullion and protect the Tierra-firme fleet.

The bulk of Spain's galleons seem to have come from two places. Before 1580, the major supplier of galleons was the Biscay region. It has already been mentioned that Alvaro de Bazan's first commission from the crown was for three galleons "de nueva invención," at least some of which were probably built on the Biscay coast (Manera Regueyra, et al., 1981: 122). We have also seen that when, in 1567, the crown decided that some of the ships in the convoys would have to be fitted out expressly for defense, it ordered the construction of a dozen Biscayan galleons, which formed the basis for the Indies Guard. As mentioned, they were owned by the Casa de Contratación.

After 1580, Philip also had the use of the galleons of Portugal. Usually they did not exceed 500 tons, whereas carracks were frequently over 1000, but after 1639, galleons of 1200 tons and over were constructed (Boxer, 1984: 396). Barros (1933) discusses late 16th-century Portuguese galleons of 200, 350 and 500 tons. Philip used them as fleet escorts and men-of-war, and by all appearances they were of the great galleon, rather than the gallizabra galleon, design. The so-called Manila galleons, actually carracks,were referred to in Portugal as naos da China, and ranged from 600 to 2000 tons (Boxer, 1984: 35).

From the documentation it is quite clear that the great majority of Philip's

galleons came from these two places, and also that knowledgable observers could easily make out the differences between Portuguese and Biscayan galleons.

Although good representations of the Portuguese ships are hard to find, a few characteristics can be inferred from the literature. One document (Oppenheim,1902: 134) tells of three vessels taken off the Portuguese coast by John Hawkyns in 1586. The masters of those vessels described Hawkyns as having altogether eighteen ships, of which four were Queen's men-of-war of 800 tons each and, "like the galleons of Portugal in appearance." The four were actually the 357-ton Nonpareil, the 448-ton Lion, the 471-ton Revenge and the 416-ton Hope (Oppenheim, 1902: 134). Only the Revenge was relatively new, although the Lion and the Nonpareil had been rebuilt in 1582 and 1584 respectively (Glasgow, 1964: 185), so we may take this as fair evidence that Portuguese galleons were not all that much different than the intermediate style of English warship, at least above the waterline. Another paper gives us a pretty good idea of the size of the Portuguese galleons in 1587. It is the report of Anthony Wheatley, on the ships he saw in Lisbon harbor preparing to go meet one of the flotas.

> He came from Lisbon the 25th of July last.
> This examinate further declareth that at his coming from thence, the Marqis de Sta. Cruz was bound out with a fleet of ships, viz. 14 galleons, 13 belonging to the King of of Portugal, the other to the Duke of Florence.
> The names of some which he knew are these: the galleon St. Martin, wherein goeth the Marqis himself, of burthen 1000 tons, who

(they say) hath 90 pieces of ordnance.
The St. John, being of the same burthen.
The St. Mark, of 700.
The galleon of the Duke of Florence, of burthen 1200.
The rest, as he heard, of burthen some 400, some 300, and the least of them 250. The other of the fleet being Biscayans, some great some small, which are very well-appointed and manned, in all fifty sails ready to go away, as they say, for the [Azores] Islands to meet the fleet that cometh from the Indies (Corbett, 1898: 195-97).

Of the fleet of about 50 sail, thirteen were Portuguese, one was private and all the rest, about 36 sail, were Biscayan. Another document tells of a fleet of 26 sail of Biscayans [mss. Basquins] as men-of-war for the West Indies (Corbett, 1898: 65), and a muster of the Indies Guard, described by Corbett as "the most important item in Philip's naval strength..." affirms the important role played by both Portugal and Biscay in the naval might of Spain:

The galleons of the Indian Guard
Lisbon: 13 galleons of Portugal, 2 great ships, 8 other vessels, 1 galleon of the Duke of Florence, 1 small galley and Recalde's Biscayans.
Gibraltar: 6 ships from Sicily, 4 great galleys.
Cartagena: 2 ships from Naples.
Biscay: 15 galleons (Corbett, 1898: xxvii).

Other documents give us an idea of the size of the Biscayan galleons. One account (Corbett, 1898: 107) tells of the sinking of a Biscayan of 1200 tons, along with 32 other ships, one of 1500, the rest of 1000, 800,600,400 to 200 tons apiece, and another (Corbett, 1898: 117), of the burning of "a great galleon of Biscay of 700 tons burden." A report on the ships in Lisbon harbor from 1587 (Corbett, 1898: 52) tells of "above 20 galleons of the King's between 500 and 300 tons. And 40

sail of Biskay (sic) ships from 100 to 500, of which 40, 20 were in road and the rest about the dock."

The only two archaeologically-investigated shipwrecks known to have originated in the Biscay region are the Santa María de la Rosa, mentioned previously, and the San Juan. The San Juan was a 300-ton Basque whaling galleon with a keel length of 14.82 meters, recently excavated from the bottom of Red Bay, Labrador, by Parks Canada (Waddel, 1986: 147). While the full constructional details have yet to be published, the remarkably complete hull remains promise to tell us much about the construction techniques and hull forms of mid-16th-century Biscayan ships.

Like the Portuguese galleons, most of the Biscay vessels were 500-600 tons or below, although there were a few excessively large ones. They were not always called 'galleons,' but the Wheatley report clearly demonstrates that the "Biscay ships" in Lisbon Harbor in 1587 were men-of-war, and Biscayan warships were frequently called galleons in other documents. An intelligence from Spain giving information on ships mustering at Lisbon (Corbett, 1898: 193) mentions "30 sail forth of the Straits termed galleons." This may have been Alvarez de Bazan's patrol fleet, in which case it would have been made up principally of Biscayan vessels.

There are very few good contemporary depictions of Spanish galleons before 1588, but some of the characteristic features can be noted.

The subject of the size of Spanish vessels has always been a favorite topic for writers of English naval history, both contemporary and modern. The theme consistently put forth was that the English ships were smaller, nimbler and quicker, and that the Spaniards' were large and cumbersome. However, most of these comments were made after the decisive encounter between the Spanish and English navies in 1588, which initiated a new era in shipbuilding for Spain. The relative sizes of the ships built prior to that event can be intepreted by viewing the final muster for the ArmadaEspañola alongside a similar list of the English men-of-war (Table 5). The two rosters demonstrate that there was not that much difference at all in size between the individual warships of the two navies. Remember, though, that the English and Spanish tons were not exactly the same. The Spanish system of measurement, as far as can be ascertained, seems to have given results of 25 per cent or more higher than that of the English (Corbett, 1899b: 179). However, bearing this in mind, it is possible to get a good idea of the size of the two fleets that opposed each other in 1588. The main factor seems to be that the Spanish had a fleet of 40 sail of merchantmen (naos and naves), 27 of which were above 500 tons and the rest above 300 tons. Against these England could show only five merchant ships of 300 tons and upwards, twenty of 200 to 300 tons and a score or so between 100 and 200 tons (Corbett, 1899b: 178n., 180-81). However, the ships listed in Table 5 are the ones set aside by the Spaniards as their principal sailing warships and would have been called 'galleons' by English

Table 5: The English and Spanish warships of the 1588 campaign (Corbett, 1899b: 180-81).

ENGLISH	TONS	SPANISH	TONS
Triumph	1100	San Martin	1000
Bear	1000	San Juan	1050
Elizabeth Jonas	900	San Luis	830
Victory	800	San Felipe	800
Ark	800	San Marcos	790
Elizabeth Bonaventure	600	San Matteo	750
Mary Rose	600	San Juan Bautista	750
Hope	600	San Cristobal (Castile)	700
Rainbow	500	Santiago El Mayor	530
Golden Lion	500	San Pedro	530
Vanguard	500	San Juan El Menor	530
Revenge	500	Asuncion	530
Nonpareil	500	Nuestra Señora del Barrio	530
Antelope	400	San Medel	530
Dreadnought	400	Santiago El Menor	520
Swiftsure	400	San Crisotbal (Portugal)	352
Swallow	360	San Bernardo	352
Foresight	300	Santa Ana	250
Aid	250	San Lorenzo	-----
Bull	200	Napolitana (Galleasses)	-----
Tiger	200	Zuñiga	-----
White Lion	140	Girona	-----

and Spanish alike. The fact that these earlier Spanish ships acquired a reputation for large size can be attributed to many things.

First, the all-important Spanish merchant fleet overwhelmingly outsized that of the English. In fact, the Spanish armed merchantmen were bigger than most of the English men-of-war.

Second, the English, when attacking a Spanish flota would naturally try to

surprise it before the it could rendezvous with the Indies Guard at the Azores. Therefore, many of the ships with which English sailors had combat experience were actually armed merchantmen, including the capitana and almiranta of each fleet. The latter two would certainly have been high-castled, but would have been relatively handy, having had only bullion for cargo, which presumably was used as ballast.

A third factor is that even the true Spanish galleons had higher castles than the English men-of-war (Oppenheim, 1903: 318n.). The special peculiarity of English construction seems to have been that not even the high-charged great-ships had particularly lofty forecastles. When the Duke of Stettin was taken to see the navy at Chatham, he described the three largest ships as, "all built very low at the head, but very high at the stern so that it made one shudder to look downwards (Corbett, 1899b: 179).

A final reason for the perception that the galleons of the Armada were larger than the English ships were the proportions and robustness of their design. Spanish ships were mainly of a short keel carrying a relatively long hull, which combined with the tall superstructures led to an unseaworthy vessel. Palacio tells us in no uncertain terms that "a ship that must be built for use in war, with regard to the measurements for the hull, keel, depth of hold, dead-risings, lateral resistance, and beam, must be of the same strength as has been given for the merchant ships, although there has to be a difference in the decks of some... "(Bankston, 1986:

147-48). In other words, a ship-of-war, which Palacio calls "la nave que uviere de hazer el uso de la guerra" (Palacio, 1944: 120), was identical to a merchant ship below the water line. Oppenheim describes them as having been "crank and leewardly," a characteristic which he attributes to broad floors and light draft. The sides were thick enough to resist shelling, and although the masts and spars were heavy enough for ships half as big again as those to which they were fitted, the standing rigging was often weak and badly adjusted. The solidity and weight which had been sought became its weakness (Oppenheim, 1903: 318n.). The size of the timbers and masts, along with the cumbersomeness which such a design produced, could easily induce the illusion of greater size.

Perhaps the differences between the English and Spanish navies was best put in perspective by William Monson, many years after the Armada conflict. He wrote:

> I have heard divers sufficient men, as merchants and others that lived in Spain before the wars with Queen Elizabeth, greatly cry down the King of Spain's ships in respect to ours; as in particular that they were huge and mighty in burthen, weak and evil-fashioned in building, lame and slow in sailing, fitter for merchandize than war; and I remember that old seamen, as Sir John Hawkyns, and others, have maintained that one of her Majesty's ships was able to beat four of them. I confess that we may rather believe it because the event has shewed it... (Oppenheim, 1913b: 66).

Of course, patriotic to the last, Monson did not attribute the whole victory to the ships. Later he added: "And therefore in comparing the Spanish ships with ours, I enter into the comparison of men, for, if it were in my choice, I rather desire a

reasonable ship of the King of Spain's manned with Englishmen than a very good ship of her Majesty's manned with Spaniards" (Oppenheim, 1913b: 67).

CHAPTER X

THE 17th CENTURY

After 1588, both the English and the Spanish built ships with renewed vigor. The English moved towards enlarging their galleon-built men-of-war until they were able to build ships of all sizes for all purposes based on that design. By 1647 there would be ships in the King's navy from 100 to 1100 tons burthen, all with keel/beam ratios of close to 3.00, usually a little more. In the first half of the 17th century, England began requiring greater uniformity among her warships, and by the middle of the century, the system of rating ships by the number of decks, and hence the number of guns she could carry, was instituted. England continued to have the strongest navy in Europe, but quickly saw increased competition from her old enemy France, and from the Dutch.

The English writers of the period would have us believe that Spanish ships from 1588 to 1650 were, once again, huge and ungainly. In the early 17th century, Monson wrote a comparison between the two navies:

> If you will enter into the true state and strength betwixt the galleons of Spain and ours, laying aside the advantage of our men or swift sailing, according to the old phrase they are bound to fight – Fight, Dog, fight Bear – till one side be overcome, which cannot be better decided than at anchor in a harbor. Let us judge the difference of ships: the Spaniards are bigger in burthen, and by consequence have the advantage to board; more spacious within board, and therefore contain more men; more decks and therefore more ordnance (Oppenheim, 1913a: 148).

Sir Walter Raleigh explained the international naval situation in his Essay on

Shipping written in 1650. He suggests (28) that Spain's warships were relatively large and bulky like English merchantmen, but elsewhere (20) that observation is qualified:

> ...for there are in England at this time 400. saile of merchants fit for the wars, which the Spaniards would call galleons.
>
> ...I say that the forenamed Kings, especially the Spaniards and Portugalls, have ships of great bulke, but fitter for the merchant than for the man of warre, for burthen than for battaile... yet I cannot deny that the Spaniards being afraid of their Indian fleets, have built some very good ships... (Raleigh, 1650: 20).

And so it seems to have been. The Spaniards were developing both the large and the small type of galleons at the same time, though they certainly built many very large ships. As an indication, between the years 1590 and 1600, the Spaniards built approximately 69 ships. Of these, 34 were of 1300 tons and above by English estimates, and eight more were of 800 tons. Seven ships built in 1592 were of 500 tons, and they were built expressly for fetching the King's treasure from the Indies. Thirteen more were between 300 and 400 tons, including three 300-ton gallizabras, and the remaining seven were below 300 tons (Oppenheim, 1914: 73-77).

As for the Portuguese, the carracks continued their voyages to the East Indies until about the third decade of the 17th century. In 1622, a book called Discursos sobre la Navigacion de las naos de la India de Portugal was published by João Pereira Corte-Real. It was composed of 75 paragraphs which divide themselves

naturally into three sections. The first 23 paragraphs are historical in nature, explaining how the Portuguese came to abandon their former (late 15th- to early 16th-century) practice of using handy 300 to 400-ton, three-deck ships, building instead unwieldy carracks of 1000 tons or more. The next twenty paragraphs attempt to demonstrate how superior a galleon was to a carrack, including in seaworthiness, sailing qualities, fighting value, and ability to take on cargoes in harbors which the heavier carracks could not enter because of their deep draft. The final section deals with salaries and need not concern us here (Boxer, 1984: 397).

That the Spaniards had small galleons resembling those of the English, and that this was well known to the English, is beyond doubt. In 1592 the English agent Andrada reported that some 40 galleons were in course of construction in the various Spanish yards, and all or most of these were designed on English or French models under the direction of Englishmen in the Spanish service (Corbett, 1899b: 340).

One enlightening document from Monson's Tracts (Oppenheim, 1903: 153) tells of a voyage by Monson himself:

> This news of the five [Spanish] galleons... made Sir William direct his course into the height the Spaniards were most likey to haul in, and coming to it he had sight of five ships, which in respect of their number and course, he made reckening to be the five galleons... but his joy was soon quelled, for coming up with them, he found them to be English ships from the straits and bound home.

Another paper from the same work (27) tells a similar story:

> The frigate of the Spanish fleet took the Garland and the Rainbow to be galleons of theirs, but seeing the flag of the Garland, she found her error... (Oppenheim, 1903: 27).

Both of these passages strongly suggest that there were more than a few ships in the Spanish fleet that strongly resembled English ships, and vice-versa, at least above the water line.

The picture that emerges for early-17th-century Spanish galleons points increasingly to two types of ships. On the one hand there were the huge galleons of over 1000 tons, which could not only carry ordnance and fight, but which apparently were also used as cargo vessels after the carracks became obsolete. A few of them accompanied the fleet to the Indies, while the rest stayed to patrol the coasts of the Iberia. When the flotas were expected, fleets of great galleons would go beyond the Azores to meet them and escort them back. The ones that accompanied the fleet to the Indies carried no cargo. For example, in the 1596 invasion of Cádiz, "...the Lords had the destroying of 55 great ships, the galleons of war excepted, all the rest were richly laden and ready in two days to sail to the Indies" (Oppenheim, 1913a: 127). Presumably they carried bullion ballast on the way home.

On the other hand, there were the fast, weatherly, mid-sized to small galleons which, if the 1590's are any indication, formed something over a third of the total number of ships. These were used specifically to carry bullion, a high-density item for which little actual space was needed, and as speedy dispatch boats, etc. They were handy sailors and probably resembled English men-of-war of the same class.

Although the 17th century saw the beginnings of a true Spanish Royal navy, embargoes were still required to fill out the fleets to the desired size. In 1650, Raleigh (1650: 20) wrote that the Spanish King, "hath no ships in garrison, and to say the truth, no sure place to keep them in; but in all the invasions he is driven to take up of all nations, which comes into his port for trade."

But by this time, England, Holland and France had already established their own colonies in the New World, and it was much too late for Spain to catch up enough to do anything about it. By the end of the 17th century, approximate parity was established among the navies of Europe, and the documentation associated with shipbuilding was elevated from an art to a science. The age of experimentation had become the age of fine-tuning.

CHAPTER XI

SUMMARY AND CONCLUSIONS

As far back as the reign of Henry III in the early 13th century, England's navy was composed primarily of sailing ships. We know very little about them except that their main function was transporting or escorting troops over the English Channel, not open-sea travel. They were larger than merchant ships of the time, but merchantmen were often used as "warships" in times of crisis. In such a situation, they were fitted with temporary fore- and sterncastles.

Henry V greatly increased the number of ships in the navy and built two very large warships, the Grace Dieu at 1400 tons and the Jesus at 1000 tons. These ships, and most of the others, had at least two masts and were clinker-built. Since the major technique of naval warfare in the 15th century was boarding, each undoubtedly possessed a towering forecastle and a shorter sterncastle, which were beginning to become permanent structures on all warships. The ships-of-war were divided into the categories of carracks, ships, barges and balingers, and both the ships and carracks were quite a bit larger than contemporary English merchantmen. The term carrack was used exclusively to refer to large ships of Mediterranean design.

Very few ships were built for the Navy between the reign of Henry V and the reign of Henry VII, and many of the old ones were actually sold. However, some advancements must have been made in shipbuilding technology, because by the

reign of Henry VII in the late 15th century, most ships had three or even four masts, as well as permanent castles both fore and aft. Henry VII only built two ships, the 800-ton Sovereign and the 1000-ton Regent, both of which probably resembled carracks, so that when crises arose the bulk of his fleet was made up of armed merchantmen. But he had other accomplishments which advanced the cause of the navy. The first was the construction of the Portsmouth dry-dock, a first-rate facility which had no equal in Spain until the 17th century. The second was the creation of a bounty system for the construction of large ships.

The origins of the modern English navy can be traced to the reign of Henry VIII. Henry recognized that ships were the only sure way of protecting his country from attack: if the invaders could not land, they could not conquer. He had a tremendous interest in all naval affairs and took personal charge of the creation of his Royal navy. By the time of his death, he had as many ships of more than 100 tons as Elizabeth had at the end of her reign.

Henry, like all European monarchs, had a great respect for the Italian maritime states. In particular, he was familiar with the galeazza di Londra, a type of Venetian merchant galleass that conducted trade with London and Flanders. With this as his basic model and with the aid of Venetian and Genoese shipwrights, he produced a new English ship type, the galleass. Towards the end of his reign, these ships were being built practically to the exclusion of all others.

The English galleasses were not the same as the Mediterranean galleasses of

the time. They were warships of up to 450 tons that carried four masts and as many as two dozen broadside guns, some of which were put below the main deck to lower the ship's center of gravity. This advance was made possible by the recent invention of the hinged gunport, combined with English (perhaps Henry's) ingenuity. Henry also brought ship-smashing ordnance into his warships, as the recent finds on the Mary Rose so eloquently demonstrate.

The galleasses had sailing qualities far superior to those of the cumbersome "carrack-fashion" warships that had dominated European naval warfare, and had unusually long keels in relation to their beams. One, the Bulle, had a keel/beam ratio of 3.64. These ships were well-described by Frank Howard as having a mature look about them, and they were the original English ancestors of the 16th- and 17th-century ships of the line.

The galleasses could be divided into three types, based on design. The different types of galleasses were quite similar to each other, at least in comparison to the ships. The advantage of these galleasses was their ability to maneuver quickly and easily, allowing them to release a broadside and get away before the fire could be returned. The aforementioned introduction of gunports below the main deck permitted the use of greater numbers of guns, since they did not upset the balance of gravity as much as artillery in the castles or on the main deck. The problem of how to increase the amount of ordnance that could be carried on ships had long been a problem, and the English solved it by lowering their guns instead of

by raising the ships' sides, as the Venetians had tried. The ram/beak indicates, though, that boarding had not yet become an obsolete form of naval warfare.

After Henry VIII's death, not much happened in English shipbuilding. There was a conservative trend back towards large ships with lofty castles, and by the time of the accession of Elizabeth in 1558, a great debate was raging on the relative merits of tall, strong ships or lower, more nimble ones.

Fortunately, Elizabeth's reign contains much more documentation on individual ships than any reign preceding it, and we can get a good idea of the shape of her ships' hulls. One such source are the Navy Lists from 1591 and 1602, which have been published by Oppenheim and Anderson. These lists give dimensions, years of construction, and other information about many of Elizabeth's ships. Another source is Mathew Baker's legacy, Fragments of Ancient English Shipwrightry, the personal sketchbook of a 16th-century royal shipwright.

These sources, and others, allow us to note a trend away from great size and strength, and towards seaworthiness and agility. The initial reaction away from the long keel/beam proportions of Henry VIII was slowly overcome, and over the course of her reign, Elizabeth's ships evolved towards keel/beam ratios of just under 3.00, and depth/beam ratios of .45 to about .48. The large depth/beam proportions apparently reflected the fact that warships were expected to be able to navigate the Atlantic Ocean, not just the Channel. The ships which exeplified the new design were, first, the Revenge, and later theVanguard and the Rainbow. The latter two

were the first to be called galleons as an official, English shipwright's term.

Throughout Elizabeth's reign there was great confusion as to the names for the different types of ships that were being produced. At the beginning vessels were known as ships, pinnaces and some word having 'galley' as its root, such as galleon, galleass, galliot or galley. The word galley in English does not appear to have been very specific, and all manner of vessels, from great-ships down to ships' boats could be so called. The word galleon was generally, though not exclusively, reserved for foreign vessels, and foreigners generally referred to English warships as galleons. By the end of the Elizabethan period, the official categories were ships, barks and pinnaces. The first category now included the race-built warships like the Vanguard and the Rainbow, while the third generally referred to ships that could use auxilliary oar power as well as sails. The term bark, though, was never very well defined, and could be used to describe ships of all sizes, although it was mostly reserved for smaller ships of the line. The lists of armed merchants contained some ships that were called galleons, and although privately commissioned to protect the merchant fleets, they were warships in every sense of the word. The generic term for warship in Elizabeth's time came to be "man-of-war."

After defeating the Spanish Armada in 1588, the English Admiralty knew that their designs were on the right track, and in the 17th-century, the trend of lengthening the keel continued, until keel/beam ratios of 3.40 were not uncommon. In addition, the increasing use of arcs in ship design lent new sophistication to the

emerging science of naval architecture, as well as to the individual ships. This century saw the introduction of classifying ships by rate, that is by how many decks she had and hence how many guns she could carry. The 17th-century vessels were based on designs conceived during the reign of Elizabeth, and ship construction became a scientific discipline in addition to being an art. From that moment on, the ship-of-war remained basically unchanged throughout the age of sail.

The Spanish had different motives behind their naval expansion, which discouraged warship construction. The lucrative New World trade made huge merchant ships more profitable to build than small, quick warships. This situation was aggravated by the fact that Spain did not have a Royal navy until the 17th century. The lack of central direction caused many problems for the Spaniards, including lack of continuity and inability to mobilize quickly.

The workhorse for the Spanish in the Atlantic was the nao. This was an ocean-going merchant ship that had evolved from the Mediterranean navis, or round ship. Until late in the 15th century, naval warfare in the Mediterranean was waged in oared galleys, which attacked by ramming at deck level and boarding. At that time, sailing vessels were thought of exclusively as merchant vessels, having had keel/beam ratios of slightly greater than 2.00. The nao kept these proportions, although they were constructed of much more substantial timbers for the rigorous Atlantic voyages.

For a while, the Spaniards could travel the open ocean relatively unmolested,

and it was always a race to see who could get back to port first with their goods. However, by the middle of the 16th century, piracy was becoming an annoying and expensive problem. Rather than spend money on custom-made warships, the Spanish developed the flota system, whereby the merchant ships would congregate at Havana or Santo Domingo and cross the sea together. It was later decreed that two of the ships in the flota, called the almiranta and the capitana, would be heavily armed and carry no cargo except for treasure.

At about the same time, the first Spanish galleons started being built on the Biscay coast. The first ones were known as galeones grandes and were built especially for guarding fleets. Later evidence in Palacio's Instrucción Nautica shows that their lines were probably not much different than those of the naos, but they had lower castles than the merchant ships, they were not so loaded down, and they were heavily armed. There was also a smaller type of galleon based on the gallizabra, but it never enjoyed the prominence of the great galleons: the Spaniards simply preferred large ships. The third type of galleon was the Portuguese version, averaging about 500 tons until the 1600s when Portuguese galleons of up to 1200 tons could be found.

The Portuguese traded mostly to the East Indies, and their main vessel was the carrack, which they called nau da India. These were the largest ships on the sea, often having burthens of 1000 tons or upwards, though the norm was 500-600 tons. They too started having problems with piracy, and Portugal developed her

own galleons to protect her merchants. The Portuguese galleons were highly-respected ships, and after Philip II took the crown of Portugal in 1580, the Portuguese galleons formed the most important part of his navy, followed by the Biscay galleons. However, as far as sailing qualities, Spanish and Portuguese ships could not match those of the English, and they paid for it dearly in 1588.

Much has been made of the differences in size between English and Spanish warships. Conventional wisdom has it that the Spanish ships-of-war were large and cumbersome, while the English ships were smaller and thus more nimble. Actually, the ships that Spain listed as official warships in 1588 were, if anything, negligably larger than the English ships. Why then this misconception?

Perhaps the main factor was the fact that the 1588 Spanish Armada had over forty sail of merchantmen attached to their war fleet, all of them over 300 tons and most over 500 tons. These were not only larger than the English merchant ships, they were larger than most of the English men-of-war. A related factor is that the English would usually try to attack the New World flotas before they met with the galleons of the India Guard at the Azores. This meant that most of the ships with which English sailors had combat experience were actually large armed merchantmen.

The other factors are perceptual. Although Spanish galleons were not really larger than English men-of-war in terms of tonnage, they did tend to have higher castles than the English, especially in the bow, making them appear larger. There is

also some evidence that Spanish ships were built with timbers that more properly belonged on larger ships, and that their ships had short keels and long decks. This, added to the effect of the tall superstructures, gave them ungainly sailing qualities that Englishmen generally associated with large ships. The combination of cumbersomeness and robustness created the illusion, the perception, of greater size.

After the Spanish disaster in 1588, Iberian shipbuilding went in two directions. On the one hand, many very huge ships were built, perhaps on the assumption that this would make them harder to sink or capture. Others were built more or less on the English model, small and nimble. They were primarily fleet escorts.

The Spanish and English shipbuilding industries started off with separate motives. The designs of their warships moved towards each other in the late 16th century, but to the end of the age of sail, England kept its competitive edge by producing ships with better sailing qualities. Ironically, even an expert could not tell the difference between a Spanish galleon and and English man-of war above the water line, except at close range. However, the English, unlike the Spanish, learned early on where to put the cream of their technology: under the waterline, in the sea.

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NOTES

[1] Tonnage from Oppenheim, 1896: 51. Not given in Anthony.

[2] Place of origin from Glasgow, 1975: 351.

[3] Built by James I of Scotland.

[4] Glasgow's keel/beam figures for Merhonour, Garland and Defiance from the 1602 list contain typographical errors that I have corrected. The new figures are computed from Oppenheim, 1896: 124, the same source listed by Glasgow. The keel/beam ratios given in the 1591 list for these three ships are, repectively, 2.89, 2.79 and 2.88 (Anderson, 1957: 322).

APPENDIX

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Ibid., pp. 66-67 (illustration: the Brygendyn).

Ibid., pp. 82-83 (illustration: the Harpe).

Pepys MS No. 2820, Baker, Fragments of Ancient English Shipwrightry, ca. 1570 and 1620, pp. 2-4.

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Ibid., p. 74.

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Ibid., p. 156.

Pepys MS No. 2800, Waegener, The Mariner's Mirror, 1588, p. 6 (map entitled: "A perfect description of the porte of Roscow").

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