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The Iberian Caravel: Tracing the Development of a Ship of Discovery

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Abstract

Caravels are the icons of the Age of Discoveries. This paper summarizes some of the aspects related to their past research and hopeful future contribution of nautical archaeology for the understanding of these elusive and almost unknown vessels. Their origins and development are analyzed and part of the standing sources for their understanding commented upon. Far from an exhaustive compilation of sources, and not pretending to be a critical analysis of the bibliography – which I intend to publish in the near future – this text is just a preliminary reflection on the problem of reconstructing the 15th – Century caravel of the discoveries.

Introduction

The caravel of the 15th and 16th centuries was a ship with a distinctive shape and admirable qualities. A gently sloping bow and single stern castle were prominent features of this vessel; it carried a main and a mizzen mast that were generally lateen-rigged – referring to a triangular sail set from a long spar at an angle to a short mast (Figure 02-01). Although the caravel had already been in use for hundreds of years, it developed into an incredibly fast, easily maneuverable vessel at the height of the Age of Discovery, and was noticed by eminent people. Gaining fame with Spanish and Portuguese voyages of discovery, these former fishing craft were sent down around the west coast of Africa and into the New World. Though *Santa Maria* was a *nau*, Columbus's smaller vessels, *Niña* and *Pinta*, were caravels. In his log from the first voyage to the New World, the Admiral of the Ocean Sea often expressed admiration for his favorite ship, *Niña*, commenting on her exceptional speed, handling, and safety. After sailing

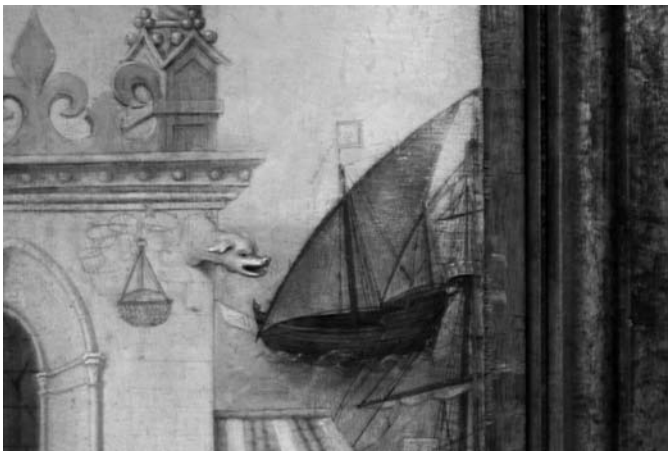

Figure 02-01 - Best known representation of a caravel. Retábulo de Sta. Auta, Museu de Arte Antiga, Linbon (Photo: Filipe Castro).

this caravel through violent storms on the return voyage, Columbus remarked, "if the caravel had not been very sound and well equipped, I fear we would have been lost" (Columbus 1987: 184). Bartolomeu Dias too sailed in caravels during his famous rounding of the Cape of Good Hope in 1488. It has become evident in the historical record, however, that not all caravels were designed the same way, and many changes were made throughout the history and development of the ship. Thus, it is difficult to define the quintessential caravel (Elbl 1985:543).

The caravel was an integral part of the Iberian expansion during the Age of Discovery. The Portuguese were able to navigate the treacherous coasts of southern Africa and reach India using of this craft, and with the same ship type the Spanish were able to traverse the Atlantic Ocean and discover the Caribbean Islands. Although this vessel is well-known as the vanguard of European expansion, little is understood about its development. In spite of the fact caravels were used almost exclusively as exploratory vessels during the 15th and 16th centuries, there is a paucity of information about this particular type of craft. Although many of these ships were reported to have sunk during the Age of Discovery, there are no confirmed physical remains of caravels in the archaeological record. Due to this lack of material evidence, most of the vessels' structural elements are unknown. A number of scholars have attempted to reconstruct the lines of a caravel throughout the last hundred or so years, but these reconstructions are conjectural and based on a perceived ideal shape of a caravel. With these ship plans in mind, full scale 'replicas'

of caravels have been built for occasions such as the 1892 fourth centenary of Columbus's voyage to the New World. The sailing capability of some of these vessels has been compared by the captains to sailing a barrel (Smith 1992:39). Consequently, scholars of Iberian seafaring and shipbuilding must look to proxy data and secondary sources in order to determine the finer structural characteristics of the caravel, as well as shipbuilding techniques, size range, rigging arrangement, living spaces, sailing capabilities, crew size, cargo space, and other ship-related details.

Obtaining a comprehensive understanding of the caravel cannot be achieved solely through researching old texts, but must also include examining a wide variety of sources, analyzing and synthesizing the data, comparing and contrasting similar works, evaluating the trustworthiness of the sources, and finally reconstructing a view of the vessel that most closely and reliably adheres to the most dependable evidence available. This approach involves drawing on many lines of evidence, including Iberian history, iconographic representations of caravels, ethnographic analogies to shipbuilding techniques still used in some parts of the world today, archaeological parallels of similarly built Iberian watercraft, and contemporary shipbuilding and nautical treatises. This research embodies a variety of themes, such as how the Portuguese became the leaders and innovators in this age of exploration. They expanded their empire to the north coast of Africa, set up trading ports all along the west coast of Africa, and traded extensively with India. The fact that they were capable of achieving the establishment of trade in these areas through expansion leads to interesting suppositions of events that led up to these accomplishments.

The Development of the Caravel

With its shallow draft, lateen-rigged masts, relative lightness, and quick maneuverability, the caravel became an amazingly adaptive vessel for the task of exploration; however, it should not be assumed that the advent of this type of ship allowed easy passage to uncharted waters. Fifteenth and 16th Century mariners, in general, faced many dangers at sea, but the unknown regions to which the Portuguese navigated were laden with additional hazards. The distances they traveled required them to secure a source of water along the way or to carry more water than on shorter journeys. They also had to face the inevitability of death along the way,

which required a larger crew. The early explorers were confronted with unfavorable weather conditions, harsh rocky coasts, unfamiliar currents and adverse winds, and limited geographical knowledge. Undoubtedly, the caravel was a pivotal factor that enabled the exploration of these unknown and potentially dangerous waters that the Portuguese entered. The question remains, however, as to exactly how the Portuguese utilized this diminutive craft to achieve such great accomplishments. The more maritime historians and archaeologists know about caravels, the more scholars will be able to study the lives of Iberian seafarers and explorers during the Age of Discovery.

Researching the development of any ancient ship begins with the investigation of its origins; tracing the vessel historically allows a scholar to analyze the usage and development of the ship as well as its structural attributes. The exact origin of the caravel can be debated indefinitely, since its development was a gradual transition. There are many possibilities and theories, but no conclusive evidence to sustain them. It is clear from historical Portuguese records that the caravel was a fishing vessel in the 13th century; however, it may be possible to trace the vessel's origin to an earlier time and even another region by examining the etymology of the term 'caravel'. Elbl reports that in the early 13th century, the term 'caravel' was connected to a small ship related to Muslim Algarvian and Maghrebine models of lateen-rigged craft made to suit Atlantic sailing conditions. Called *qârib* this vessel was well equipped to travel in shallow waters and was used as a fishing boat, coaster, and light warship (Elbl 1985:545). Although little is known about the technical details of this small Arab vessel, it had preferred features that allowed it to transform into progressively larger forms, much like the caravel. Because the caravel presumably had some of the same characteristics of the *qârib*, some speculate that the word 'caravel' is derived from *qârib,* and, therefore, the vessel is of Arabic origin.

Spanish and Portuguese scholars, during the 19th century, also sought Roman and Greek terms that could have spawned the word 'caravel'. Jal's *Archéologie navale* even suggested an Italian origin for *carabela* as *cara bella*, apparently owing to the beauty or grace of the vessel. Although some possible origins of the word 'caravel' were proposed, the scholars found no references to the design and construction of the ships they were attempting to trace to the 15th-century vessel, except that they were referred to as

small, light vessels with good sailing capabilities that traded widely inside and outside the Mediterranean (Edwards 1992:420).

Despite the uncertainty concerning the etymology of the word 'caravel', the first mention of the Portuguese vessel in an official document was its integration into the English fleet upon its return to Gascony in 1226 (Michel 1876:1, 153; Elbl 1985:546). By examining the sources in which these early caravels appear, as well as other contemporary ships, an indication of the size and capacity of the early caravels can be found. Early sources, such as the *foral* (chart) of Vila Nova de Gaia, refer to the caravel as paying the lowest of the entry tolls (Marques 1944:7-8; Elbl 1985:546). By comparing the caravel with other ships on the list, a relatively small size and capacity can be attributed to this early version of the vessel. Throughout the centuries, this changed as the utilization of the caravel also changed.

Returning to the 13th Century caravel, a variety of forms can be seen. It is known from the *foral* of Vila Nova that these caravels were small and of limited capacity. This is logical, as during this period of their development they were likely used primarily as fishing vessels along the Atlantic and Mediterranean coasts; their shallow draught and low sides were fit for such use. It is also conceivable that these ships were employed for trade and, therefore, could have been fully decked at this time. Since many ships during this period were similar to the caravel in size and rigging, a tentative comparison can be made with other vessels regarding tonnage and keel to beam ratios. The 13th-Century caravel is surmised to have been a lateen one-or two-master under 30 *tonéis*, with a keel to beam ratio of 5:1. This is rather high compared to the ratio of the ship during its last stages of development in the 17th century, which had a keel to beam ratio of 2.64:1, based on instructions set forth for a caravel of eleven *rumos* in the 1616 nautical treatise *Livro de traças de carpintaria* by Manoel Fernandez. The ratios and tonnages of the 13th-century vessel are speculative, but as Elbl (1985) notes, the 14th Century record – dated AD 1307 – from the Biscayan area mentions small caravels with crews of nine men each. According to Azevedo, these manning ratios in the 15th century represent vessels of 18-20 *tonéis* (Azevedo 1934; Elbl 1985:548).

There is little doubt that caravels continued to be utilized as fishing and commercial vessels during the 14th century. There is, however, an odd absence of the ship in records, which cannot be easily explained. Caravels

are not mentioned in historical accounts other than the Biscayan records of 1307, nor are they depicted in the available iconography of the period. Despite this nonappearance, there was definitely a shift in the size of caravels as they seem to have taken over the functions of another light Portuguese vessel, the *barinel*. The *barinel*, which resembled the Atlantic *balener*, was better suited to sail in the Bay of Biscay than other southern ships of the same size. This shift may be indicative of transitions from a coastal vessel to one capable of faring well in the high seas as is noted in Catalonia in the first half of the 15th century.

The *setee*, a light vessel with a long hull, lateen sails, and a size comparable to a caravel, is mentioned in an ordinance of 1438 issued by Alfonso the Magnanimous: "…we know that the *setee* was in other times a light oared vessel and now it is the heaviest ship, of greater board and capacity for long voyages; the same for the bark…today it is taken in general as a vessel of lateen sail that consists of three masts" (d'Albertis 1892:41; Elbl 1985:549). For these reasons, it is plausible to assume that throughout the 14th century the caravel underwent alterations – such as increases in carrying capacity – that made it somewhat more suitable for ocean voyages.

It is easy to see then why navigators during the Age of Discovery used caravels to voyage along the west coast of Africa in the 1440s. Earlier explorers used barks of about 25 tons, which had a single mast. They also experimented with the longer and larger *barinels*, but neither of these vessels was adequate for the increasing length of the voyages (Unger 1980:212). Being longer, lighter, and of shallower draft, the caravel was chosen to replace the *barinel* in the voyages of exploration down the west coast of Africa. Other key reasons were the caravel's speed and its ability to sail to windward, which was paramount for return trips into the trade winds. This early 15th Ccentury caravel had more admirable qualities than previous ships used for reconnaissance, but was still far from perfect. The ship's great lateen sail required a large crew, which was dangerous because the small exploratory vessel could not carry enough fresh water for the sailors.

During the 15th century Iberian shipbuilding underwent a new phase of design, adapting the vessels to meet to the demands placed on ships of discovery. To illustrate the elevated preparation of shipyards and shipping of the 15th century, Dom João II of Portugal (1477-1495) ordered a *nau*

of 1,000 *tonéis* burden to be built, in a time when they rarely exceeded 300 *tonéis*; the keel of this vessel was 31.50 m long and the ship's length overall was 50 m (Barata 1987:161). There are records of other impressive ships from Portugal, such as *São João* of 1533/34, which was one and a half times the size of the largest Indian ships (Barker 2001:215). Such ambition also called for changes in the caravel as a ship of discovery. Rather than relying solely on the technical knowledge of naval architects, these demands were taken on by skilled craftsman, who were capable of transforming the geometry of the vessel to suit the requirements of a sea-going explorer (Barata 1987:167).

As mentioned previously, the caravels *Niña* and *Pinta* were chosen to accompany the nau *Santa María* for Columbus's attempt to discover a route to the East in 1492. By this time in Spain, however, the caravel had largely transformed from the *caravela latina* to the *caravela redonda*; the former wielding lateen sails while the latter was rigged with a combination of lateen and square sails. The Portuguese retained the lateen sails for their caravels, because they better suited their purposes along the west coast of Africa. The Spanish caravel was now a three-master with a square sail on the main and fore masts, and a lateen sail on the mizzen mast. As in the case of Columbus's *Pinta*, the caravel could be converted from a lateen-rigged vessel to a square-rigged vessel. This new sail arrangement provided the necessary adjustments to make the caravel what was commonly referred to as the best sailing vessel of its time. The caravel continued to increase in size, but was still small enough to be easily maneuvered. As the ship became heavier, it also became beamier in order to increase the carrying capacity for each meter of length. The length to beam ratios were now likely in the range of 4:1 to 3:1 (Unger 1980:214). The caravel's development over the centuries made it a viable choice for exploration, trading, warfare, and piracy.

It is evident from the historical record that the Portuguese caravel underwent a gradual development since its inception as a fishing vessel in the 13th century. By carefully examining such historical data as presented in the previous paragraphs, scholars can compare similarly built ships from the archaeological record in an effort to understand how the caravel was built throughout its various developmental phases. Moreover, historical research assists archaeologists in further understanding the shipbuilding trends that were affected by numerous circumstances in the medieval

and post-medieval eras. These trends were influenced by socio-political, economic, and environmental conditions of the periods and cultures under study. Additionally, information that is gleaned from the historical record can be compared with other lines of evidence in order to substantiate and assure the reliability of the sources.

Archival Evidence of the Caravel: Treatises and Manuscripts

Contemporary treatises and manuscripts, many of which describe the practice of Iberian shipbuilding, are excellent tools for understanding the construction sequences and capacities of ancient ships. Unfortunately these documents do not become available until the late 16th century, when records of shipbuilding practices were written and kept; before this time information was safeguarded in the minds of skilled masters who passed on the traditions, both orally, from generation to generation, and by shared work experience. Additionally, as Casado Soto points out, the combination of low life expectancy and the rigid secrecy that was practiced regarding this specialized knowledge ensured that these traditions would not survive in writing (Casado Soto 2001:131).

In Spain there was little mention of shipbuilding in Castilian documents before the reign of Christian kings, and when ships do appear it is usually only with regard to their names, types, and occasionally tonnage. With the reign of Charles V (1516-1556) and the expansion of foreign policy, however, there was an increase in management techniques. When Phillip II (king 1556-1598) ascended the throne even more was accomplished; he regulated navigation in convoy, set a standard for mercantile shipbuilding, and introduced technical specifications that led to improvements in safety (Casado Soto 2001:135). Phillip II provided incentives to shipbuilders by exempting sales taxes on the purchasing of shipbuilding materials. Likewise, Phillip II established an efficient system for measuring the hulls and capacities of ships, and he was the first European monarch to use a prototype to build ships for the armadas, choosing the galleon as the model (Casado Soto 2001:135). It is during his reign that documentation of shipbuilding techniques and navigation grew the most including the following published examples:

1536, Alonso de Chavez: *Espejo de navegantes*

ca. 1560, President Visitador: *Papeles*

1568, Domingo de Busturria: *Memorial*

ca. 1570, Rodrigo Vargas: *Apuntamiento*
1575, Juan Escalante de Mendoza: *Itinerario de navegación*
1581, Cristóbal de Barros y otros: *Discusión de prototipos de galeón*
1587, Diego García de Palacio: *Instrucción náutica*
1611, Tomé Cano: *Arte para fabricar, fortificar y aparejar naos*

These documents are useful tools for studying the history of shipbuilding and navigation, but caution must be taken when interpreting them. The various authors were influenced by their own professions and the extent of their experience in shipbuilding is largely unknown. Nevertheless, these manuscripts and treatises give information on types and amounts of raw materials needed for shipbuilding, as well as dimension and tonnage of ships. The documents listed above give no indication of how ships were built; they merely list the capacities and tonnages of vessels. The few remaining Iberian nautical treatises are more helpful in understanding how these ships were constructed. Four in particular deal with shipbuilding in detail and deserve brief attention here: *Livro da fábrica das naus*, *Instrución náutica*, *Livro primeiro da architectura naval*, and *Livro de traças de carpintaria*.

Father Fernando Oliveira's book, entitled *Livro da fábrica das naus*, dates to 1580, and is the earliest surviving treatise dealing with the construction of Iberian vessels. Fernando Oliveira was not a shipwright, but he claims to have studied in shipyards throughout Europe including Italy, Spain, France, and England. He had varied interests and pursued many goals during his life, and may be considered a true renaissance man. Some of his professions included sea pilot, sailor, adventurer, priest, and writer, and he had an extensive knowledge of ships. His book is comprised of nine chapters, and although incomplete, it provides a wealth of relevant information. One section details the materials employed in shipbuilding, such as iron nails, oakum and pitch for caulking, and grease used in lubricating the vessel. Additionally, Oliveira briefly describes various kinds of ships, including *naus*, galleys, galleons, and caravels. Furthermore, he goes into detail on the construction and measurement of ships, which is extremely useful. Oliveira illustrates how the frames of ships are predetermined using Mediterranean lofting techniques that still survive in parts of the world today. This was achieved by using algorithms such as the *graminho* to calculate the rising and narrowing of the floor timbers, which gave the shape of the ship's hull. The *almogamas* were the first and last pre-determined frames of the vessel. The remainder of the frames was probably inserted after ribbands –

wooden bands temporarily attached longitudinally to the pre-determined frames – were used to get the whole curvature of the vessel. Measurements are given in the standards for 16th-Century Portuguese shipbuilding*; dedos* (1.83 cm), *palmos* (25.67 cm), and *rumos* (1.54 m). Other instructions, such as the use of arcs to determine bow and stern rakes, are also included in considerable detail (Oliveira 1991; Domingues 2004).

Doctor Diego Garcia de Palacio's *Instrución náuthica* is the second surviving treatise on shipbuilding and was published in Mexico City in 1587. The majority of the book was written in dialogue between a Biscayan and a Montañes, a common form of writing during that time. This treatise is a valuable guide on a variety of maritime subjects, including astronomy, navigation, duties of officers and crew members, and ship design. It is an important work as it provides Garcia de Palacio's notions of ideal ship proportions. In his description of a *nao* of 400 *toneladas* Garcia de Palacio gives a keel to beam ratio of 2.13:1, a length to beam ratio of 3.21:1, and a depth to beam ratio of 0.72:1. Although these proportions are for a *nao*, Garcia de Palacio asserts that they could be used for any size ship. The treatise also contains sections detailing the design of hulls, masts, spars, sails, rigging, ship's boats, artillery, and other features (Garcia de Palacio 1988). Garcia de Palacio also includes helpful drawings of his descriptions in his manuscript.

Livro da architectura naval, composed by João Baptista Lavanha, was published around 1609. Lavanha, born in Lisbon in the middle of the 16th century, worked in the courts of both Spain and Portugal. He taught mathematics at the Academy of Madrid and was appointed Engineer of the Realm of Portugal in 1586 and in 1591 Lavanha was named Chief Cosmographer. His treatise is divided into seven chapters, the last one further separated into five sub-sections. The first three chapters are concerned primarily with general architecture, but the fourth deals with architecture as it pertains to naval construction. The rest of the manuscript describes materials, timbers, and other necessary components for ship construction. Lavanha gives detailed instructions on how to build a four--decked *nau* with a keel length of seven and one-half *rumos*, or 11.55 m. His specifications include swinging arcs to achieve the proper curvature of frames and rakes, construction of the ship's transom, scarfing or joining of the keel, narrowing and rising of the bottom of the vessel using a *graminho*, and positioning of the pre-determined frames of the ship, among a host of other directives (Lavanha 1996; Domingues 2004).

The fourth treatise, *Livro de traças de carpintaria*, is by a shipwright named Manoel Fernandez and dated to 1616. The *Livro de traças de carpintaria* is a valuable book because it was supposedly written by a man with practical experience in the shipyard, although there is some contention among scholars whether he spent much time constructing or just theorizing. There are two parts of this treatise: the first section lists dimensions of various ships and their primary components, such as keel, stem, and sternpost. In this first part, Fernandez sets forth instructions on how to build a variety of Portuguese vessels, including galleons of varying tonnage, carracks, warships, brigantines, and caravels (Fernandez 1995; Domingues 2004). The second part is a collection of drawings of the ships described by the author in the first section of the manuscript. Regardless of his true affiliation with the shipyard, Manoel Fernandez was a man with the presence of mind to record the general rules and procedures for building certain Portuguese – and perhaps Spanish – vessels of the late 16th and early 17th centuries. His drawings and lists of dimensions of various ships are invaluable sources for scholars of Iberian shipbuilding because they give a perspective of the three dimensional aspects of Iberian vessels, many of which cannot yet be examined archaeologically.

Ethnographic Studies of Iberian Shipbuilding Techniques

The shipbuilding treatises that have survived provide scholars with at least a rough guide as to how ships were built in the 15th and 16th centuries. These same methods may have been used even earlier, for there are some traditions that never completely fade away. An example of this is the aforementioned 'Mediterranean method' of frame molding. This method survives today in certain parts of the world, including Bahia, Brazil. Ethnographic studies involving modern day boat builders can yield some astonishing and extremely useful information. The following study illustrates how this pertains to the study of the caravel.

Situated on the northeastern coast of Brazil, Bahia is immersed in history, especially concerning ships and seafaring. The discoverers first reached these shores using caravels, and also in the smaller version, the *caravelão,* which was perfectly adapted to the reef strewn coast of northeastern Brazil. Gaff sails were soon substituted for lateens in these coastal vessels, which retained the windward ability and required a much smaller crew. Up until 1960, fishing and transportation of cargo was done in wooden

sailing vessels, including *barcos, lanchas, saveiros,* and *canoas* (Sarsfield 1985:85). These vessels were vestiges of the original ships of exploration, although they suffered adaptations to the coastal environment. But in the 1960s, when highway construction and large commercial ferries began to dominate, the traditional way of life changed and boat building began to wane. Nevertheless, According to Sarsfield (1985) the ancient boat building traditions were not completely extinguished. Some of the old boats were being bought and repaired for recreational purposes. Many were re-rigged as schooners and before long became increasingly popular. Soon, all the old boats were sold and there was a growing demand for this new pleasure schooner. Once again the boat building industry began to thrive, and although boats were built for pleasure instead of work, many of the traditional methods of construction were retained and can be seen today.

Sarsfield's journey to Bahia and observation of boat builders in this region uncovered that boats were constructed by the method of Mediterranean molding. This was the same technique used by Iberian shipbuilders to construct carracks, caravels, and naus during the Age of Discovery (Sarsfield 1985:87). By carefully studying these Bahian boat builders, scholars such as Sarsfield can get an authentic perspective of how boats were built in the 15th and 16th centuries. Certainly there are variations in the methods used by the modern Bahians, but the basic building methods have survived to this day. Sarsfield described the manner of construction of the Bahian boats:

First the keel, usually hewn from a single tree, is set up. Next, sternpost and stem are fixed upon the keel, together with their respective knees. The angle made by the stem with the keel in conjunction with the knee provides a large surface of deadwood that gives these boats, and very possibly their caravel ancestors, a certain amount of windward ability (Sarsfield 1985:87).

Through ethnographic studies researchers are able to get a physical sensation of how ancient vessels were constructed, in addition to the written knowledge that is obtained from studying manuscripts. Such studies also enable scholars to detect the nuances when comparing archaeological evidence to historical documents and other references. Since very few places – perhaps some parts of Portugal and Newfoundland, Canada – still practice this type of boat building today, more ethnographic research needs to be done before these shipbuilding practices become extinct.

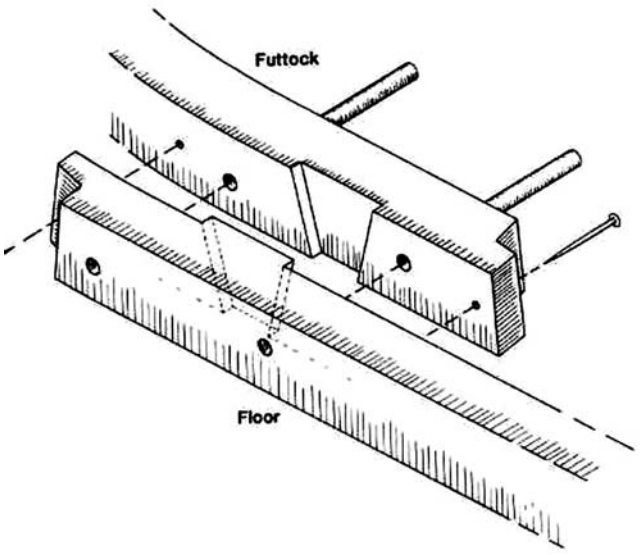

Figure 02-02 - The method of joining the floor to the futtock (after Oertling. 1989a: figure 5).

The Archaeological Record: identifying the unknown?

Although there are presently no known surviving timbers known to belong to caravels, it is essential to incorporate archaeology into the investigation of this type of ship. It is another line of evidence that ensures, through careful comparison and assessment, a thorough and accurate depiction of the vessel. There are a number Iberian ship remains that have been found in the recent past, some of which were about the size of a caravel of discovery. Since the Molasses Reef and Highborn Cay wrecks may represent the structural limitations of a caravel more than the larger shipwrecks, these two wrecks will be examined briefly to give substance to the concept of the construction of an Atlantic vessel. The Molasses Reef wreck is a 16th Century ship that was discovered off the Turks & Caicos Islands, in the British West Indies in 1980. Excavation began in 1982 to analyze the preserved part of the hull, which was only about 2%. The hull was of oak (*Quercus sp.*) and the floor timbers were joined to the futtocks with a dovetail scarf, in the Iberian way, with two transverse treenails and two nails (Figure 02-02). The timbers were also locked together with dovetail joints (as depicted by the projecting piece and corresponding cavity in Figure 02-01). That the frames were preassembled before they were placed on the keel is evident in the method of joining the floor and futtock (Oertling 1989a:232-3). This ship had at least 11 to 16 frames that

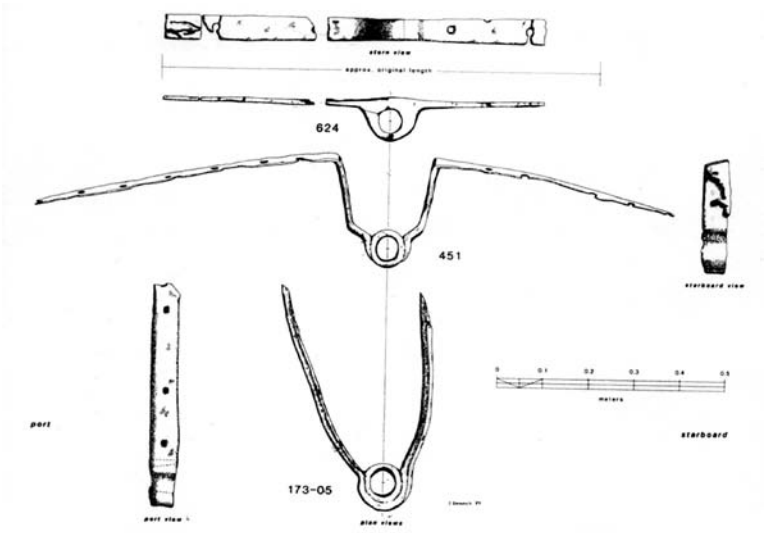

Figure 02-03 - Three gudgeons from the Molasses Reef wreck (after Oertling 1988:figure 5).

were preassembled. There were also three nearly complete gudgeons found at this site (Figure 02-03), which indicates that the ship had a flat transom and exposed sternpost. Finally, there were heart blocks – wooden blocks with holes for extending rigging lines – at the site, which means it was probably square-rigged rather than lateen-rigged; there were no indications of blocks or toggles to facilitate the rapid movement of the lateen sail from one side of the ship to the other (Oertling 1989a:239).

The second wreck is the Highborn Cay wreck, a 16th Century Iberian vessel discovered in 1965 on the Bahamas Grand Bank. Excavations for this armed vessel began in 1983. Artillery pieces, including bombards and culverins, as well as anchors, were brought up from the site (Oertling 1989b:249). There was 12.64 m of the keel remaining, out of an estimated 12.75 m keel. The ship was approximately 19 m long and 6 m in breadth. This vessel features three pairs of buttresses that laterally reinforced the mast step, which is an extended portion of the keelson (Figure 02-04). The supporting buttresses lie on top of the floor timbers, and fit into the notched stringers on their outboard ends (Oertling 1989b: 249). The keelson was notched over the tops of the floors, and holes were cut to accommodate the bilge pump. The hull was of oak (*Quercus sp*), and also had the characteristic filler planks that were part of the ceiling planking. Finally, the futtocks and frames were attached in the manner of the Molasses Reef wreck, by treenails

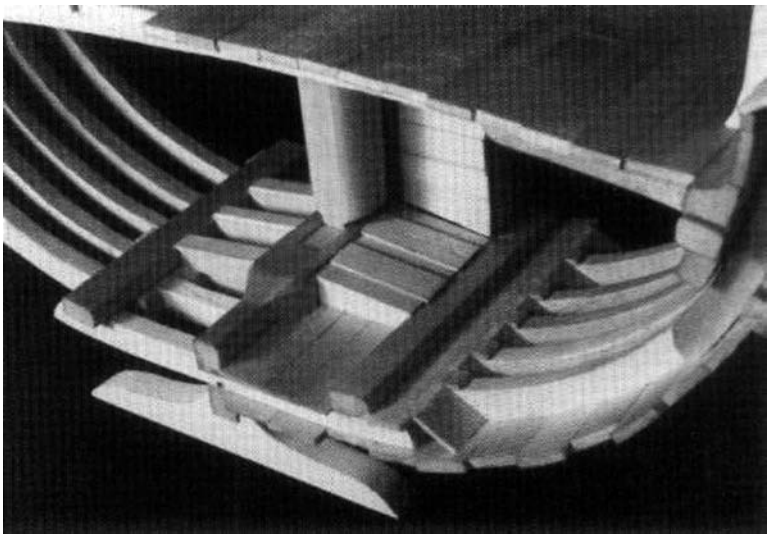

Figure 02-04 - Features of a 1:20 scale construction model showing extended mast step similar to the 16th-Century Molasses Reef wreck (after Oertling 1989:figure 4).

and nails driven through the molded surface. Alignment of the futtocks and floor frames was provided by dovetail scarves (Oertling 1988:118).

There are certain characteristics of Iberian shipbuilding methods from this era that are evident in these two wrecks. Oertling put together a list of traits that have been found together in Iberian shipwrecks from the 16th century, such as an expanded keelson to accommodate the mast step. Other traits include rigging chain assemblies, preassembled central frames, ceiling and filler planks, keelson notched over the floor timbers, and a flat transom, among a list of 12. These Iberian traits are to be taken as a whole instead of individually, because other types of vessels may naturally show any of the features listed. Taken collectively, however, they represent a type of vessel with the characteristics necessary to survive and thrive in the Atlantic Ocean. A 15th or 16th century Portuguese or Spanish caravel would be expected to possess most, if not all, of these Atlantic vessel characteristics. Although these traits provide valuable clues as to how a caravel could have been constructed, presently there are no archaeological remains of such a vessel—thus, still others sources must be examined.

Exploring the Iconographic Evidence

Another source to consider when investigating a vessel of the past is iconography. The contemporary visual representations of caravels

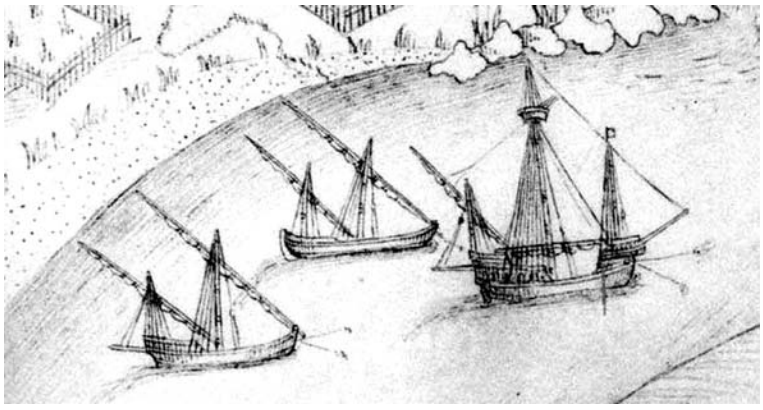

Figure 02-05- Caravel at Valença do Minho (after Pires 1988: figure 38).

show the shape of the vessel; its rigging, and other details that can be extracted from an exterior view of the ship are generally above the waterline. Like other sources of the past, caution must be used when interpreting iconography, because it can be deceptive: the nature of the art could be stylized; the object rendered may be simplified due to lack of knowledge; and there is often times no specification of the vessel type. It is also difficult to date images, either because information is missing, or because of artists' tendency to copy previous models while distorting them in the process (Casado Soto 2001:139). Some of the extant images of 15th and 16th Century caravels, of varying quality, do at least reveal some of the hallmarks of the ship. Figure 02-05 is a picture from the early 16th Century *Book of Fortresses of Duarte Damas*, depicting three vessels from Valença do Minho (Pires 1988:54). The ship in the center is a caravel bearing a mainmast and mizzen, both lateen-rigged. The characteristically low, gently sweeping bow is portrayed, which distinguishes it from the other two, larger ships. The caravel is depicted as having relatively low sides, with a single castle. This stern castle is not a dramatically rising superstructure, but rather a simple deck to assist sailors with the operation of the mizzen mast, which is stepped at the aft portion of the castle. The mainmast is situated at the center of the vessel, and wields an enormous lateen yard, with the sail furled. Clearly, this vessel appears designed for navigating in shallow waters, and is appropriately closest to the shore.

The traits of the caravel from the *Book of Fortresses of Duarte Damas* are typical of the attributes exhibited in most of the other available iconography,

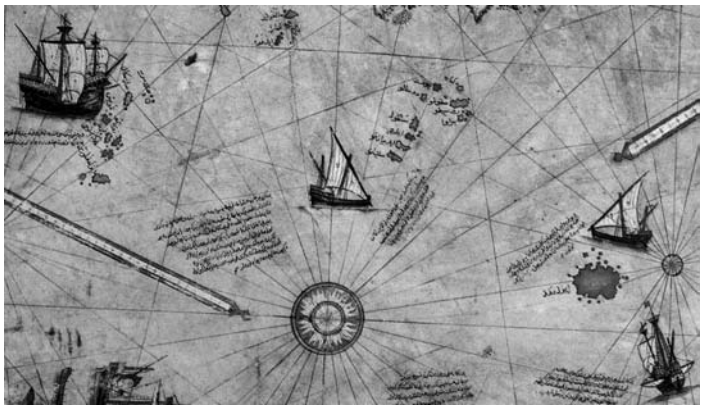

Figure 02-06- Caravel at in the Piri Reis Atlas (after a map @ http://www.capurromrc.it/mappe/!000piril.html, accessed in October 10 2006).

such as the caravels from the Mapa de Piri-Reis of 1513 shown in Figure 02-06 (Pires 1988:54 and 55). This two-masted, lateen-rigged vessel has the small stern castle, low sides, and general shape characteristic of a caravel. The most apparent difference is the shape of the bow, which is not as gently slopping as most other depictions of caravels. As mentioned previously, distortions occur and therefore iconographic resources cannot always be trusted as accurate renditions of particular vessels. Nevertheless, comparisons of many images yield notable characteristics that can be tentatively attributed to specific ship types.

Conclusion

It is evident from the information presented in this paper that, although currently archaeologists cannot directly study the physical remains of an Iberian caravel, an enormous amount of knowledge can nevertheless be gained from various lines of available evidence that relate in one or more ways to the caravel. By carefully and critically analyzing the sources that do exist, scholars can develop a distinctive description of this vessel's attributes, development, and historical significance. Although a certain amount of knowledge obtained from various sources of information is up for scholarly interpretation, a well-organized and systematic approach can produce the most accurate conclusions. When tangible archaeological evidence of a caravel has been discovered and identified, nautical archaeologists and historians will be able to study the ship in a context that will enable comparison of data from historical, ethnographic, iconographic, and

archaeological sources, providing scholars with the affirmations of their research and adding to the information gap regarding these ships of discovery.

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