

# Chapter 10

## Historical Documents as Sources for the Study of Shipbuilding in Spain



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**Abstract** Studies on shipbuilding in Modern Spain have been increased with new research that has complemented historical analyses and archaeological evidence. This interdisciplinary line of work is also enriched by studies carried out by a prolific school of specialists in naval engineering. Throughout a fascinating and irregular historiographical production, there have even been interesting reconstruction projects for replicas of *naos*, galleons, and frigates inspired by the classic architectural tradition of the sixteenth to eighteenth centuries. There is valuable evidence of material culture that gives us iconographic information about the proto-ships of the first oceanic voyages, such as the mysterious ex-votive figure of the *Galleon of Utrera*, which existed in the hermitage of Consolacion de Utrera in Seville until the beginning of the twentieth century. The reproduction in the Naval Museum of Madrid made by J. Guillén Tato around 1930 is seen by historians and archaeologists as a faithful portrayal of a galleon from 1540. Other experiments have led to conjectural reconstructions on several occasions, such as during the celebration of the Fifth Centennial of Discovery; the construction of the so-called Andalusian Galleon (currently a 500-ton, four-masted ship) or replicas of the *naos Victoria* (also at Expo92) and *Santa María*, which are still sailing, both built by the Nao Victoria Foundation. In the following pages I will expose the main historical sources for the study of shipbuilding.

### 1 Introduction

Studies on shipbuilding in Modern Spain have been increased with new research that has complemented historical analyses and archaeological evidence. This interdisciplinary line of work is also enriched by studies carried out by a prolific school of specialists in naval engineering (Achútegui Rodríguez 1996). Throughout

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a fascinating and irregular historiographical production, there have even been interesting reconstruction projects for replicas of *naos*, galleons, and frigates inspired by the classic architectural tradition of the sixteenth to eighteenth centuries. Coín Cuenca has clearly explained the technical and methodological problems that the designs of these replicas create due to inconsistencies in measurements and perspectives (Coín Cuenca 2018). There is valuable evidence of material culture that gives us iconographic information about the proto-ships of the first oceanic voyages, such as the mysterious ex-votive figure of the *Galleon of Utrera*, which existed in the hermitage of Consolacion de Utrera in Seville until the beginning of the twentieth century. The reproduction in the Naval Museum of Madrid made by J. Guillén Tato around 1930 is seen by historians and archaeologists (Fernández González 2000) as a faithful portrayal of a galleon from 1540. Other experiments have led to conjectural reconstructions on several occasions, such as during the celebration of the Fifth Centennial of Discovery; the construction of the so-called Andalusian Galleon (currently a 500-ton, four-masted ship) or replicas of the *naos Victoria* (also at Expo92) and *Santa María*, which are still sailing, both built by the Nao Victoria Foundation.

Historiography delves into aspects of an unfinished debate on the origins of the different schools and architectural traditions in different regions of the Iberian Peninsula, the influence, possible or not, of other schools of shipbuilding, especially Mediterranean, Nordic-Baltic, French, English, etc.; the construction techniques used (lapstrake, flush laid Mediterranean tradition, or the floor-futtock), probable survivals of systems inherited from Antiquity, especially from the Arabs, the Vikings, or the Romans; and other aspects that are currently being dismantled or confirmed depending on new historical-archaeological evidence, as the case of the Urbietta wreck has demonstrated (Izaguirre and Valdés 1998, pp. 35–37; Rieth 2006, pp. 603–604, 607). It is obvious that the knowledge of the evolution of shipbuilding will from now on have a strongly interdisciplinary component with a predominance of scientific and exhaustive study of the wreck remains located in submerged archaeological sites. From the beginning of the first oceanic navigations the construction of a ship was done by laying the keel, and on it and according to its characteristics the payment was made to the contractor (*asentista*) or the builder. This was done in the second half of the seventeenth century but there is already evidence that it was done in Andalusia at the beginning of the sixteenth century.<sup>1</sup> The growth of this industry, strongly localized in port and foreland areas, conditioned the control and access to the available resources, especially wood. Along with the constant growth of local naval industries in the Iberian Peninsula, the emergence of a naval industry in America cannot be forgotten, also promoting the transfer and migration of labour, technology, and knowledge.

The comprehensive study of shipbuilding in Spain has generally been carried out in the context that gives primary importance to the socio-institutional framework of

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<sup>1</sup>Museo Naval Madrid (hereafter MNM.) Colección Vargas Ponce, Doc. 84, 1658, 12 de marzo, San Sebastián, fols. 172–175. Contract between Cristóbal de Ayalde on behalf of Esteban de Irigoti, regarding the Ship “Santa Bárbara”, and Juan Domingo de Echeverri.

fleets and navies and to the technical characteristics of shipbuilding architecture. The focus has been directed at explaining the evolution of shipyard policies, the administration of fleets and navies, the contracts and economic plans behind the shipbuilding industry, as well as the logistics of provisioning supplies, which included timber. Although abundant in general, these studies pay more attention to the eighteenth century as being the century of the most important centralization in the history of the Spanish Navy (Torres Sánchez 2013; Wing 2015; Valdez-Bubnov 2018). These works, although very important, have barely described the documentary and archaeological analysis of real ships, whose remains are located at the bottom of the sea or perhaps abandoned in coastal and intertidal areas. This perspective is essential for the study of shipbuilding in these centuries, as has been done for cases prior to the fifteenth century, and especially in the historical archaeology of the Modern Age in other countries, especially in the UK, and in a relevant way in France and the Netherlands. Underwater archaeology and historical archaeology in Spain are more developed for times prior to the Age of Discovery, as I myself have highlighted in the reasons that led me to present the ForSEADiscovery project (Crespo Solana and Nayling 2015; Crespo Solana 2019). Furthermore, in this historiography it is also evident that, with some honourable exceptions, wood has hardly been given importance as a resource for shipbuilding (Quintero González 2004; Baudot Monroy 2012; Reichert 2016).

Undoubtedly, a pending challenge for us is to be able to compare data on wood sampled in modern wrecks with a real and adequate historical dendrochronology both in the Iberian Peninsula and in America, which does not currently exist.

For more than three centuries, a complex process of politicization of the natural resources of the forests took place, and during this process the Spanish Crown promoted the advancement of knowledge in naval technology, and the networks of agents involved in wood and ship businesses were densified. Global timber trade intensified, and the ship became a matter of state and a war business. For the sake of good scientific accuracy, it is almost impossible to understand the evolution of Hispanic shipbuilding from the sixteenth to the eighteenth centuries, dwelling only on architectural and technological criteria without understanding the parallel evolution of the organization of the navies and fleets of the *Carrera de Indias*—a topic that I develop in Chap. 3 of this book—and the control of wood for the naval industry. In the following pages, I will try to expose, from the theoretical-historical and codicological perspective, the main sources for the study of the evolution of shipbuilding in the Hispanic Monarchy.

From a codicological perspective, it is possible to carry out an analysis of manuscripts and other non-printed texts. The latter, unlike the treatises that are not very abundant, do exist in great quantity and it could even be said that unpublished texts are still located in archives and libraries. In reality, along with treatises and ordinances, other documents related to contracts and diverse documentation are also essential when studying the evolution of how shipbuilding was understood in each era and what type of historical agents participated in this technological and industrial emergence. In addition, there are other types of historical sources that can be very useful in complementing the archaeological

analysis of the submerged remains and understanding why there are so many differences between theory and reality on the Iberian ship. The evolution of the construction of different typologies of ships—merchant ships, galleons, and frigates—poses questions that cannot be properly addressed before considering an important previous step. This previous step considers the ability to connect the historical dendrochronology of the Iberian Peninsula with a good and accurate catalogue of wreck timber samples. Both these tasks constitute our pending work. But how were the changes that resulted in the different phases that the construction of the Iberian ship went through reflected in the historical documentation and in the architectural treatises?

## 2 Documentation for the Study of Shipbuilding in Spain

In reality, the evolution of shipbuilding in the kingdoms of the Hispanic Monarchy was multidirectional and dispersed, both from the normative point of view (treatises and ordinances) and geographically. In the diverse local schools of Iberian naval technology, regional traditions of the different kingdoms were mixed, including those from Portugal. The transfer of technological knowledge between regions constituted a transfer of ideas and constructive experiences, especially between 1580 and 1640, when Portugal was one more kingdom of the Habsburg conglomerate. Furthermore, it is still a mystery how the constant transfers of knowledge took place between regions of the Mediterranean, between different areas of the Iberian Peninsula, northern and central Europe, and southern France (Cazenave de la Roche 2018).

Many of the manuscripts and printed documents existing between 1500 and 1800 refer to the debates taking place in institutions and in the Spanish Crown in relation to four main issues. First and foremost was the technological requirements of the ships to be used for the *Carrera de Indias*, as the American route was the most important economic objective of the Spanish Habsburg dynasty. In relation to this first question, two basic problems seem to have been the focus of most debates of the time: the tonnage of the region that would establish itself as the main producer of ships (with the Basque Country ahead of the Andalusian areas) and the problem of access to the Barra de Sanlúcar, layover port of the *Carrera de Indias*.

Secondly, ships had to serve in the war and commerce navies simultaneously, and it was difficult to find the perfect ship type for both purposes. This produced the long experimentation on the architecture of these ships, not always loyal to ordinances, *cédulas* and treatises and that, paradoxically, has produced many divergences between the analysed theoretical models and the archaeological remains.

Thirdly, there was no centralization of the navies in the kingdoms of the Hispanic Monarchy (in fact, it did not exist until 1704) (Crespo Solana 2017), and given the need for ships for both commercial fleets and maritime warfare, the Crown demanded or confiscated private ships that in many cases were built following different constructive formulas, carried out by contractors and master carpenters who did not

follow the established laws, and this provoked a continuous debate on the reality of these ships and the correct or ideal way to build them. For this reason, and as fourth factor, the evolution of the contents of manuscripts, printed documents, and treatises on naval architecture went through various stages corresponding to different situations and demands of Spanish naval policy, the European wars and trade, especially with the American ports. This gave rise to a very diverse and heterogeneous production of ships, of multiple denominations and subject to a complex descriptive epistemology.

It can be said that the evolution of modern naval engineering was also strongly influenced by other factors: the wood demand processes; the geographical organization of shipyards, construction, and caulking areas; and the need of the Spanish crown to organize administratively the various navies and fleets of war and commerce (which I describe in Chap. 3 of this book). Logistics and spatial organization in relation to the transportation of wood resources from cutting areas to shipyards and caulking facilities was another factor to consider, as well as an important reason why the crown was always interested in forestry control (Martínez González 2013). These imperatives influenced both the timber trade and its import, as well as the construction models themselves, but also the space logistics of shipyards.

Several types of historical documentation related to shipbuilding can be highlighted. As Jan Glete has already asserted, most of the information regarding ships is still in the form of manuscripts, treatises on naval architecture, and unpublished and scattered sources (Glete 2002). The nautical treatises, the ordinances, and norms that were written from 1540 onwards, as well as other documents, such as the reports of the contractors in which the dimensions (in *codos*) and proportions that their ships had to have are used to calculate the ratios of the over overall maximum length and the keel, as well as the other ratios in relation to the keel of the boat and other timbers of the vessel. According to some authors the keel is not always the most important measurement. Some designs are based on the maximum beam, the flat of the floor, and the depth (Hormaechea et al. 2012).

I establish the following relationship by virtue of the documentary nature of the sources, but their content is still lacking a detailed analysis:

1. Codex, or treatise, printed or published or unpublished manuscripts on shipbuilding in Spain.
2. Sets of ordinances and legislative compendia.
3. Representations, proposals, and reports submitted to the boards and councils. Some of these documents were outlines of treatises that were never published or did not circulate openly. I also include here non-printed documents that were circulated at the time among agents related to the circles of shipbuilding experts. Sometimes these documents are the written mirror of rivalries and discussions between different ways of seeing and understanding the methods that should be used to build ships.
4. A last group, even more heterogeneous, would be correspondence and other documents of diverse types, exchanged by the navy and fleet personnel, contractors, and traders of naval supplies. This group is more difficult to categorize as it

is included from contracts to randomly located notarized documents about the work carried out by master carpenters and other traders in the shipbuilding industry.

Both the representations (*representaciones*) and reports and the last documentary group also offer information on the wood that was required to build a certain ship. In general, this documentation has been less studied, but it gives a lot of information about experimentation in shipyards, arsenals, and coastal or riverine locations, so that this documentation definitely requires regional analysis. It is also necessary to include in this framework the notarial documents, that in some cases have even given good results for the knowledge of the activities of master builders, carpenters, and caulkers. Although this documentation has been more marginalized in historical-archaeological studies due to its heterogeneity, it has been used in some case studies on wrecks of archaeological importance, such as the cases of the *San José* Galleon, sunk off the coast of present-day Colombia in 1708, or the Galleons of Manuel de Velasco's fleet that sank in Rande Bay in 1702 (Phillips 2010).

Unfortunately, manuals that were written and used by riverside carpenters or master carpenters of the time have not reached the present time. The art of building ships was in the hands of local constructors and many of them were migrant workers between cities and ports, illiterate in most cases. The shipbuilder and the riverside carpenter belonged to a socio-professional category to which little research has been dedicated in Spanish or Portuguese modernist historiography. It is probable that knowledge organized in a systematic way did not exist or if it did, it has not reached us. Many of these master carpenters belonged to associations of artisans that perhaps had their manuals or guides. Unfortunately, these documents do not seem to have survived. There were master carpenters and shoreline carpenters who probably belonged to some form of guild, and there were also the so-called white carpenters dedicated to the wooden construction of small parts and components of the ships, generally known as *motonería*, usually set of frames and blocks for working the lines of a ship.

I present here a summarized explanation of each of these documentary types.

The first important document is the shipbuilding treatise. The contents of these treatises, rich in descriptions and less in iconography, except in extraordinary cases such as the work of Antonio Gaztañeta, *Arte de Fabricar Reales*, contributed to the codification of knowledge about construction types. This codification allows us to get closer to how this knowledge was transmitted and how the techniques evolved throughout the different schools and traditions. However, it is necessary to highlight two issues. Firstly, and as I have said before, the shipbuilding industry originally had a local character related to the demands of commercial shipping led by groups of constructors that were almost always self-educated.

Secondly, at least for the sixteenth and seventeenth centuries, these treatises are relatively few compared to the incessant constructive work organized by the Crown and carried out from so many regional nuclei. Nor do we know, as yet, to what extent the knowledge of the master carpenters may or may not have influenced the codification of knowledge in the first official treatises. The rapid nationalization of

the naval industry from the first decades of the Age of Discoveries and the political focus on the specific instrument of naval power that was the ship does not seem, however, to have much influence on the creation of an official *tratadística*, a treatise writing tradition. The work of Alonso de Chaves, “*Espejo de Navegantes*”, written around 1537, although it did not appear edited until 1895 by Cesáreo Fernández Duro, was a treatise on the ocean routes known at the time and written by a pilot and manufacturer of navigation instruments, but it does not mention shipbuilding (Aguilar Aguilar 2014). The work of the Portuguese Fernando de Oliveira, “*O Livro da Fábrica das Naus*”,<sup>2</sup> published around 1580, was one of the first Iberian shipbuilding treatises, almost contemporary with that of Escalante de Mendoza (1575), but still it was written after the decrees, *cédulas*, ordinances, contracts, and “*acostamientos*” that were produced in the Court of the Crown of Castile since the beginning of the debates on the organization of the navies and fleets for maritime traffic with America. However, some of the regulations that some of the Castilian writers and memorialists would accept followed the “Three to One” rule explained by Oliveira. The “Three to One” norm came from an ancient and medieval tradition, and it seems it was the norm in the proportion of sailboats from the second half of the sixteenth century in both the Mediterranean and the Atlantic (Hormaechea 2017).

When these treatises were written, there was already an ancient and long oral and unwritten tradition of construction in local economies that had arisen under the protection of the local and port economy related to the demand for regional activities. Soon shipbuilding began to become a matter of state, of imperial policy. This is something linked to the reinforcement of the Hispanic monarchy and the many attempts to centralize a hoarding of resources to face the announced war in Northern Europe and the defence of the extensive maritime empire. To what extent this affected local and regional economies is something that is still pending research, but the truth is that the Hispanic Monarchy began the search for the perfect ship. At this time, and despite García de Palacios’ innovative proposal, the “*as-dos-tres*” rule would still be used, because of influences from the Mediterranean and more specifically from Ragusan builders. It must be said that from the end of the sixteenth century, the situation becomes complex when trying to separate what were really shipbuilding treatises from the many printed manuscripts, reports, and *memoriales* that were circulated, many of them in response to the debates about the fixed establishment of a royal naval architecture that was being enacted in the Council of State, in the Court, and in the circuits near the monarch. I will make a quick mention of them although it would be necessary to analyse in more detail the contents and, especially, the networks of influences behind these works that perhaps may not always be catalogued as shipbuilding treatises.

Works focusing on the construction of the second half of the sixteenth century are located in this treatise search for the ideal ship of the Atlantic: the first example is the work of Juan de Escalante de Mendoza (1575): “Itinerary of navigation of the seas and western lands” (*Itinerario de navegación de los mares y tierras*

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<sup>2</sup>Edited in Lisbon, Academia de Marinha, 1991, Original Manuscript (1570).



*occidentales*). Escalante, born in Asturias, was general captain of the New Spain fleet in 1595 and died in Nombre de Dios (Panama) in 1596. The form of dialogue that appears in Escalante's *Itinerary* is used in various treatises as was customary in texts of the Renaissance and the Early Modern Age both in literary writings and in economic-political treatises or pamphlets. The first book of the *Itinerary* is dedicated to shipbuilding, describing the proportions and size of the ideal ship, as well as the materials required for its construction. As in later works, the ship is defined by a series of measurements, the main ones being the beam, the flat of the floor, the keel, length, and the depth. Very much in the Renaissance way, the proportions that these and many other dimensions of the vessel must maintain between themselves are established, so that it is enough to define the beam, measured in *codos*, to fix all the remaining measurements. Meanwhile, in 1587 Diego García de Palacio published "Nautical instruction for the proper use and regiment of the Naos, their design (*traça*) and government according to the height of Mexico" ("*Instrucción náutica para el buen uso y regimiento de las Naos, su traça y gobierno conforme à la altura de México*") (Fernández de Navarrete 1851, vol. 1, pp. 337–339; Picatoste y Rodríguez 1891, pp. 128–129; García Icazbalceta and Millares Carlo 1954, pp. 316–320).<sup>3</sup> Born in Ambrosero (Cantabria) in a family of navigators around 1530–1539, he experienced his scientific awakening in America, dying around 1595 (Manzano Baena 2003, pp. 17–19). His biography, his various positions in institutions, such as the Council of the Indies, the audience of Guatemala or The Royal Pontifical University of Mexico, where he was rector between 1581 and 1582, have been extensively studied. The same year of the publication of his work, in 1587, he was appointed by the Viceroy of Mexico, the Marquis of Villamanrique, Captain General at the head of a squadron with the aim of sailing from Acapulco in pursuit of Sir Francis Drake, but this fleet never went to sea.<sup>4</sup> Perhaps due to his experience as chief in charge of the war fleets, he wrote another work, the "Military Dialogues". His "Nautical Instruction" is divided into four books and only one is dedicated to the explanation of the construction of ships. It is written as a dialogue between a Biscayan and a mountain man. García de 's work is based on his experience on the Pacific coast, but we do not know where he got his knowledge on naval architecture. The interest of his description perhaps lies in the fact that he speaks of the "suitable ship", or ship adjusted to a trip, of 400 tons (*toneladas*), corresponding to a beam of 16 *codos*. In reality, García de Palacios gave rules that deviated from the long-standing formula of "one-two-three" ("*regla de as-dos-tres*", la "*Santísima Trinidad*", that is, one cubit of depth every two cubits of beam and three cubits of length. His work is completed with a nautical vocabulary of more than 500 terms, including the first known preserved plans or drawings on naval architecture. Nevertheless, some scholars argue lines drawings did not appear until the eighteenth century but this is only a theory (Taylor 1958; Phillips 1987, pp. 293–296). There

<sup>3</sup> Archivo General de Indias (hereafter AGI,) Audiencia de México, vol. 1, fol. 40, (9th of May 1596).

<sup>4</sup> Letter to the King, Puerto de Realejo, Nicaragua, about Drake's incursion, 30 April 1579 <http://www.mcnbiografias.com/app-bio/do/show?key=garcia-de-palacio-diego>



are two copies of García de Palacio's treatise in the Library of the University of Salamanca and another in the Naval Museum of Madrid. Both copies are included in the compendium "Maritime Heritage". The "*Nautical Instruction*" shows similarities with contemporary Portuguese treatises, especially with the *O Livro da fabrica das naos* (Oliveira 1995).

The *Diálogo entre un Byzcaino y un montañés sobre la fábrica de navíos* may be included as part of the reports and manuscripts submitted to the Court or to the councils. However, if we compare it with the works of Cano, García de Palacios or Escalante, it is doubtful whether this "Dialogue", which appeared around 1630 should be considered as a treatise in the strict sense. According to Isabel Vicente Maroto, the manuscript of the "Dialogue" was the work of Pedro López de Soto, to criticize the ordinances of 1618 (López de Soto and Vicente Maroto 1998). The "Dialogue" disagrees with Escalante de Mendoza when he said that the Biscayan and Portuguese construction was superior to all its counterparts. The author of this dialogue "adduces as an example and justification of his proposals what was done in the Flanders Navy, the famous Dunkerque frigates, whose ships are built and manned following the Flemish systems, which the author recognizes as superior to the ones employed in Spain, superiority that he also attributes to the Dutch enemy" (Revuelta Pol 2017, p. 65) ("*aduce como ejemplo y justificación de sus propuestas lo hecho en la Armada de Flandes, las famosas fragatas de Dunkerque, cuyas naves se construyen y tripulan siguiendo los sistemas flamencos, que el autor reconoce como superiores a los empleados en España, superioridad que igualmente atribuye al enemigo holandés*"). He proposed "flat" ships, suppressing quarterdecks and castles, as well as improving artillery. The author proposes the construction of a 500-ton galleon according to his "*tratadillo*" so that the prototype can be verified.

At the beginning of the seventeenth century and in the framework of a political discourse that overstated the importance of shipbuilding, the work of Tomé Cano, deputy of the University of *Mareantes* of Seville and pilot of the *Carrera de Indias*, born in Tenerife, was published in Seville (Cano 1964). The importance of the context in which this work was written is related to the political influence of shipbuilders and members of the navies related to the business of the *Carrera de Indias*. This is more important than one might think at first sight since evidence of a rivalry in regard to the systematization of the architectural rules for ships that had to navigate in the Atlantic fleets and galleons is glimpsed between regions, especially between Andalusians and Basques. The builders Juan and Lucas Guillén de Veas "master shipbuilder for his majesty" (sic) supported Tomé Cano's system and thereby established new rules for the so-called new ship factory (*Nueva Fábrica de Navíos*). Apparently, Tomé Cano's work was written around 1607, although it did not begin to be published until 1611, coinciding with the promulgation of the first ordinances. It is written in the form of a conversation between three people while they sail down the Guadalquivir: Gaspar, Leonardo, and Tomé, someone who acknowledges having travelled 53 years to the Indies completing 29 trips, perhaps a hagiography of the author himself. Cano's work is a treatise on naval architecture that also criticizes the naval policy followed by the crown. For him, this business is not profitable for the shipowners and he proposes that the king maintains his own ships, as a royal

navy. From his experience in the fleets that travelled between Seville and Veracruz, he knew what the indiscriminate use of old and damaged boats could entail. In fact, in 1617, he had to answer to the Casa de la Contratación for running aground and abandoning (“*echado al revés*” sic) the *nao Santa María de la Rosa*, because it was useless for the return trip to Spain (Cano 1964, pt. Introduction of Marcos Dorta, p. 19). The problem with his work is that it does not include plans or drawings as in García de Palacios’ work. But like other treatises, it establishes the measurements of all the parts and elements of the ship starting from and in proportion to a main measurement, the beam. It proposes a beam of 16-*codos* and a keel of 34 *codos*. Actually, the measurements proposed by Tomé Cano are similar to the ones of the Ordinances of 1618, which were promulgated to abolish those of 1607. Is this perhaps a triumph of the social groups of shipbuilders and members of the fleets of the *Carrera de Indias*, such as the Veas brothers? Cano elaborates extensively on the measurements of the *naos* starting from that of the beam, which is the “*Foundation of the entire construction*”, from which not only the hull but also those of the masts, top-masts, yards, etc. are derived. Cano takes the 16 *codos* beam *nao* as a model, to which he gives six *codos* of depth on the first deck and 34 *codos* of keel length, proportions that are maintained if the beam increases. Cano asserted that the newly manufactured ships are supposed to have larger keels.

Despite the enormous shipbuilding activity between 1589 and the second half of the seventeenth century, in parallel with the promulgations of multiple ordinances, legislative compendia, and contracts, it can be said that the industry does not experience a new boom until the second half of the seventeenth century. Around 1635, it seems that a new book on construction was written by the admiral of the Indies fleet, Jacinto Antonio de Echeverri. According to evidence it was an “incomplete and anonymous speech on shipbuilding” (“*Discurso incompleto y anónimo sobre construcción naval*”). It is likely that another work signed by Juan de Echeverri<sup>5</sup> was written in 1673. Other treatises have remained less visible, such as works written by Diego Brochero, Juan de Veas and Diego Ramirez (1614), López de Guitián (1630), and Juan de Echeverri (1673) (Fernández Duro 1880; Hormaechea et al. 2012, vol. 2). In the last decades of the seventeenth century, most of the information related to shipbuilding is compiled in the “Compilation of the Laws of the Kingdoms of the Indies” (“*Recopilación de las Leyes de los Reinos de Indias*”), approved in a pragmatic of May 1680 and edited on repeated occasions. Apart from this legislation, the figures of two writers appeared in the last decades of the seventeenth century: Antonio de Gaztañeta e Iturrizalza and Francisco Antonio Garrote. The first, Antonio de Gaztañeta (1656–1728) is perhaps one of the most important geniuses of construction and he developed his extensive work between 1688 and 1723. In 1688 he would publish the “Art of building royals” (“*Arte de fabricar reales*”) in manuscript form, as a chronicle of the process of construction of two galleons, the Captain and the Admiral of the Navy of the Ocean Sea (*Armada del Mar Océano*) published in facsimile in 1992 (Gaztañeta e Iturrizalza 1992). He would also be

<sup>5</sup> MNM. Colección Vargas Ponce, VII, Doc. 62, fol. 74; T. XVIII, Doc. 112, fol. 155.

the author of: “North of navigation found by the reduction quadrant” (“*Norte de la navegación hallado por el cuadrante de reducción*”) (Gaztañeta e Iturrizalaga 1692); “Universal geometric quadrant for spherical conversion to planes, applied to the art of sailing (1693)” (“*Cuadrante geométrico universal para la conversión esférica a los planos, aplicado al arte de navegar*”); “Proportions of the measures arranged for the construction of a war vessel of seventy *codos* of a keel” (1712) (“*Proporciones de las medidas arregladas a la construcción de un bajel de guerra de setenta codos de quilla*”), and the “Proportions of the most essential measures for the manufacturing of new ships and war frigates”(Gaztañeta e Iturrizalaga 1720) (“*Proporciones de las medidas más esenciales para la fábrica de nuevos navíos y fragatas de guerra*”). His work is key to understanding the construction of the last galleons, although it is a set of documents where the author collects notes. There are 293 pages numbered from 001 to 286, plus 199 repeated, and another seven preliminary pages without a number. Only 196 pages have something written, and the remaining 97 are blank pages apparently reserved to continue writing. His work collects notes regarding the construction of different ships, such as the Captain and Royal Admiral of the Navy of the Ocean Sea, and the San Francisco galleon that was built for the *Carrera de la Plata*, but the central subject is the description of the construction of the Royal Captain of the Ocean Sea, *Nuestra Señora de la Concepción y las Ánimas* (Fernández Duro 1996; Apestegui 1998). The work of Francisco Antonio Garrote, “Measures given for the construction of a 60-gun frigate, and response of the Marquis de los Velez to Captain Garrote”(“*Medidas dadas para la construcción de una fragata de 60 cañones, y respuesta al Capitán Garrote del Marqués de los Velez*”) appeared in 1690, offer construction models opposed to those of Gaztañeta. The analysis of these works, due to their size and characteristics, deserves a separate study.

## 2.1 *Legislative Compendia, Sets of Ordinances, and Cédulas*

The Hispanic Monarchy began to legislate on shipbuilding in the sixteenth century. Between 1503 and the legislation of the fleet system in 1561 projects containing some provisions on the type and tonnage of ships were developed for the organization of fleets and navies. Related precisely to concern for the ships of the *Carrera de Indias* and the composition of the fleets from 1521, measures were initiated for the protection of fleets and navies, fixing convoyed navigation with armed vessels for the entire trip protected by a navy ship. The “Armada de Guarda Costas” (Coast Guard Navy) was also created to protect the Canary Islands-Azores-Sanlúcar de Barrameda triangle, a problematic and dangerous area due to the presence of enemy fleets as well as other specialized navies in areas of geographical influence as political-military and commercial influence of the Hispanic Monarchy during the Habsburg era was expanding. These facts were essential to review and legislate on the tonnage of ships. The increase in the tonnage of the ships was a direct consequence of the protection and improvement laws of the navies and fleets of the Indies.

It might seem that the Crown was more interested in the ships than in the protection of the ports. The ordinances of the sixteenth century on the tonnage and supplies of ships also set the equivalences of measuring units. For example, the volume of the Castilian barrel (*tonel macho castellano*) was equivalent to that of the ton: 1385m<sup>3</sup>. In 1522 the minimum size of the Carrera vessels was 100 tons, but there were variations in 1531, 1534, 1535, 1539, 1541, 1543, 1550, 1552, 1568, and in 1587 the minimum size was already 300 tons although there were cases of up to 500 tons.

The documentation of the period mentions the lack of prudence of the masters of *naos* when overloading the ships, the reason that led to the creation of the Visitor of Sanlúcar de Barrameda as well as of Seville, and other figures to monitor that the laws of the Crown were fulfilled (Mira Caballos 2005, pp. 32–33). But the law and the practice were discordant. Discussions on ships with shallow draft and light weight to “discover” took place, a dilemma that became the eternal subject of debate by the Spanish Crown. It was contradictory to search for the perfect ship with shallow draft (to access rocky coasts, explore, return to Seville going up the sometimes shallow Guadalquivir, or access the ports of Flanders during war) but sufficient strength and cargo capacity to load goods and artillery. For three centuries, shipwrecks were caused by running aground on the rocks, especially in the Gulf of Mexico, the Caribbean Sea, and in the Antilles. And this was even more serious since whenever there was war in Europe, ships from the Carrera fleets were seized to go to the war navies. In fact, in his report of 1556, Pedro Menéndez de Avilés complained that all the ships going to the Indies were old, after decades of attempts by the Spanish Crown to organize the fleets according to models that were already unpractical for the ocean route. This report of 1556 was the one that would soon become the basis of the Indies fleet system from the decree of July 16, 1561. Apart from the considerations devoted to how navigation should be organized, this *memorial* highlights the need to build “the best ships that sail by sea”, insisting on a latent problem since 1534. However, Menéndez de Avilés did not see as prudent the construction of ships weighing more than 400 tons due to the problem that it would entail when trying to navigate the Guadalquivir river upon return from America and demanded to watch over masters and shipowners who used to make alterations in the hulls in order to increase cargo capacity on the ships.<sup>6</sup> But Menéndez de Avilés was not a shipbuilder, he was a governor and sailor. The discussions between Cádiz and Seville for the possession of the port for the Indies trade would drag on for centuries until in 1717 the *Casa de la Contratación* (Spanish Board of Trade) was transferred to the Bay of Cádiz. In this context, galleon construction experiments were carried out in which their tonnage tended to increase, making it increasingly difficult to navigate the Guadalquivir to Seville, as was the case with the ships built by the Genoese merchants Grillo and Lomelin, the galleons “*de plata*” built around 1660 (Serrano Mangas 1989).

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<sup>6</sup>Archivo General de Simancas (hereafter AGS). Consejo de Castilla, 46, document number 38. Report of 1556: “Memorial sobre la navegación de las Indias, hecho por Pedro Menéndez de Avilés que fue por capitán general a la Nueva España y vino de ella, año de 1556”.

The sixteenth century remains a mystery due to the apparent scarcity of official treatises and the evidence of the circulation of naval knowledge that would soon afterward lead to a legislative body on what we could call an official naval architecture of the Hispanic Monarchy or, the debate on its legal and strict systematization.

It must be said that the great legislative period on shipbuilding did not appear until the first decades of the seventeenth century, a stage in which the shipbuilding industry was intended to be more controlled by the political authorities, leading to the enactment of ordinances. The seventeenth century continues the trend of perfecting the oceanic ship with fixed proportions according to a mathematical model. The proportions are fixed in the ordinances of 1607, 1613, and 1618 (Rodríguez Mendoza 2008). It must be emphasized that the process of promulgation of the ordinances involved a parallel experimentation, as well as discussions between experts and elites close to political power. The ship became a matter of state and on many occasions a good part of the regulations intrinsic to its construction remained within the scope of political “secrecy”. One of the figures behind the first shipbuilding ordinance was Admiral Diego Brochero, who addressed a speech to the king, with a report inspired by Tomé Cano’s work, after previous consultations with the Duke of Medina Sidonia. In 1594 he was appointed Admiral General of the Royal Navy of the Ocean Sea.<sup>7</sup> By royal order he was called to the council of war as a result of the issuance of his *memorial* to the king, in which he made known a study and consideration of the state of the navy, emphasizing and denouncing the bad treatment, lack of consideration, and contempt for the sailor, the defective armament of the ships, “*there being no one who knew how to handle them, nor a school where to learn it*” (*no habiendo quien los supiera manejar, ni escuela donde aprenderlo*). Brochero drafted and put into effect some “Ordinances for the navies of the Ocean Sea and fleets of the Indies” (*Ordenanzas para las armadas del mar Océano y flotas de Indias*), signed in 1606, shortly before the Cédula of the Ordinances, issued in January 1607. This document, analysed by Goodman, exposes the need for reforms in the organization of the navy, but stops at the ships that were to be built for the constitution of the navies and fleets (Goodman 1997, p. 242). In 1605 Brochero proposed a new design for longer, narrower vessels that were lighter and more manoeuvrable. He commissioned the construction of 15 warships of less than 200 tons, but this first attempt failed, although an important advance was made: two iron *brazales* (bracers) were installed on the hull to set the allowed float limit in order to prevent shipowners, in their greed, from overloading ships. This measure was a consequence of the shipwreck of poorly designed ships in the West Indies. It should be added, as a curiosity, that the Spanish created the waterline 270 years before a certain Plimsoll, which is why it is called in English the Plimsoll Line or the Water Line.

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<sup>7</sup>AGS. GA 604, Consulta del Consejo de Guerra, 7 oct. 1603, Consulta de la Junta de Fábricas, 23 julio 1603.

The first Ordinance was created in 1607 and it established measures for each tonnage and type of galleon to be built. Apart from the measurements, *codos*, tons, and proportions, issues related to the concerns of the Crown were specified, especially the cargo that each ship had to carry according to its tonnage: “*The Indias contracting house that resides in Seville must name a person of science, and conscience who recognize, look, and consider what each ship of these measurements can carry, so that it can leave, and enter through said “barras” (estuaries and sand banks) without lightening the cargo on board, and safely make its navigation; and because the owners of naos; and loaders cannot use their disorganized greed to use deception, close to this person said two iron signals in the stem, and stern of each ship that serve as a limit so that until there, and no more the ship is loaded, so that the iron, or signal is above water, and this person has a book in which the part where it touches on the Ship the said signals declaring in how many codos of water is that sign*”.<sup>8</sup> Although the Ship Certificate of Tonnage of 1613 is the most complete, previous measures had already been established for the gauging of the *naos* of “privates taken for the service of my navies”. (“*navíos de particulares que se tomaren para servicio de mis armadas*”). The regulation of labour in this ordinance is significant. It even described the tools used by the “armadores” “*And because it is the custom among the armorers not to bring the necessary tools required in their labour, respect for which I ordered to provide them with tools, which they lose, and take from each other, and for lack of them they use the ax, which is the ordinary one they bring, and with it they waste a lot of wood, and spend more time in what they crave, considering this, it is considered convenient for my service, benefit of the Royal estate, utility, and profit from the same armorers, which, like the ordinary salary that has been given to them up to here, has been four reales, be four and a half each day in the lordship of Vizcaya, Guipuzcoa Province, four villas on the coast of the Sea, Asturias, and Reyno de Galicia with the condition that none of our Carpenter, nor the caulkers can carry more than two apprentices, and the cable makers one, and these should not be paid more than they deserve according to the sufficiency of each one that has to appear in the factories to the superintendent of them, and in the navies to the captain of the armorers, with the condition that from now on I myself will not give them any kind of tool, other than the grinding stones, and to the officers who are from houses will not be given this salary entirely but to each one according to what they deserve*” (*passim*).

In 1607, the king “being my Navy of the Ocean Sea in the river and port of the city of Lisbon (sic)” (Fernández-González 2010) described the tools and the work in the port: *The carpenter must bring ax, saw, or saw, ariela (plane?) of two hands, gurbia (curved chisel?), three types of drill bits, a hammer, a mallet, and two chisels. The caulker must bring caulking mallet, five caulking irons, gurbia (curved chisel?), magujo, mallet, hammer, ripping hook, three different drill bits from the aviator thickening. The Cavillador (treenail maker?) must bring drill bits, aviadores, drills, and mallets.* In other documents we learn that caulkers use caulking irons, devil

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<sup>8</sup> Quoted in Fernández de Navarrete, MNM, fols. 588–590.



irons, caulking mallets, shot plugs, breaming hooks, scrapers, and ripping hooks. The theft or loss of the tools of the armourers was severely punished with the penalty of 5 years rowing in the galleys. The promulgation of the Ordinance of 1607 was displaced only a year later by the contract signed by Vicencio Centurión and Ambrosio Spínola in 1608. In 1613 a new Ordinance for the ship factory is stipulated, on important dates, after the signing of the Peace of London in 1604 (Fernández-González 2010). These Ordinances of 1618 affected both warships made for the king and merchant ships promoted by individuals. They were intended to be compulsory, establishing 14 orders of ships depending on the size of their beam, from 9 *codos* of beam to 22. It calls all ships under the type of ships and does not distinguish between war and merchant ships. According to Revuelta Pol, “Comparing the main measures contained in the works mentioned above, including the Ordinances, an evolutionary process is observed in the ships, with a tendency to greater slenderness, both due to the increase in the keel-to-beam ratio and to the decrease of the volume of the quarterdeck and castle, making ships more “flat” (*razos*), an expression used by Christopher de Barros as early as 1581, equivalent to the English term “razed” or “race-built”, applied to the improvements introduced by Hawkins in the English galleons by that same time. Coincidence little known to British historians” (Revuelta Pol 2017, p. 63).

The ordinances seem to have remained in force except for modifications introduced in 1666 and 1679. In the second half of the seventeenth century the ship of the line was consolidated in England and in Holland, making the galleon obsolete. It was a ship capable of integrating the function of war and armed transport, with artillery and not only subordinated to boarding techniques, such as the galleon. The “Compilation of the Laws of the Kingdoms of the Indies” published in 1681 includes almost all, practically, the previous legislation, since the time of the Emperor Carlos V (Fernández-González 2010). It cannot be forgotten that all this legislation was made in parallel to several attempts made in vain by the Crown, to unify and centralize the navies between 1604 and 1643. In 1624 the Admiralty Board sent watchmen to the kingdom’s ports so that the product of their collections (fines for trade and for contraband generally) would be used to manufacture and assemble galleons. In 1647 Don Juan José de Austria was named Captain General of the Sea (Ceballos-Escalera y Gila 2012).

## ***2.2 Representations and Reports to Boards and Councils, in Some Cases Drafts of Treatises That Were Never Published or Less Well Known***

How was the knowledge process to improve naval architecture developed from the first phases of the maritime worldwide expansion? The problems arising from the debate between the administration and the contractors implied that the fleets were either owned by the crown or had to be built privately and were directly related to



whether the ship was really capable of fulfilling the dual merchant and warfare function expected of it. Historically, the most closely linked areas to naval manufacturing were the Cantabrian Sea, the Andalusian Atlantic coasts, and the Mediterranean façade. These areas were not completely isolated from each other. In fact, there was a lot of rivalry between them and sometimes cooperation, but above all, from all these areas, *memoriales* and reports were sent to the Court and the royal councils with the intention of promoting a certain type of trade and constitution of navies, and especially, a model ship. This was a reflection of the fragmentary constitution of a Monarchy that encompassed different kingdoms and states with different cultural and technological traditions.

A classic idea repeated in Spanish historiography is that technological progress during the fifteenth and sixteenth centuries arose from the integration of two construction traditions from the Mediterranean geographical areas and adaptation to Atlantic navigation requirements. This hypothesis aims at simplifying the apogee of a long tradition of technological transference resulting from the practical experience of sailors and builders, such as the Niño family or the Pinzón family. These were Mediterranean merchants—trading between Italy and Southern Spain—at the end of the fifteenth century, and their experience facilitated the development of navigational skill for the Atlantic Ocean exploration. It is true that from the thirteenth century the typologies proliferated and multiplied, although they shared some basic characteristics in the structure: “*the frame-based structure, carvel planking, rigging with bowsprit, fore, main, and mizzen masts, on which square sails and lateen sails are mounted*” (Revuelta Pol 2017, p. 56). Based on this scheme, galleys, *galíotas*, and *galeazas* were built in the Mediterranean, where Venetian and Ragusan experience was important. It cannot be forgotten that a good part of the ships that served the Spanish crown were built in the Italian ports, especially in Naples and Sicily. Before the fifteenth century, the naval industry of the north of the Iberian Peninsula fueled the campaigns of the *Reconquista* war in Andalusia while later, in the sixteenth century, it was the source of a large proportion of the ships built for trade with America that left from the shores of the Gulf of Cádiz, as Seville was the official capital of this trade by royal decree. An important shipping activity in Barcelona also developed following construction of the great arsenal of 1378. Shipyards built in the Middle Ages, such as at Seville, Malaga, Valencia, and Barcelona, generally continued to be used during the reign of the house of Austria, although in the sixteenth and seventeenth centuries shipbuilding was promoted in Orío, Pasajes, Bilbao, Deusto, Zorroza, Portugalete, Castro-Urdiales, Santoña (Colindres), and Santander (Guarnizo) in the north. In Andalusia there were small shipyards in San Fernando, Sanlúcar, and Algeciras, while on the Mediterranean coast, apart from the shipyards in Barcelona, Valencia, and Malaga, there were shipyards and arsenals in Cartagena, Alicante, Denia, Tarragona, Tortosa, Badalona, Arenys, San Felú de Guixols, Mataró, Masnoy, Palamos, Ibiza, and Mahón. As yet, the importance of each of these shipyards on the Hispanic naval map is relatively poorly understood. Regional studies are important to understand the transfer of technological knowledge that occurred in and between shipyards (Olesa Muñido 1968, vol. II, pp. 894–902).

In the last decades of the sixteenth century, significant events took place for the subsequent development of the naval industry and architectural models. In particular, the Cantabrian-Basque areas, Galicia, Catalonia, and western Andalusia began different phases in terms of construction models. Until now very little is known about the possible influences, reciprocal interactions or innovations that occurred in each area from a comparative perspective because most of the current literature on the subject is based on the study of local and regional characteristics of this industry. Another main event, without a doubt, was the crisis produced by the loss of the Navy in the 1580s, in the battle against England in the North. At the same time, Guipúzcoa (especially Pasajes and Oria) became important centres of specialized naval production in the construction of large ships for the Royal Navy and Fleet and for the *Carrera de Indias* (Odriozola Oyarbide 1998, p. 93). In these decades, coinciding with the institutionalization of the *Carrera* fleets, the origin of most of the ships destined for these fleets was Cantabrian. However, almost at the same time as the American expansion, a shipbuilding industry began in the Indies, with the launching of the first ship built by the Spanish in America in 1496, and reaching a certain scale at the initiative of Cortés from 1519 onwards (Gardiner 1954). Other American centres became cores of local shipping industries, such as Guayaquil. Cuba, specifically Havana, also experienced an early construction period before becoming the important arsenal that developed in the eighteenth century (Clayton 1978, 1980).

The regulation of the *Carrera de Indias* war and merchant navies produced endless information regarding the construction, characteristics, and tonnage of the ships. However, the most accurate sources about what was really happening in local shipyards and arsenals are the reports and *memoriales* on specific cases of ships, galleon, and fleet construction, of which there is much documentation. Much of it is contained in the Vargas Ponce Collection Catalogue and many of these cases have been studied by Serrano Mangas, Mira Ceballos, or Casado Soto. Reading all this enormous documentation that goes from certifications or Royal Certificates for the purchase of materials for the galleon shipyards and construction of various types of ships, to more precise documents on shipbuilding, it is possible to extract detailed information worthy of being codified in a database. Part of this documentation comprises or makes reference to *memoriales* of shipbuilders and it is still largely unknown. As a general rule, these *memoriales* had constructive measures for the concrete formation of specific and determined squads and navies, such as the case of the Antonio de Oquendo fleet in 1623, or when the *Avería* (tax to cargo) system contract was imposed. Depending on each situation, new features were introduced in the construction, such as when “the keel was lengthened and the draft was decreased”, that is, they became more galley like, in the case of the galleons of the Navy of the Ocean Sea (*Armada de la Mar Oceánica*) (Serrano Mangas 1989, p. 21). The prototypes for the construction of “galley-like” galleys or galleons are not in the ordinances, not in the treatises or in other official documentation, but it is visible in this type of document. It would be necessary to make an ordered list of all this documentation with the express contents in relation to the innovations little by little agreed upon experience for the introduction of architectural innovation. It was in

this dialectical context between the needs of the *Carrera de Indias*, that is, the defence and maintenance of the commercial system with America, and the offensive policy in northern Europe, that the galleon emerged as the quintessential model of Iberian construction. The galleon is a product of an evolution, a product also, of the state and private interests, whose construction system was partly veiled by the “war secret” and which gathers in its architectural methodology traditions from different regions connected to the Hispanic Monarchy, a subject that has yet to be studied in depth. In times of war, the best equipped galleons were assigned to different service commissions. The first regulations were not in the form of ordinances, but in the form of “*reales pragmáticas*”, granting of bonuses, and “*acostamientos*” by which prizes were awarded to those who manufactured large ships, as well as *cédulas*. Ship manufacturers were expected to build vessels of 1500 or more *toneles*.

At the end of the seventeenth century, there is a large number of *memoriales* on shipbuilding, such as the *memorial* of Diego López de Guitián Sotomayor, quoted by Serrano Mangas, which argued that galleons needed to be strong with good sailing characteristics and therefore should be built with a long keel to avoid major damage in Atlantic storms such as dismasting (Serrano Mangas 1989, p. 21).<sup>9</sup> Serrano Mangas analyses how, at that time, the construction of an Armada galleon (Armada’s ship or escort, destined to fight) was differentiated from the “*Galeón de Plata*” (Silver Galleon), which accompanied the Indies fleet and protected the precious metals it carried. Very early in the seventeenth century, a problem that conditioned the shipbuilding of the *Carrera* ships was the Sanlúcar de Barrameda bar, which complicated navigation at the entrance into the river Guadalquivir. In 1623, Antonio de Oquendo admitted that the 600-ton ship *Santiago* “to be able to enter and exit the bar and on the first voyage he acknowledged that it was not appropriate to navigate the *Carrera*”.<sup>10</sup> Another problem was the controversy between awarding contracts and the centralization of construction in the hands of the Crown. Curiously, despite the ordinances imposed between 1607 and 1618, the contract system continued to be used. Juan de Amassa and other shipbuilders proposed different prototypes for the construction of more appropriate vessels for the *Carrera*. The contract system was backed by the shipbuilders and *armadores*. For example, in his *memoria*, Juan de Amassa (1635) recognized: “*And recognizing his Majesty as impossible to preserve this Monarchy without the help of the ships of private contractors, only with his Majesty’s own war ships, it has been the only remedy to find a way to build ships that carrying the cargo carried by the merchant, have the ability and convenient disposition to carry two lines of artillery to have within itself not only enough defence, but also to serve at war with the advantage of two artillery weapons as long as it is in his Majesty’s service*”.<sup>11</sup> Other initiatives like those of Tomás de Larraspuru or Francisco Díaz Pimienta contributed to continue the debate on shipbuilding. Larraspuru (1582–1632), a Gipuzkoan sailor and general in the service of

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<sup>9</sup>MNM Mss. 1311, Memorial.

<sup>10</sup>MNM, Mss. 84. Report of the Contratación about the barra de Sanlúcar.

<sup>11</sup>AGI, Indiferente General 1872, Memorial of Don Juan de Amassa, February 1635.

the King, conceived a model of a boat as a product of his extensive experience suffering the problems of the Guadalquivir bar and the Seville monopoly. In 1625 and 1629 he had to observe the sinking of his admiral ships from the fleets he commanded at the Sanlúcar bar when he returned to Seville, as well as a *patache* and the stranding of three silver galleons and two merchants. In 1631 Larraspuru launched in the Havana shipyards, after applying some technical recommendations from Macebrandi and Bartolossi, a galleon, with clear influences from the Ragusan school. However, a report prepared by the Casa de Contratación in 1675 on the Sanlúcar bar, said that: “*General Tomás de Larraspuru built, with the same intention of entering through the bar, the galleon Marimorena, and it was recognized not to be on purpose because it threw the men from the decks by balancing, and of three trips it made, in two it returned dismasted, throwing in the last trip all the three masts and all these losses have not been due to stormy accidents, to which vessels are subject everywhere, but originated in the Sanlúcar bar*” (Fernández de Navarrete 1995, pp. 725–726; Fernández Duro 1996, pp. 295–297).<sup>12</sup> For his part, Antonio de Lajust, built ships for the Carrera until 1629.<sup>13</sup> He commanded the *San Antonio*, which was part of the 1630 New Spain fleet under the command of General Miguel Echazarreta. He was replaced by Admiral Manuel Serrano captain of the galleon Nuestra Señora del Juncal, which sank in the Gulf of Mexico.<sup>14</sup> Lajust’s *nao* also wrecked “a league to windward from the port of Tabasco” with a load of cochineal (*cochinilla*) (Peñaflares Ramírez 2008).

These shipbuilders were also technicians who improved the construction and sometimes also contractors because they acquired obligations with the crown to build ships according to some characteristics that they expose in their *memoriales*, in search of the perfect ship. Some of them wrote *memoriales* that we can consider small shipbuilding treatises, but we only know others from indirect documentation about their construction projects, especially consultations with the Council of the Indies or the Indies and Navy War Board. Sometimes, they erred in their architectural calculations, they experimented like Alonso Ferrera or Juan de Hoyos, who were contract-builders. The provisioning of naval supplies (*avituallamiento*), a term under which everything a ship needed for its rigging and finishing was included, was also subject to the competence of the Council of the Indies and the Junta, which in addition supervised the transport or importation of timber. The parallel organization of various boards, such as the Board of Works and Forests Del Soto de Roma (in charge of timber supplies to Cartagena, Badajoz, Cádiz, Seville and Malaga) as well as many other meetings held in 1603, 1621, 1624, 1627, 1640, and 1656 and

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<sup>12</sup> MNM. J. A. González Pañero et al., Catálogo de la colección de documentos de Sáenz de Barutell que posee el Museo Naval (serie Simancas), Madrid, 1999, Mss. 372, n<sup>o</sup> 105, 106 y 107; MNM. Catálogo de la colección de documentos de Vargas Ponce, 1999, serie segunda: numeración arábica, vol. III, ts. 3, 13 y 14A, págs. 21, 141, 150, 154, 163 y 167, docs. 198, 206, 209, 211, 19, 119, 5 y 35;

<sup>13</sup> MNM Mss. 40. Memorial de las naos que ha fabricado Antonio de Lajust desde el año de 1614 hasta el de 1621.

<sup>14</sup> AGI, Contratación 1178, N. 1.R.1.

the fact that the experimentation of naval construction coincides with activities to convert forest areas into places for timber supply makes the documentation related to this issue dispersed and makes the research work difficult.

This section would include shipbuilding projects, which proliferated from 1540 onwards. Álvaro de Bazán's project, for example, discussed at these meetings in 1540, was aimed at creating a naval system which was different from the existing one. Bazán presented several projects and he signed a contract based on the construction of three galleons and six *galeazas*. It received widespread criticism, including from the Council of the Indies and Menéndez y Valdés himself (Mira Caballos 2005, p. 52 et seq.). In part, his projects failed because in return he asked for too much, a kind of exclusive contract over the Indies trade or a monopoly on the sale of colonial merchandise to which the merchants were opposed. However, this project is the precursor or inventor of the *galeaza*. "They will be galley and galleon bastards, and they will not have as much of a galley as the Venetian ones because they are very shallow on the side to go to the Indies, they will have 200 *tonelas* more or less. These ships will be very light from the sails because of a certain secret that they will have in the making and in the sails, so much that no ship of those that have gone to India (...) sails as much as they do" (Mira Caballos, *passim*). It had oars, destined only for the operations of exit and entry to the port or at the time of positioning the ship for battle, hunting or fleeing from another vessel. The fourth project was accepted by the emperor on October 7, 1549. In this project, Bazán promised to prepare six galleons (three ordinary and three of new invention) (*Galeones de "Nueva invención"* of the Marquis de la Bazán) and three *galeazas* 4 months after the signing of the contract. This project introduced technical improvements for the galleons: "The cut or gauge of the plan and of what goes underwater of the said two galleons is and goes in such a way and measures and so different from those used that for this reason and because of their size and shape they are very light".<sup>15</sup> The contract was signed in Valladolid on February 14, 1550 (Mira Caballos 2005, p. 56). In this context, the supervision of the fleets of the *Carrera de Indias* became a central issue in the debates in boards and councils. The *Carrera de Indias* will reinforce a rivalry between the Andalusian and the Guipuzcoan schools of builders in relation to shipbuilding.<sup>16</sup> This rivalry carried out by the Seville seafarers' guild against the Guipuzcoan builders had ups and downs due to the convenience of organizing the fleets in convoys and the monopolistic intention of locating the final departures and arrivals in Seville where traffic should be controlled despite the concessions made with many peninsular ports. Bernardino de Mendoza's project appeared around 1548, and although he was not the one who invented the convoy system, his project was the one that succeeded in 1561 with the Ordinance of the Fleets and Galleons

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<sup>15</sup>AGS, Consejo y Juntas de Hacienda, 20–45, *passim*.

<sup>16</sup>MNM. Colección Vargas Ponce. Three "representaciones", to the King, to the Consejo de Indias and to Juan de Idáquez y Diego de Ibarra "sobre la pretensión de los mercaderes mareantes de Sevilla de ser preferidos a los fabricantes de naves de Guipúzcoa para la navegación de la Carrera de Indias", Doc. 58, 1612, fols. 88–89.

System.<sup>17</sup> The report was also addressed to Juan de Idiáquez, who had had, as a war adviser, an active role in the preparation of the Invincible Armada of 1588 and was very strongly linked to the Duke of Medina Sidonia. Further, systematic analysis is needed on the large body of unpublished documents related to this debate, associated grievances, and the prevalence of the fleet system and particular types of ships. Years of debate and competition went on around the construction of ships with the rivalry between Seville and Guipúzcoa, and the “*visitas de navíos*” (inspections) of the ships of the *Carrera de Indias*, some built in Guipúzcoa, in parallel with the continued demand for ships for war and trade. The Atlantic trade required the construction of high tonnage ships and equipment to make the *Carrera* as safe as possible. It was the search for the perfect merchant and war ship that creates the form of the galleon. These ships had to make port in New Spain, Nombre de Dios, and Santo Domingo as well as many other particular Antillean areas with hazardous coastal features such as rocky bottoms and coral reefs that produced continuous shipwreck events. In addition, Bernardino de Mendoza’s project was criticized as the *galeazas* that carried oars could be a problem due to the excess of human presence on board. Mendoza proposed a system based on fleet navigation and that each ship that joined the fleet was well equipped and in good condition although he criticized the *avería* (taxation) system.

### 2.3 Correspondence, Entries, Contracts, and Other Documents

From the beginning of the sixteenth century, there is information in private correspondence and manuscripts specifying the need for ships and their mobilization at sea which, little by little, influenced the delivery of detailed reports and literature on shipbuilding that encouraged change or adaptation of precedent constructive models. This experimentation, as we have said, in the hands of *carpinteros de ribera*, was reflected in the construction of various typologies. Galleys were typically rigged with a main mast and at most another mast in the bow, the foremast, which held lateen or triangular sails. Such an arrangement had been shown to be more suitable for Mediterranean winds when used as an aid to the strength of the oars. Although the galley’s purpose was primarily for war and did not have much draft, many galleys were used to carry merchandise—this combination of commercial and military use was frequent from the thirteenth century onwards. Until the end of the seventeenth century, galleys formed the backbone of the war fleets that operated in the Mediterranean, and they did not disappear from its waters until well into the eighteenth century. However, the substitution of propulsion by oar by that of sail became widespread from the beginning of the seventeenth century. In a letter sent from the Duke of Osuna, in Naples, to Felipe III on June 2 1618, he comments on the interest of Berber pirates in round ships (*naves redondas*): “having seen how

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<sup>17</sup>AHN, Diversos, Doc. de Indias, núm. 93, fol. 1r-5v



little they knew of round vessels, not long ago, today they disarm their galleys in order to arm round ships” (Fernández Duro 1885, p. 362; Fernández Izquierdo 1989). At the beginning of the reign of Felipe II, the poor condition of the galleys led to a reform to replace contracts by direct administration at the hands of the king’s officials, in 1557, thus increasing both their number and the state ownership of these fleets of galleys. New contracts were signed with the Duke of Medina Sidonia and with the Marquis of Santa Cruz (Phillips 1991, pp. 207–209). As in the case of the galleys, other types of ships were built by the contract system between private merchants and the Crown. A good part of these contracts was produced as a result of the debates that took place in the special meetings organized in the Court. In 1584 there was a Galley Board (*Junta de Galeras*) in Madrid to resolve the dilemma between contracts and administration, which was resolved in favour of the contractors.

From a comparative point of view, the descriptions of ships contained in the documents generated by these Boards and meetings between experts and between these and members of the Council refer to descriptions where the search for an ideal size of ship is seen, sufficiently important as to be armed and light and aerodynamic, or hydrodynamic to be able to overcome, when returning from trips to America, the bar of Sanlúcar de Barrameda. However, the safety of navigation in these areas affected the entry into channels and ports in various areas, whether they were the *Carrera de Indias* ships or the Dunkerque fleets. This technical circumstance could be said to have greatly affected the measurements of galleons. The Spanish crown insisted on the construction of large ships, as this was supposed to give them ease of naval combat. The load capacity of each ship was measured in tons (*tonelas*), that is how many barrels of a certain size each ship could carry. This and other manuscripts discuss the advantages and disadvantages of smaller or larger ships. Escalante de Mendoza maintained that the ideal ship for the Indies route should be 500 tons, on average: Galleons could have about 1000 tons and smaller *naos* or *naves* 100. The discussion on the measures and their usefulness given the geographical and technical constraints is present in almost all the documentation of contracts. Builders, wood merchants, and members of the Councils had a difficult challenge to meet: they needed large ships with artillery but at the same time with great draft to load merchandise while they could be easily manoeuvred when crossing the channel of the Guadalquivir, the rocky shores and reefs of the Gulf of Mexico, or the harsh conditions of the North Sea and access to the Flemish river ports. Having it all at once was almost impossible although it should be noted that the galleon was the centre of the great debate of the Crown of Castile. These vessels were built by contract with an *armador de navíos* or *asentista*: a style that apparently prevailed. But the king’s officers participated, mainly in the provision of materials, especially wood, which was a global trade that came to be controlled and intervened through numerous networks in which the elites near the crown, the contractors, and merchants, many of them foreigners, participated. Much of the documentation on seats and contracts is catalogued in collections such as those in the Madrid Naval Museum (the Navarrete and Vargas Ponce collections). However, there is still a lot of unpublished documentation and some other that has been the subject of monographs.



Among the latter are the works on the 12 galley-like galleons built by Menéndez Avilés in 1568 in Deusto and the “other” 12 galleons built in Guarnizo between 1589 and 1591. Sometimes the use of the same name or concept for different projects can be confusing. Other cases are, for example, the “asiento” of Gregorio Sarmiento’s *galeaza*, from 1589<sup>18</sup>: the great models of ships built in the Cantabrian Sea by Álvaro de Bazán the old between 1540 and 1550, which I have already mentioned, among others. Between 1581 and 1582 a set of documents edited by Cristóbal de Barro was drafted, as a result of the commission made by Felipe II for the construction of a squadron of galleons for the Army of the Guard of the *Carrera de Indias*. According to Casado Soto this is the origin of the birth of the Hispanic war galleon typology for ocean navigation. In 1588 eight of these ships were part of the Gran Armada and some of them were able to return to Spain. The archaeological interventions on wrecks of this Great Navy could give us more information about this historical mystery barely outlined in the works of Colin Martin, Casado Soto, or Miguel San Claudio and in the documentation of Menéndez Avilés and Cristóbal de Barros. It has been said that most of the great galleons perished in the battles that took place during the War of Succession to the Crown of Spain between 1699 and 1714, such as the cases of the lost fleet at Rande in 1702 or the shipwreck of *San José* in Colombia. The truth is that by the end of the seventeenth century the galleon had already evolved into the shape of the ship of the line of the following century.

### 3 Epilogue: the consolidation of a Hispanic Naval School in the Eighteenth Century

The complete annihilation of ships during the War of Succession and a change in political direction versed in Bourbon centralization led to the unification of a royal navy, first postulated in 1704. After the war ended, the activities of Minister José Patiño y Rosales, president of the Casa de la Contratación transferred to Cádiz in 1717, the creation of the Intendency of the Navy, and the subsequent appointment of Patiño as Secretary of State were factors contributing to the reorganization of this Navy and, of course, to a revision of ship architectural regulations. It is known, as it has been well studied, how even the increasing mobilization of resources for war affected the State itself (Torres Sánchez 2013). In the treatises written by statesmen of the time such as Gerónimo de Uztáriz or Antonio de Ulloa, appears the problem of wood supply and the consolidation of a constructive style that would characterize the Spanish merchant and war fleet until the Battle of Trafalgar. José Patiño was instrumental in the naval reorganization program. He issued new ordinances for the centralization of all the navies and fleets, which were united with the exception of the Navy of Galeras and the Navy of Windward (*Armada de Barlovento*). But in addition, he even personally took care of obtaining the financial means to ensure

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<sup>18</sup>AGS, MPD, 16, 164

that the navy had qualified personnel, centralizing a single Royal Navy, promoting maritime commerce, establishing some ordinances: Ordenanzas of José Patiño, president of the Casa de la Contratación in 1717; *Proyecto de Flotas y Galeones* (1720), *Arsenals* (1723), *Cuenta y Razón* (Account and Reason) in 1725, Body of the Ministry of the Navy (1725), Enrollment of Sea (1726), Surgeons (1728), and Intendants (1735). In the eighteenth century, even the Juntas were continued, such as the Junta de Marina, established in 1715 and 1716 by Minister G. Alberoni and others, but in short, this centralized navy continued with the main objective it had since the sixteenth century: the defence of colonial trade with America. The reforms of Felipe V did nothing but to consolidate this intrinsic relationship, although now attempts were being made to reinforce the means of financing and organization that it lacked previously. In 1717, Patiño was about to open a Royal Shipyard in Cádiz, which was in charge from that moment on of managing these money inflows and the size of the ships. However, Patiño was going to leave Cádiz in a hurry and the management ended up again in the hands of Francisco de Varas and Valdés. A good part of the contemporary information on ships is contained in works related to naval and maritime trade, such as the works of Antonio de Herrera, “General history of the events of the Castilians in the lands of Tierra Firme of the Ocean Sea (*Historia general de los hechos de los castellanos en las tierras de Tierra Firme del mar océano*)”, 1726; or that of Antonio de Capmany, “Appendix to the maritime customs of the book of the consulate: contains a collection of laws and statutes of Spain from the thirteenth to the eighteenth century, relating to naval trade ordinances, Historical memoirs on the navy, commerce and arts of the old city of Barcelona and Ordinances of the naval navies of the Crown of Aragon” (*Apéndice a las costumbres marítimas del libro del consulado: contiene una colección de leyes y estatutos de España desde el siglo XIII hasta el XVIII, relativos a ordenanzas de comercio naval, Memorias históricas sobre la marina, comercio y artes de la antigua ciudad de Barcelona y Ordenanzas de las Armadas navales de la Corona de Aragón*). To this is added the monopoly of some large firms of merchants, well related to the Crown, such as the Goyeneche family or the contractor Daniel Van Eden, in relation to the business of transporting wood, during the War of Succession.

The creation of the Intendance represents the culmination of José Patiño y Rosales project to turn the Bay of Cádiz into a centre of naval provision and storage as well as to redirect the benefits of trade to the construction and organization of navies (Crespo Solana 1996). Patiño’s speech turns the commercial and naval revitalization plan into a preliminary draft of the national shipbuilding industry that should focus geographically on the Basque-Cantabrian areas (hence the subsequent intervention of Antonio de Gaztañeta) and Andalusia. In Cádiz, the use of such a singular geography in the double system (private and institutional) that defined the Spanish trade in the Indies came from the emergency of creating a centralized navy, created in 1704 in the awareness that trade and the empire had to be defended on both sides of the seas with a good legislative base and to replace the old position of Admiral Mayor of Castile. The latter had become a hereditary political-military appointment that had lost its naval responsibilities in the face of a more than fragmented conjunction of navies and fleets that had no common leadership. The

admiralty, divided between the admirals of Castile, Granada, and the Indies, had responsibility for the navies but their evolution was very irregular and their general powers were varied or passed to other newly created positions such as that of the captain general of the Sea (1517). The connection with this preceding situation is little studied except in Calderón Ortega (2003) and Ceballos-Escalera (2012). With the Royal Decree of February 1714, all existing squads and fleets were ordered to be unified. This was reaffirmed in the legal project in June 1717 with the promulgation of Ordinances for the Navy and the installation of the General Marine Intendance in Cádiz (Crespo Solana 1996; Baudot Monroy 2012).

Several circumstances must be considered. The dilemma over whether shipbuilding expenses should be based on centralized resource management or in the form of contracts between the crown and private merchants was a problem that continued throughout the eighteenth century. This supposed a total privatization of resources and, therefore, of the ships themselves, something that evidenced the limited capacity of the Crown to have everything under control. According to Carla Rahn Phillips, only when a state is fully developed can it become a regulator of the production capacity of others (Phillips 2010). Both systems, central administration and contracts, coexisted. In fact, in the organization of arsenals and the creation of new shipyards, the strong presence of the contracting system in shipbuilding businesses is notable.

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