Chapter 13
A Shared Sailing: Artillery and Ocean Warships

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Abstract The work focuses on the study of the different types of cannon used during the first decades of the sixteenth century and the reforms that had to be carried out on ships to be able to accommodate a greater number of larger and heavier cannons. A special emphasis is made on carracks and the first uses of gunports in the Mediterranean Sea, especially during the Naples wars at the end of the fifteenth century. The Mediterranean was the main area where the use of guns and fighting between fleets was developed.

1 Introduction

Ships probably started using firearms in the mid-fourteenth century, shortly after they were invented and began to be used in land sieges. There are few iconographic and documentaries sources that allow us to know precisely the artillery—forms and materials—that armed medieval and early modern ships. However, ships were modifying their lines as the artillery increased its power. The research that has previously focused on the evolution of warships has not studied, in-depth, the impact that guns had on ship modification. When thinking of a ship armed with artillery, we must consider that the types of guns could be all the same and not necessarily different. This is important when the shooting rate and charging methods are discussed. When the size and effectiveness of the artillery increased, its manufacturing process became specialized and there is no doubt that in the Modern Age gunfounding became a semi-artisan production or, what is the same, semi-industrial process.

Therefore, the current orthodox opinion was—even today is—that: (i) Individual cannon were "one-offs" before the eighteenth century; (ii) The technology available from the fifteenth century onwards was not conducive to repeatability, and (iii) There was no mass production system. However, recent studies have shown that this is not true. Following a pattern, the guns did not have to be all different ("unique"), the system could have reproduced as many copies as needed ("repeatability"), and consequently this would suppose a new production system ("mass production" or

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"repeated production"), even when parts of the process were artisanal. Thus, prior to the eighteenth-century artillery gunfounders were ready to use repeated production techniques and were able to cast identical guns. In other words, it is standardization. The problem to achieve a complete standardization in artillery came from the lack of uniform measurements—the case of the Spanish empire and other crowns—and from bureaucratic problems of the central powers (López Martín 2011).

Through a real-scale drawing and the strickle board, the gunfounders could make as many identical pieces as they needed. The lost wax method was never used in the manufacture of artillery because the mold was destroyed during the process, having to start from scratch every time a new gun was made, and the system would have been slow and extremely expensive. However, the system based on the drawing and the strickle board allowed the reproduction of as many clay copies as necessary to produce hollow molds from them. The strickle box for casting allowed the work division in the gunfoundry. This was more evident when the guns commissioned were the same and the gunfounders had to produce the same pieces in shape and caliber. With this system, the master gunfounder could make more cannon in a much faster and cheaper way. Copies could be reviewed by workshop apprentices while the master could focus on new designs or new assignments. Calibers could be regulated even since the fourteenth century. During the second quarter of the sixteenth century, the caliber stick allowed equal proportion for stone, lead, and iron ammunition with weights from one pound to 100 pounds, so the gunfounder previously knew the exact dimensions that should be given to the calibers. A different problem, but closely linked, was the unification measures, which affected more than one territory, for example, those governed by the Catholic Monarchy. Even so, in a wider view, this method can be understood as a semi-mass production system or repeated production system. It has been ensured that only from the eighteenth century onwards cannon were cast with the same molds. This is not true. Gunfounding—and the arms industry in general—sought from the beginning the quickest and cheapest way to duplicate the pieces produced. It was an indisputable advantage to have a ship armed with identical cannon, of equal caliber and that could use the same ammunition.

It is not the purpose of these pages to answer why it has always been thought that there was no repeated production in artillery, or why all gunfoundries under the same power did not manufacture the same types of pieces of equal measurements and calibers, in each series of cannon cast, so that the ammunition of each type would fit them. These issues have been studied in other works (López Martín 2011). It is, however, to establish guidelines for the use of artillery on ships, guns that for a long time were the same as used on land. To try to create a common lexicon of ancient artillery in each language (e.g., Spanish, Portuguese, English, French, etc.) is nonsense. Vanoccio Biringuccio was not at all interested in comparing cannon names already in 1540. Therefore, specific cannon names will not be used here beyond "cannon," "culverin," "bombard," "swivel-gun," and little else. Likewise, demonstrating where and how the cannon were used for the first time, or the successful use of broadside gunnery is also outside of the scope of these pages.

2 Types of Artillery and Ships

The first cannon might have been cast in bronze. The bronze casting needed a master gunfounder to shape the mold and then mix and melt the metals, proceed to cast at a very high temperature, and review the piece by hand once cooled. Even with only one master, the casting process required heavy economic investment and a large number of assistants in each of the stages, making the final product more expensive than the forging of iron. Copper and tin also had a higher price than iron. However, even being the final product was more expensive, bronze cannons were used for a longer period of time. Andrés de Espinosa, a gunner from Seville, said so in 1576 when, in the dialogue he wrote for the examination of young pupils, he claimed that a piece of bronze was more valuable than a piece of iron "not only because the metal is more expensive, but also because it is safer to shoot," especially if the metal was meted with the appropriate alloy (Fernández Duro 1881).

Bronze cannons were made for both muzzle loading and breech-loading. Either construction techniques or the way to shot were affected by the type of material. A muzzle loading gun consisted of a closed tube in its later part, that did not allow gas to escape and use all the force of the gunpowder in order to achieve a more powerful shot to a greater distance. For this reason, a bronze cannon was much safer than a wrought-iron one made in two pieces. It also was more durable. Bronze cannon, which had gone hand in hand with the development of the artillery since its invention, were used to arm ships. However, throughout the fifteenth and early sixteenth centuries, the problem to ship them was the weight, because, with equal dimensions, a bronze cannon was much heavier than a wrought-iron one. This affected both the ship structure and its stability. Another problem arose when using muzzle loading guns since their firing required a great number of tools for cleaning and loading. Breech-loading was faster. For this reason, bronze cannons were also made breech-loading in two adjustable pieces, the chase, and the chamber. The projectile used was usually iron.

Wrought-iron was used in the manufacture of artillery due to its lower economic cost: a forged piece was cheaper, usually faster to produce (depending on the size), and needed fewer qualified gunners. For this reason, iron was used for the manufacture of artillery at the early stage. However, the iron working technique forced to make slightly different pieces, because while the bronze was melted and shaped in previously prepared molds, the iron had to be worked hot with the hammer to shape it at the forge. The most common wrought-iron pieces used in ships during the fifteenth and sixteenth centuries were bombards and swivel-guns (no matter now the names given to them in each country or European region). To make the piece by the standard method, the master smith used a wooden armature, the length of the proposed cannon, to form the core of the barrel, surrounded with longitudinal bars of iron or *staves*, fixed rigidly. Red-hot iron bands were added over this structure at right angles to the axis. When quenched, the bands contracted to pinch the staves together. The grip was sufficient to withstand the discharge of gunpowder. The larger the piece the more bands were needed. In an alternative way of constructing

the barrel, instead of longitudinal staves, a single or two wide iron strips of the length of the barrel were clamped together into a tube and then braced externally by the bands. However, it seems that these structures would hardly stand a powerful gunpowder explosion and they only appear in small pieces (López Martín 2011). Due to the bars and staves technique, the wrought-iron pieces could not be loaded with heavy amounts of gunpowder because they could explode due to a failure in one of its numerous joints. Excessive heating by continuous firing was the main problem of an artillery gun. Since the chase and the chamber were two independent pieces, there was a loss of pressure in this type of piece, which led to reaching smaller ranges. A large bombard was tremendously heavy and the absence of trunnions on it forced to keep the piece secured by ropes to a "box" or primitive carriage, usually a pair of thick and sturdy boards arranged at right angles able to absorb the strong recoil produced when firing. These carriages had solid wheels and progressed into spoke wheels. Iron cannon used stone ammunition due to friction in the bore. All these features discouraged wrought-iron guns. They had another disadvantage. A shot fired with a bronze piece could exceed 500 m/sec, while a shot fired with a wrought-iron piece could barely exceed the speed of sound, 340 m/sec. These results were obtained in shooting tests made with modern replicas of original pieces recovered from the *Mary Rose* (Hildred 2005). The average range of bronze pieces was between 1000 and 1500 m or even more, but its maximum effectiveness was between 800 and 900 m depending on the type of piece, the material (and therefore the weight), ammunition, and last but not least, the gunpowder composition. The optimum average range of wrought-iron pieces was between 500 and 800 m. Presumably, original pieces loaded by experienced gunners with powerful gunpowder charges could reach significantly higher speeds.

The Vasa Museum has also carried out firing tests with a replica of an original 24 pounds gun recovered from the *Vasa*, sunk in 1628. Different shots were fired against a reconstruction of the *Vasa*'s hull section at the level of the lower deck of 4 × 3 m and 75 cm. thick, oak made, and similar dimensions as the original, located at 35 m. The projectiles penetrated the target as if it was paper in 99% of the cases with an accuracy of centimeters. Only one projectile did not pierce the target due to the lower powder charge with which it was fired. Every shot produced a large, dense, cloud of smoke that impeded vision. These tests give a reliable testimony of the power of the artillery used in ships (Dr Mårten Granberg, Vasa Museum, pers. comm. 2014). The Museum staff of the Danish frigate *Jylland* has carried out the same type of test with similar results.

These were the reasons for first using bronze guns and then cast-iron artillery. Wrought-iron pieces did not stop being used for being outdated, except if one considers that its manufacturing technique was obsolete in comparison with monobloc bronze tubes. When the Spanish gunner Luis Collado criticized forged iron guns in 1586, bronze pieces had surpassed those of wrought iron, and cast-iron ones began to overlap those of bronze. It was purely a matter of technological challenge, and the change was gradual. It has not been found a way to form a typology based on technical construction or metallurgical criteria for wrought-iron pieces because they were similar throughout Europe and each master or workshop gave his personal shape to

the pieces if particular designs had not previously specified by the Crown, as standardization also affected the wrought-iron artillery. An attempt to form a typology is the study from stylistic criteria, for example, of the shapes given to the lifting and reinforcement rings, since they can form groups that indicate the workshops which forged the pieces since there were no different masters, or workshops, working with the same forms. This feature did occur throughout the continent. Thus, the shapes of lifting rings that the masters or workshops that made the wrought-iron guns for the *Mary Rose* are not the same as those that the masters or workshops made for the conquest of Granada by the Catholic Kings. There is no much research on master or workshop marks, especially in swivel-guns (López Martín 2011).

Swivel-guns—either in bronze or iron—were smaller pieces than cannon and bombards, both in length and in caliber. They could be built with the bars and staves technique or in a single cast piece. They were also breech-loading pieces with the difference that their chambers were not simply adjusted to one end of the chase, but had to enter in the main body at a certain angle and then fix them on the back by a lock or latch. Since they were breech-loading pieces they did not need to be introduced inside the deck to reload, because it was easy for the gunner to reload the gun from the rear end of the breech. Logically it was a great advantage over the muzzle loading guns. Swivel-guns were mounted on deck in a hook. They used stone or lead ammunition and occasionally shrapnel and their use was anti-personnel. Like all breech-loading parts, rotating pistols expel gases upon combustion that can cause a loss of power. Its average range was between 300 and 500 mt. Swivel-guns were used on ships until the eighteenth century. Breech chambers were used as modern cartridges, allowing a higher rate of shot, as the gunner only needed to change one chamber for another. The breech chambers, independently of their material, fitted precisely to the piece and formed a set. This was extremely important when it came to unifying calibers since all the pieces of the same caliber used the same type of chamber and were interchangeable. This increased the rate of fire. Guns, chambers, ammunition, and even the loading and cleaning tools were frequently marked with a special sign that identified them. Standardization was systematically sought since the fourteenth century (López Martín 2011).

The manufacture of artillery from cast-iron required much more complex technology than bronze, and its use was very limited until the gunfounders reached the temperature necessary to melt the iron and the method became cheaper. Since the late Middle Ages, the new blast furnaces could achieve significantly higher temperatures (around 1450 °C), which facilitated a higher absorption of carbon in the metal, and much more efficient exploitation of the ores. As a result, castiron became a widely accessible and cheaper alternative to bronze. In sum, depending on the period, technological knowledge, and expected technical requirements of the resulting metal, iron guns could be made by either welding together pieces of bloomery or wrought iron by hammering in the solid-state, or by directly casting liquid high-carbon iron into molds. Cast-iron cannons are documented during the first 30 years of the fifteenth century and were already used in Danish ships in the second decade of the sixteenth century. When the blast furnaces technique was improved it was possible to melt iron artillery much cheaper than the bronze one and to an

unprecedented scale. It was the reason why the fleets began to arm their ships with iron cannons (López Martín 2011). When talking about ship-borne artillery, it is also necessary to take into account the period, the geographical stage, the manufacturing technique—the material with which it was made—and its dimensions, since all these factors were decisive for its use. It is not the same to deal with large castings as with small wrought-iron pieces, as both were used at the same time. Both manufacturing techniques and dimensions varied over time and were used in an overlapping manner, so there is no need to attempt to categorize material-based, nor ask when gun improvements were made that allowed them to be placed onboard.

Finally, it is necessary to point out the fact that cannon had a great commercial value. This was due to both its value as a weapon of war and the economic value of metals, especially bronze guns due to their high resistance to corrosion. Bronze guns could be melted again in new pieces of modern designs. Resistance to corrosion is the reason why many shipwrecks lack bronze cannons. The recovery in situ of bronze artillery from a shipwreck was a priority action if its location was known and the remains were not sunk at great depth. The lack of bronze cannon which is frequently found in shipwrecks should not lead to thinking that ships were armed mostly with iron cannon, or even that they did not have bronze cannon at all. These were the first to recover.

3 Changes in Ship Shape

Fourteenth-century cannon were of small size and their effectiveness was very reduced both in campaign and sieges to fortifications, but the everlasting war between the European crowns made the firearms progress spectacularly fast. Corned or granulated gunpowder favored a variation in the size of the pieces that were progressively increased since the end of the century. When better gunpowder combustion was achieved due to the corning process, shorter powder chambers became feasible and the difference in ratio between chambers and barrels was reduced. When cannon with long barrels turned out to have a greater range due to an increase of the ball velocity in the bore, not only was the cannon shape modified but targets could now be attacked with new confidence. The first half of the fifteenth century was the period of giant guns, with 50 cm caliber or more. The size increase was supported by the idea that the larger was the gun, the greater was the range. Therefore, the more destructive was the gun. Taccola's *De ingeneis*, completed in 1433, warns of the problem of making large pieces saying that a heavy bombard could not be transported by horses. Taccola's solution was the manufacturing pieces with detachable components and use oxen for their transport (López Martín 2011). In addition to these transport problems, such large pieces were impossible to mount on a ship. In the fall of Constantinople, the great siege cannon-train of Mehmet II played a determining role, but such pieces would have broken a ship in two.

The fall of Constantinople coincided with the climax in the techniques of iron forging and bronze casting in artillery. There are examples of these giant pieces. In

wrought-iron the *Pumhart von Steyr* (early fifteenth century, ca. 8000 kg); the *Michellettes* (ca. 1423, 363 cm); the *Dulle Griet*—the largest European wrought-iron cannon in existence—(ca. 1448, 500 cm, 16,400 kg); or the seven breech chambers of 142 cm in length each, built before the middle of 1489, that the Catholic Kings took to the siege of Baza. Their barrels were lost during the Napoleonic Wars, but their calibers reached 46 cm and its total length was around 3 m, so each bombard had an approximate length of 450 cm. Outstanding bronze pieces are the Dardanelles gun—the oldest dated cannon in the West—(cast in 1464, 518 cm, ca. 17 tons) and the *Schöne Katharina* (cast in 1487, 365 cm) (López Martín 2011). In 1869 a great Turkish siege gun was fired three times in a trial and the shot distance reached was 5.2 km. With cannons like these, the Ottomans conquered Eastern Europe and the Catholic Kings took Setenil after 15 days of intense bombing. Nevertheless, these pieces were a technological dead-end. Changes would occur in the development of cannon shape, but the construction technique remained the same. The limitations of the forge restricted its role and evolution. Cast-iron artillery had less impact on European warfare at the dawn of the Early Modern period, as the casting technique was problematic. However, bronze was soon the preferred material for warlike sovereigns who perpetuated in casting their status, mottoes, and heraldic bearings. If it was well cast bronze, an alloy of copper and tin, was more resistant than iron, which soon corroded when exposed to the air, and more important, bronze could be re-cast with new designs as many times as necessary (López Martín 2011).

During the second half of the fifteenth-century artillery in Western Europe developed in a different direction: smaller dimensions and calibers combined with maneuverability and easy transport. This led to cannon proliferating all over Europe. The political powers sought to achieve this in the shortest time possible. These pieces already existed, but now they became predominant. It was a great difference. France and Burgundy took the lead in this development and Portugal were not far behind. Diebold Schilling's chronicles completed during the 1470s and the 1480s confirm the use of smaller, more maneuverable artillery mounted on two-wheeled wagons pulled by horses instead of oxen. It was the type of artillery that Charles VIII of France had placed in Tours in 1488 (when Duke Francis II of Brittany died) prepared for the annexation of the Duchy of Brittany. It is known thanks to the spy reports sent to Spain to Ferdinand the Catholic. Examples of this type of piece have also survived (López Martín 2011).

It is evident that giant bombards could not be mounted on a ship, but pieces of smaller dimensions and calibers. However, during the second half of the fifteenth century, it was still not possible to mount a large number of guns, since their weight exceeded that which could support ship structure. For this reason, the structure had to be adapted to the guns. The strategic need to use large-caliber and size (but not giant) cannon onboard ships became a driving force in Renaissance shipbuilding (Zwick 2016). In other words: in the close relationship between shipbuilding and gunfounding, it were ships and not cannon which had to increase in size (Alcalá-Zamora y Queipo de Llano 1974). Thus, it seems clearly true that armament altered both tactics and warship construction long before the 1530s (Rodger 1996).

For a long time, cannons used in the ships were not different neither in the form nor in the material of the guns used on land. Muzzle loading bronze pieces were more difficult to load and weighed more than wrought-iron guns, for which to build a ship with large and numerous pieces of bronze was supposed to alter considerably its stability and balance and therefore its navigability. The total weight of the artillery was limited until the end of the fifteenth century when the shipbuilding technique managed to develop ships of a size and design that allowed them to sail on an oceanic scale, and modify their structure in order to achieve the use of a considerable number of cannon. The bombardment from a distance of static (a fortress) or moving (a ship) targets in order to eliminate their offensive or maneuver capacity before taking it to assault or collision, was what motivated the change in shipbuilding (Adams 2013). Since the guns mounted on board were not all the same in design, weight, and measurements—because until well into the seventeenth century a ship was armed with all the available stock at the arsenals—, the total weight of the artillery—or, in other words, the sum of the weight of each gun—was random and, therefore, different for each ship or for each voyage. When ships continued to increase in size and the modifications made to their structure were again improved, their sides could be first assembled with fixed batteries of bronze cannon and later with cast-iron cannon.

Therefore, cannon design, weight, size, number, and loading method, conditioned ship shape, forcing important changes since these five factors—which are inherent to the evolution of the warship up to the present day—depended on the tonnage that the ship could support without endangering its stability (Hildred 2005). Ships had to be modified in order to allow for the increase in the number of powerful large-caliber pieces on board. Thus, the artillery forced the ships to modify their structure from the third quarter of the fifteenth century in the same way as it already had in the land fortifications at the beginning of the same century. Sebastián de Covarrubias' *Tesoro de la lengua Castellana o Española* (Cobarrubias Orozco 1611) defined a ship as "a well-armed castle of people and ammunition that moves through the sea" (Trejo Rivera 2005). When did these changes occur? Where did they happen? Did they arise spontaneously or were they motivated by each other? These are questions that are still to be answered, but these pages may be a new attempt to should shed some light on this issue.

The first change made to the ships was motivated by gun firing, an action that involved both loading and recoiling. Both factors forced to make a wider bridge in order to provide more free space that would allow the handling, easy loading, and recoiling of the pieces when fired. For these reasons, guns used in ships at the end of the fifteenth and the beginning of the sixteenth century were mainly breech-loading, which allowed loading without the need to move it from its firing position. The number of breeches varied depending on the rate of fire. The limited space on the deck made it difficult to load a muzzle loading gun. When it was fired, it had to be removed from its position in order to clean the residues that had remained in its core (hot traces of hot burned or unburned gunpowder, particles of the block, pieces of cloth, etc.). After being fired, it had to be loaded again with another ball and placed back in firing position. However, this difficulty did not prevent the use of

heavy and long bronze pieces. Such pieces have been recovered from different shipwrecks. For example, two guns were cast between 1498 and 1510 for Johan Herze, mayor of Lübeck. They were mounted on the *Engelen* (second of this name) sunk in 1565. In the Venetian attack on Trieste against Emperor Maximilian in 1507, eight galleys and two ships [*naos*] were used, from which 20 pound balls were fired at a distance of 3000 steps from culverins and basilisks 20 feet long (5 m long cannon firing at a distance of about 4 km. (López de Gómara 2000). These types of pieces have also been preserved.

Gun recoil increased according to cannon size and its powder charge. The bigger the gun, the more gunpowder it needed and the more recoil it had. The Vasa Museum has carried out (Oct. 2014) firing tests with a replica of an original 24 pounds gun retrieved from the *Vasa* sunk in 1628. The tests began firing four projectiles, the largest of which weighed 3.3 kg. with a powder charge of 2.65 kg, which generated pressure on the chamber of 731 kg/cm^2 (10,400 psi) and initial velocities at the muzzle between 360 and 399 m/sec. The recoil distance of the barrel was 1.6 m, enough for the chase to retract and be recharged on the deck. Shooting tests were also carried out leaving the gun unattached: with a charge of 1.1 kg, the recoil was 1 m; with 2.2 kg. the cannon retreated 5.64 m; with 2.65 kg, 7.65 m; and with 3.3 kg, 9.5 m. When the cannon was retained it was tied to two one-tonne steel weights each with a five-centimeter thick rope. The results of these experimental tests give an idea of the tremendous force of gun recoil when it was fired. In the mid-sixteenth century, the Portuguese Fernando de Oliveira warned about the recoil of such large guns in small ships "*porqueosabrem e desbaratammuyto*" (Oliveira 1555). The concern about leaving free space around cannon is easily understood.

The second change or modification was to provide greater strength to the decks to be able to support the weight of the guns, which was increasing throughout the years. To the extraordinary weight of the guns was added the cargo of goods—excessive, badly distributed, and frequently increased illegally—resulting in fatal outcomes, especially when sailing with strong swells or facing powerful winds. Of course, the bigger was the ship, the more cannon could be mounted on her decks. But the increase in the number of pieces on the bridge and in the castles moved the center of gravity and endangered the ship's stability. The solution was to place the heaviest guns as low as possible near the center of gravity to avoid endangering the stability.

This resulted in a third and transcendental modification that changed the shape of warships forever: the creation of a long deck with open gunports at regular intervals (another variation of the castle loopholes) through which guns could fire, and equipped with lidded ports to open or close them. However, the weight of the artillery placed on the lower deck and the opening of artillery gunports in a long battery under the bridge weakened the structures of the hulls built with the clinker technique. The assembly of heavy and powerful guns on the top of round sterns did not need great changes, but it was even easier to place them in flat sterns or square finished sterns. In addition, placing the same guns in the lower part of the ship and firing from both sides of the hull required that the width of the battery where the guns were placed was carried to the stern, and in this case, it was also easier to finish

in square or flat shape. In order to build that long battery and open gunports on both sides, it was necessary to reinforce the basic structure of the hulls, the beams, and the reinforcements to support the weight of the guns and their violent recoil. These modifications were a serious structural problem for a ship built with a clinker technique, in which the main tensions were transferred through the hull, so that opening a considerable number of gunports weakened it considerably. However, it was not a problem for a ship built with the carvel technique (Zwick 2016). This change was crucial for shipbuilding.

However, carrying cannon on the lower bridges to avoid disturbing the ship balance and the opening of artillery lidded gunports on the lower decks had an inherent risk of sinking since it required the gunports to be located dangerously close to the waterline. Gunports must be opened and close very quickly and be as watertight as possible once closed. Some ships sank because they could not close in time a gunport that had been below the waterline as the ship slinked beyond the critical point. The opening of such gunports on the side of the ships was a crucial addition. It allowed the change from carrying one or two guns during the fifteenth century to complete batteries of 112 guns or more in the eighteenth century. Until the eighteenth-century cannon were the same as those used in land sieges, because, broadly speaking, there was no regulated naval artillery. So basically the success of having heavily armed ships did not depend on the guns but on the ships.

Despite their tremendous importance artillery gunports have not been studied in-depth and there is no precise chronology for their first uses and subsequent development. The invention of gunports is usually placed at the beginning of the sixteenth century. Traditionally, its creation has been attributed to a French shipwright master who supposedly devised them at the beginning of the sixteenth century. However, in addition to being difficult for a shipwright to carry out such an innovation—as he would have no experience in warfare techniques or artillery science—, it is a statement that has no scientific basis based on reliable historical sources. Although its first appearance remains unknown, and it had to be a process of continuous evolution in shipbuilding, it is clear that someone, somewhere, had to have the genial idea. There is, however, reliable pictorial evidence that offers chronological patterns.

Gunports probably had to appear during the second half of the fifteenth century as an evolution of the loading and ventilation doors that were placed on the sides of the ship. These remained closed when the ship sails, while open in port they facilitated loading and the ventilation of the main deck. There are fine fifteenth-century examples of these doors. One is Beato Angelico's *Stories of St. Nicholas of Bari, three youths put into brine and St Nicholas saves a ship from sinking*, ca. 1437 (Vatican Museum cat. 40,252), painted for the chapel of St. Niccolò in the church of St. Domenico in Perugia. The table shows three ships, two of which have cargo and ventilation ports located near the stern. Another example comes from Antonio Pisano, *Pisanello*, who also dedicated himself to the design of war machines. He worked for Alphonse V of Aragon, King of Naples, during 1448 and 1449. It is very likely that his drawings of large cannons correspond to royal guns stored at the arsenal of Naples, which the French embarked on with the intention of taking them

to France in 1494. Likewise, his ship drawings were not just Renaissance sketches of particular beauty and proportion but designs capable of being made, something of great interest to a Renaissance prince (López Martín 2011). There is a group of detailed ship designs from *Pisanello* or his workshop. Two of them had to be part of the same folio (Fig. 13.1). They have reduced castles to bow and stern. The side near the stern has a large opening or lidded port. The other smaller openings which can be seen aft, the chocks, were used to release the ropes to tie the ship up in port.

Pisanello's drawings were not isolated cases. The famous print of a Man-of-war turned to the left (Ashmolean Museum, University of Oxford, WA1863.2929) by the Master W with the Key—Willem Vanden Cruce?—, made for the Duke of Burgundy Charles the Bold ca. 1468, shows a three-masts carrack on the port side armed with small cannon and a large opening on its side (the engraving has also been dated between 1467 and ca. 1495). From about 1468 it is a drawing of the *History of Alexander the Great*, also made for the same Duke. It shows that the opening could also be occasionally used for rescue works (Fig. 13.2). In 1474 the *Amtliche Berner Chronik* (Official Chronicle of Bern) was commissioned by the city to Diebold Schilling, who between 1478 and 1483 submitted to the city's town hall a three-volume work with more than 600 illustrations showing events that occurred in Classical antiquity. There is a drawing within the first volume that shows the siege of a city in which the attacking army is using hand cannons and crossbows.

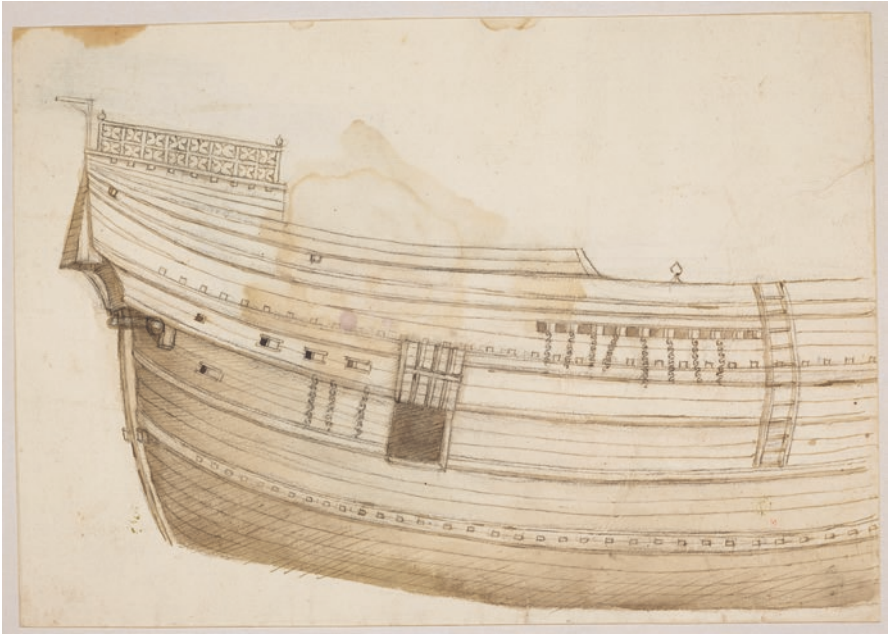

Fig. 13.1 Half hull of a ship by Antonio di Puccio Pisano, *Pisanello*. Codex Vallardi, mid-fifteenth century, inv. 2287r. Detail of stern with a large opening or loading gunport. (Source: Musée du Louvre. Photo © RMN-Grand Palais (musée du Louvre)/Michel Urtado)

Fig. 13.2 *Des Fais du grant Alexandre*, Quintus Curtius Rufus, 1468–1470, French translation by Vasco da Lucena (detail). An opening or loading gunport at the stern is being used to rescue soldiers. BnF, Ms. Français 257, fol. 39v. (Source: gallica.bnf.fr/BnF)

They are arranged behind a long wooden parapet with four open gaps at a regular distance. Such a structure does not differ from the section of a ship hull where the ports would be open. Another drawing shows a large bronze bombard settled on the ground and adjusted with a piece of wood to control the recoil. The gunner is about to fire the gun while another, who brings him a projectile, is lifting the parapet by a rope that protects the gunner, a protection that is exactly the same as lidded gunports used in ships.

What emerges from these drawings is that if these constructions and mechanisms were painted during the 1480s, it is true that they were already used on ships at that time or, thought of how to do it. In fact, the problem had to be how to include them in a ship without affecting its structure and safety. Another drawing of the second volume shows a group of soldiers in a rowing boat whose prow and stern are protected by wooden fenders in the form of castles and various pieces of bronze artillery (if they were made of iron Schilling would have painted them the same color as

the soldier's steel armor). The boat has no lidded gunports. Next to this boat is a large bronze bombard arranged on a floating board and with a large and thick piece of wood in its stock to stop the recoil. The display of such a bombard on a ship deck should not be very different. Finally, another drawing from Schilling's *Spiezer*'s chronicle shows a large vessel on the starboard side armed with six bronze cannons, due in this case to the striated decoration of their chases. One is placed in the middle of the aft castle and another in the bow, mounted on a carriage used also in land sieges, with a pointing system in height, which Schilling drew profusely in his works. Four others are located on the side, protruding through holes in the hull. Although they lack lidded gunports, the drawing makes it clear that the guns had already been placed on the sides of the ship, even if it was on the bridge and not on the main deck. The elevation systems drawn by Schilling were used in cannons with vertical appendages in the breeches that allowed them to raise or lower the barrel depending on the shot angle. Many cannons with these appendages have been preserved, including the aforementioned cannons cast for the mayor of Lübeck Johan Herze, recovered from *Engelen* sunk in 1565.

If this type of artillery equipment were made in Switzerland(!) during the last quarter of the fifteenth century (although the events narrated in the chronicles were earlier and occasionally occurred outside the Alps), it is clear that Schilling very well knew warfare techniques, cannon types, combat gun carriages, and how to place artillery in sieges. What these drawings show is that land sieges found some answers that were later transferred to naval combat. If the modifications in naval warfare did not happen earlier it was not due to a delay in the advances in artillery, gun design, the improvement of gunpowder, or in the construction of gun carriages, but because of the impossibility of shipbuilding to incorporate large cannon on board. Powerful large-caliber guns, corned gunpowder, and gun carriages adapted to each type of cannon already existed and were being successfully tested and improved in land battles. Therefore, shipbuilding had to evolve to allow the implementation and development of the advances made in land warfare. This evolution did not happen at the same time in those different parts of the continent, nor at the same speed, and the transmission of the advances would be carried out by shipwright masters, by soldiers trained in the art of war, or by the ships themselves, which linked some ports with others, either being chartered for war or commerce or were captured as booty. Its adaptation to different scenarios should not have been the same either.

For the years in which Schilling illustrated his works, perhaps the gunports should not be common or were widely disseminated. This is demonstrated by the work of John Rous' *Pageant of the Birth, Life, and Death of Richard Beauchamp, Earl of Warwick*, a manuscript with war drawings made in the South of the Low Countries, perhaps Bruges, after 1483 (BL MS. Cotton Julius E IV). The drawings show in great detail the English fighting against the French and Genoese, but no artillery gunports appear on any ship. The only weapons carried by the ships are wrought-iron cannon mounted above the top of the gunwale. Five similar wrought-iron, "*culebrinas de mano,*" probably from the end of the fifteenth century, are preserved in the Museo del Ejército, Toledo (Spain). They have small calibers, one-piece

long tillers, no priming pans, and they have no master or workshop marks but each bears initials, probably corresponding to the ships on which they were mounted.

Likewise, Biagio d'Antonio *The Betrothal of Jason and Medea*, ca. 1487, also shows two ships on each side of the Apollo temple where Jason proposes Medea marriage (Fig. 13.3). They are two great three-mast ships with elevated castles of prow and stern. The one on the right, behind Medea, with the stern in view, has a side opening with an open lidded door and the rope or cable which opens and closes it from the chock is clearly visible. The other boat on the left, behind Jason's back, has the opening hidden behind the coast, but it is possible to see the same rope or cable that comes out of the chock of the first deck. It can be deduced that it has another port located in the same place as the ship at the back of Medea. However, the cable is located near the main mast, while the boat on the back of Medea is closer to the stern. This could suggest that there are at least two openings on the side of each ship, which is a big step forward from the previous examples with a single porthole open on its sides.

Another less detailed image appears in the Chronicles of Nuremberg by Hartmann Schedel, an illustrated history of humanity from Creation until 1490. It was printed in Latin (*Liber chronicarum*) and in German (*Die Schedelsche Weltchronik*), by Anton Koberger in Nuremberg in 1493. It included a large number of woodcuts from important cities of the time. The print of the city of Cologne includes the image of a ship with seven openings in the starboard band and although they are not lidded, they could hardly have any other sense than to place a firearm with which to defend themselves.

It is clear that the opening of gunports was a fact closely connected to the opening of the loading/ventilation doors or portholes. Once these were opened, would it

Fig. 13.3 Biagio d'Antonio's The Betrothal of Jason and Medea (attributed), Florence, ca. 1486. Two great three-mast ships with elevated castles at prow and stern. Both have side openings with lidded doors. (Source: Musée des Arts décoratifs, Paris, PE 102, © MAD, Paris)

be possible to make other openings for the artillery at regular intervals on the side of the ships or even at sea level, which could be opened and closed while the ship was sailing, and which were sufficiently watertight? (Barfod, 1990). There is an entry in the documentation of Princess Joanna of Trastamara's voyage to the Low Countries in 1496, which contains an explicit reference to artillery-topped gunboats (*vid infra*). This is one of the first written references. However it is clear that while others should exist, it appears that they have not yet been found or published. There is no doubt that the gunports were a transcendental innovation in the ship's shape, but there were still other modifications to be made such as the gradual elimination of the great inclination of the decks. While a merchant ship could have sloping decks that ascended into the high fore and aft castles, a warship needed more horizontal decks where the artillery could be mounted and handled easily. Thus, the high castles (which stood as homage towers similar to the fortresses), had to gradually reduce their height to avoid complicating the positioning and use of the cannons in them. The stability and firepower of a ship were always detrimental to usable space.

The recoil of the guns produced enormous pressure on the decks and beams but also required more usable space on the deck. In order for the abrupt movement of the cannon backward to be properly contained and the loading operation to be carried out in the shortest possible time, carriages were needed to absorb the recoil and relieve it by means of a complicated set of pulleys and thick ropes that slowed the cannon and quickly returned it to its newly loaded site. This needed a large free space around each cannon in which the gunners could move to handle a varied repertoire of utensils to load and clean the bores. The average time to recharge the piece and return it to its site depended on each situation (the gun, the men, the combat…). The number of cleaning and loading tools was smaller in the case of breech-loading cannon. It was necessary that the gun carriages were adapted to each type of gun and they have to fit in the best possible way to each ship model. Little is known about the shape of the early carriages on board and how they were tied at the end of the fifteenth century and the first half of the sixteenth century, though they should not differ much from land ones. An innovative change in the wheels of the naval carriages was the absence of the metal bands present in most of the land warfare carriages. Such reinforced bands damaged ship decks and for this reason, the embarked carriages did not present this type of reinforcement, as it has been verified in the excavations of the *Lomellina* (*vid infra*) and the *Vasa*.

Ships may have systematically alternated different types of guns depending on their material of construction as a solution to distribute the weight of artillery on decks. The late gothic tapestries of the Parish Museum of Pastrana (Guadalajara, Spain) offer some hint of this alternation. The tapestries consist of two series that narrate the deeds of Alphonse V of Portugal in the campaign in North Africa. The first series narrates the disembarkation, siege, assault of Arzila, and the taking of Tangier occurred between 20 and 29 August 1471 in four large fabrics (11 × 4 mt.) woven around 1475 in Tournai, probably by PaschierGrenier on cartons of the court painter Nuno Gonçalves by order of Alphonse V, who gave them to the Spanish House of Mendoza, whose IV Duke, Rodrigo Díaz de Vivar de Silva Mendoza, donated them to the collegiate church of Pastrana in 1667. The second series, much

less known, narrates the capture of Alcazar Seguer in 1458 in two fabrics sewn around 1490 in a workshop in Brabant.

The second tapestry from Alcazar Seguer—Marching from Portugal, crossing, and arrival to Alcazar Seguer—shows a ship whose stern is armed with five cannons (Fig. 13.4). The number is not relevant, but the fact that they are iron and bronze pieces. There is no doubt because the rest of the guns that were represented in the tapestries also make clear the perfect difference with the embroidery of a different color. These pieces placed in the aft castle, called *guardatimones*, fired against an enemy ship that had the intention to disable the rudder. It is evident that cannon alternation of different materials was already used at the end of the fifteenth century. It is also seen in another illumination of the History of Alexander the Great (*Faits du Grand Alexandre*) made around 1470. Later examples of this alternation—such as the *Mary Rose* shows—are nothing but the survival of previous practices. A lidded gunport is visible in the stern of the ship of the siege of Alcazar Seguer, in the starboard band, although without cannon. Presumably, the port side will carry another similar port. These lidded ports located in the stern are also observed in one of the two carracks represented in the *Tavola Strozzi* (Fig. 13.5). The table shows the triumphal entry of the Aragonese fleet in Naples after the victory in Ischia on 7 July 1465, with the galleys in line and two three-mast carracks at the dock picking up their rigging.

Fig. 13.4 Taking of Alcazar Seguer. Second cloth of the capture of Alcazar Seguer. Pastrana tapestries, ca. 1490. Brabant. Museo Parroquial de Tapices, Nuestra Señora de la Asunción de Pastrana, Guadalajara, Spain (detail). Stern of a ship with alternating bronze and wrought-iron artillery (Photograph by author, 2018)

Fig. 13.5 *Tavola Strozzi*, Francesco Roselli (atributted), ca. 1472, Museo Nazionale di San Martino, Naples. Two great carracks at the dock with lidded ports located in the stern. (Source: Ministerio per i Beni e delle attivita' culturali e del Turismo, Polo Museale)

4 Early Examples of Embarked Artillery

Some of the first uses of gunpowder in Europe were recorded during the Hundred Years War in relation to the war in the English Channel (some others occurred during the Spanish Reconquista against the Muslim Nazaries, though these pages are not the appropriate place for their discussion). According to Froissart, it seems that around 1340 Castilian ships fighting in the Hundred Years War carried "culverins," not the long cannon used 200 years later, but long handguns of small caliber. The first documented payment in England for cannon came in 1345, in relation to the Crécy campaign (López Martín 2011). From there, its use begins to generalize. As we have seen in the preceding pages, guns were developed and expanded during the fourteenth and fifteenth centuries and were not used at sea because of the ship's design and construction. The number, weight, and size of the cannon increased as shipbuilding progressed.

The development of the large-scale onboard artillery occurred in two distant geographical areas. The first was the Mediterranean, where the confrontation between the Christian and Muslim powers provided undoubted advances in tactics and weapons. The Naples wars between France and Spain perfected these advances because the logistics and resources employed far exceeded everything seen previously (the Turks armed large fleets but did not have serious opponents until the frontal clash with Spain and her allies). The achievement of these tremendous efforts was due to a coherent foreign policy based on the use of permanent ambassadors and huge financial resources available for both crowns which had not excessive controls by the different estates or city councils. The second geographical area was the Baltic sea, where a political and mercantile war between the Hanseatic League, the Low Countries, and Denmark was fought. The struggle for commercial supremacy led to the construction of large warships and, as in the case of France and Spain, the Danish Crown sought the means to freely use resources and ships. Both the Mediterranean and the Baltic are closed seas with just one access channel, huge natural resources, and continuous struggles for political and commercial interests

carried out by the different states. The Indian Ocean, where the Portuguese opened a commercial expansion route to India, was undoubtedly important, but the weapons and ships followed the models developed in Europe since, it was, after all, a transfer to that part of the world of the war fought against the Ottoman armies and fleets in the Mediterranean.

The question of when ships were specifically built for war in the Mediterranean is extraordinarily difficult to answer, but in the Baltic, there were more precise geopolitical conditions that help to establish a tighter chronological clamp for the construction of great warships. It is commonly accepted that large ships—especially large warships—were at the forefront of shipbuilding and design. Large vessels should have been the first to move from the clinker technique to the carvel technique. However, before finally leaving the clinker, probably during the first or second decade of the sixteenth century, both construction techniques were used at the same time in the same ships.

Archaeology has provided two conclusive examples of this alternation in ship construction techniques: the *Gribshunden* and the *Mary Rose*. Both were built in the vicinity of the English Channel and both had carvel-built hulls while their castles were clinker-built. Carvel-built hulls are simpler to build, lighter, and require less caulking, making them cheaper and more flexible. However, when ships were growing in size, the weight of a more complex rig with large sails and long decks prepared to receive large bronze cannon, required hulls capable to support great weights and could successfully guarantee battle platforms adapted to broadside gunnery, besides facing high seas and oceanic winds. The carvel-built technique was more appropriate for these purposes. Where these changes occurred for the first time is difficult to say. The second tapestry from Alcazar Seguer, which represents the crossing to Alcazar Seguer in 1458, shows in great detail a large ship from the stern with a large sterpost formed by an articulated plank with hinges that follows the curved profile of the keel (other rudders in the tapestry are completely straight). The whole hull seems to use the clinker technique whereas the stern castle uses the carvel technique. This tapestry was sewn around 1490 so both techniques were in use in the Low Countries area at the time.

5 The Mediterranean and the Naples Wars

In terms of artillery, it is difficult to establish a fixed number and type of guns arming “Iberian” ships, but rather for “Mediterranean” ships. The Mediterranean was undoubtedly a scenery where hull design, complex rigs, tactics, and weapons for Iberian ships were perfected. The kingdom of Naples and the republics of Venice and Genoa played a key role in the development of great battleships driven by rivalry between themselves and by the Turkish threat. The Naples wars served to perfect logistics, although in the Spanish case, mainly for the crown of Castile, the effort made since the first half of the fourteenth century to gain control of the strait of Gibraltar and keep open communications with Perpignan and Sicily—the great

Spanish naval base in the Mediterranean—at the end of the fifteenth century, it served as the basis for the preparation of the Naples wars. Castile had a powerful merchant fleet on the Cantabrian, Andalusian and Mediterranean coasts. In 1481, Castile had sent a 70 ships fleet to confront the Muslim siege of Otranto. Since 1492 Indies fleets needed continuous planning, more efficient administration, and increasing financial resources. At the same time, the important naval experience of the Crown of Aragon in the Mediterranean since the Middle Ages was indispensable for the Naples wars. Notwithstanding, the human, financial, and warfare resources were defrayed by the Crown of Castile. It is not surprising to find in the recent non-Spanish historiography an almost total absence of the key role played by Castile in the Naples wars. However, the evolution of the attitude of Ferdinand the Catholic from the initial protection of the local branch of his Neapolitan dynasty to the definitive conquest of the kingdom was conditioned both by the availability of Castilian resources and by the different phases of the conquest of Granada (Hernando Sánchez 2015).

Spain and France had extensive lands facing both the Mediterranean and the Atlantic that served as communication channel between the naval technologies that existed in the Levant and the Atlantic façades. Other routes through which technological advancement in shipbuilding could be spread are found in the work of experienced soldiers who fought on both shores and on the ships themselves, which linked one port to another. It seems that political circumstances were a decisive factor for local shipbuilding and the mobility of foreign shipwrights (Zwick 2016). All these conditions occurred in the Mediterranean.

The ultimate consequence of the descend of Charles VIII to Naples in the summer of 1494 was the military occupation of the kingdom, which forced the Catholic Kings to give a naval response to uphold the rights of the legitimate Neapolitan king, Ferdinand II, married to the sister of the Catholic King. Thus began the first war for Naples. What Ferdinand the Catholic was really looking for was the incorporation of the Neapolitan kingdom to the kingdom of Aragon and thus neutralize the French threat to the kingdom of Sicily, whose legitimate king was, precisely, the Catholic King. After the end of the Granada war, the conquest of the kingdom of Naples became the main objective of Spanish foreign policy as a mechanism to isolate France. When at the request of the Catholic Kings, the Holy League of 1495 was formed, Charles VIII was forced to return to France and left the Duke of Montpensier as lieutenant of Naples. The partial withdrawal of the French troops left some losses in punctual land fights, such as Fornovo (6 July), or in sporadic corsair attacks at sea, for example, the capture made by Biscayan and Genoese corsairs of the artillery taken by the French troops on 22 February 1494 at Castel Nuovo "the most beautiful in the world, all copper (bronze)," which had been shipped to France and collected in an anonymous illustrated inventory of the Neapolitan artillery, preserved today at the Louvre (Ladero Quesada 2010; López Martín 2011). The difference between the French artillery and that taken in Naples was probably that the first had advanced austere designs that fired more powerful iron projectiles instead of stone. The fame of the French artillery train had spread so quickly throughout Italy that the fortresses rushed to capitulate one after the other without

the French having to fire a single shot. Leonardo da Vinci left a sample of the types of French cannon used by Charles VIII and Louis XII in two drawings made between 1513 and 1515. Several pieces from those series have survived (López Martín 2011).

Spain could not yet fight on equal terms on land with the French army or face Charles VIII's artillery. However, Spain took advantage of the sea. This was the reason for the Catholic Kings to send two fleets in order to prevent the French troops from getting reinforcements. The first fleet, sent in January 1495, was composed of 25 ships—a carrack, seven *naos*, 17 caravels—and a crew of 1873 men under Galcerán de Requesens, Count of Trevento, who had been in command of the fleet in Ischia (the fleet represented in the *Tavola Strozzi*). The second fleet was sent between March and April 1495 and was formed by 25 caravels that transported infantry troops (3450 people) under the command of Gonzalo Fernández de Córdoba, a veteran of the Granada war. Four other Basque ships that sailed in June from La Coruña transported 300 pieces of artillery to the land troops of Fernández de Córdoba and for the Requesens fleet. Once in Naples, 100 pieces were kept for the fortresses defense, while the other 200 were sent to the fleet. Despite the Spanish defeat of Seminara (21 June 1495), Spanish troops entered Naples on 7 July, although Castel Nuovo and Castel dell'Ovo remained in French hands until December. The Duke of Montpensier capitulated on 27 July 1496, thus ending the war and the French presence in Naples.

With the war finished the French corsair actions against the Spanish merchant fleet of Flanders increased. It was the reason for the Catholic Kings to ordered in the autumn of 1495 that the merchant ships be armed with weapons and artillery. However, the official but brittle peace was an uncomfortable situation for Spain, because a month after the French capitulation in Naples, the Catholic Kings were about to send with a great fleet their daughter Princess Joanna (later Queen of Spain and Duchess of Burgundy) to the Low Countries to marry Philip Duke of Burgundy. The fleet had to bring Margaret of Austria—Philip's sister—to Spain to marry Prince John.

To fit the circumstances a large fleet was started to form in August 1495, composed of ships of the Crown and merchant ships adapted for war (Ladero Quesada 2003). This fleet is also an important example of armament embarked. The two largest ships within the fleet were two Genoese carracks hired by don Juan Manuel, the Catholic Kings' ambassador, according to a contract signed on 20 February 1496, having as intermediaries the Genoese factors established in Seville (see Appendix 1). It was planned that the carrack of the Adelantado of Murcia, 760 tons, whose construction was about to end and her rig was going to be installed shortly, would also be within the fleet. Another carrack was built in Ondarroa (Vizcaya). Due to their huge dimensions, carracks were the best ships for transport large shipments, troops, and important retinues. Carracks and great *naos* were preferred by the Catholic Kings and their construction was stimulated with a cash bonus and other advantages to the shipowners, who preferred, however, Basque ships of between 100 and 300 tons and Andalusian caravels of between 60 and 90 tons because they were cheaper to build and maintain, and charter for trade (Ladero Quesada 2010). Armada's supply was made in Andalusia and Galicia. Finally, the

fleet was formed by 22 large ships and 20 medium vessels: the two carracks, five caravels, 15 *naos*, and 20 pinnaces. There were no galleys due to their lower capacity to navigate in oceanic waters (although galleys were used on certain occasions through the sixteenth century in the Atlantic). Pinnaces were used for rescue, warnings, disembarking, and towing operations. Coming into the English Channel the pinnaces had to go in order, with the oars and gunpowder arms prepared, scouting the route ahead. Most of the ships came from Guipuzcoa, Vizcaya, and Cadiz, though the fleet departed from Laredo (Cantabria). The crew was formed by 2260 sailors and 2250 men of war. Finally, the total number of people in the fleet rose up to more than 5200 people.

The contract offers important aspects about the rental of large ships. The Crown paid the pilots' salary, and the captains paid nothing since they sailed until they returned, including mooring in ports or any other tax. The captains could carry out actions of privateering—if there was a chance—obtaining the usual percentage, except against ships belonging to the Doge of Genoa, the Duke of Milan, and "his subjects and friends." Employers could carry any merchandise they wanted as long as their weight did not exceed the weight of the ballast they used to carry—stone, pebble, or sand—and that should not interfere with the useful space of the people and beasts they carried. As witness signed Domingo Centurion, a member of the Genoese family of bankers and merchants who had established branches in Italy, Spain, and the Low Countries. Among the activities of this family was the purchase and sale of second-hand ships. The *Victoria*, the only surviving ship of the Magellan expedition that sailed around the world for the first time under the command of Elcano in 1522, was purchased by Esteban, Domingo's brother, in Seville in February 1523.

The Genoese carracks of the fleet had to be "*alterosas de castyllos,*" which means with high castles to prow and stern, 1000 tons and 130 crewmen each. The carracks' names, *Buzol* and *Lerca*, come from their Genoese ship owners, Gregorio de Buzol and Esteban de Lerca. The former sank in front of the sandbanks of the Flemish coast upon the arrival of the Princess in September 1496. The *Lomelllina* (probably also called *Lerca*) in which the Princess went, sailed afterward to the Naples war. The rent of each carrack cost 750 gold ducats per month and was paid 2 months in advance before setting sail from Genoa and another month before setting sail from Cadiz. They had to sail from Genoa to Cadiz without stops, and in addition to the crew, each carrack had to carry a ship's master (i.e., a captain), a pilot, a guardian, a crossbowman, two caulkers, two barbers (i.e., surgeons), four trumpeters, 15 pages, 20 gunners [*lombarderos*] and 40 cabin boys. Other people were officers and sailors. All but the boys must be over 18 years old. Each carrack had to have "its strong and firm bridge or corridor covered with sturdy boards," both above and on the sides, to attack and defend, as was customary in the carracks of war. They had to be protected by pavises—wooden shields that protected from firearms—, bows and crossbows. Each carrack carried 110 crossbows and 100 bombards, each firing 20-pound stone balls. Among them, there should be three "*que tiren sotacubierta con sus conpuertas levadizas.*" This is undoubtedly an early written reference to lidded gunports placed on the main deck under the bridge and firmly

establishes that lidded gunports were in use before February 1496, since the contract already requires that the carracks must carry three pieces, each, placed in the first deck, emplaced in lidded gunports. The breech chambers of each bombard had to be able to be used in others of its same type and thus caliber. Any different bombard had to have two or three chambers of its own category. Hence, calibers were regulated and this is standardization. Another clause in the contract says that, if the six bombards that had to be placed "*sotacubierta*" could not be bought in Genoa during the whole month of February, they had to be acquired in Spain.

However, gunports are not represented in Melchione Ferraiolo's *Cronicadella Napoli Aragonese*, written sometime after 1498, *terminus ante quem* of the chronicle. It narrates with drawings the 4 years elapsed between Ferrante I of Aragon's death in 1494 and the entry of Federico I in 1498, thus, between the French invasion and the first Naples war, which Ferraiolo witnessed. The buildings, landscapes, and ports were carefully executed in detail, such as the fleets and the ships—*naos*, carracks, galliots, and galleys—, which appear in numerous scenes. A two pages view of the Gulf of Naples shows the Aragonese ships in the open sea ready to confront the French fleet anchored in front of Castel Nuovo (Fig. 13.6). The largest ship, a carrack seen from the stern, bears Aragonese flags and several ships sails around her, including a large galleass with a cannon mounted in the bow as a "*pieza de crujía*" with the arms of Aragon aft, which it seems to be a later addition as the galleass is incomplete and breaks the perspective on Castle Nuovo. In another scene (f.115r) appear four large ships. The two bigger represent a carrack and a *nao*. The distinction between them is very well appreciated. The carrack is longer and stylized with high castles, especially the forecastle, which presents a great development, and a large sail on the mainmast. The *nao* is more robust and compact and carries a large square sail in the main mast and a Latin sail in the mizzen. It is not the only drawing within the chronicle that both types of boats are represented. A proof that the scenes depicted are trustworthy is a drawing of the French artillery taken to Naples (f.122r) in which there is a wrought-iron bombard next to a large two-orders faceted bronze cannon with plain cascabel, a convex cone, which is piercing to receive a handling ring. The cannon is firing an iron ball. Two guns dated 1488 made for the city of Neuchâtel (Switzerland) along with a life-size drawing, show the same shape. These features confirm the date of the chronicle to the end of the fifteenth century (López Martín 2011).

The odd number of bombardsin the carracks of Princess Joanna, three, is remarkable, except in the case that they could move from one side to another. It is possible that the placement of the three pieces on the main deck was similar to what is seen in a miniature of Jean Colombe's *Faits des Romains*, ca. 1485 where a large warship has two guns located in round gunports without lidded doors. Above there are four unlidded ports cut into clinker planking possibly to place cannon. The same gunports without lidded doors appear in a copy of Olivier de La Marche's *Le chevalier délibéré*, ca. 1500–1516, in which another ship carries six wrought-iron guns over the gunwale and two other looming through almost identical gunports located in the main deck. The reference to Princess Joanna's carracks fits much better to a drawing of a three-volume manuscript copy, 1510, of Enguerrand de Monstrelet's *chronicle*

Fig. 13.6 Melchione Ferraiolo's *Cronica della Napoli Aragonese*, ca. 1498, fol. 116v-117r. A two pages view of the Gulf of Naples shows the Aragonese ships in the open sea ready to confront the French fleet—"*Larmata francesa*"—anchored in front of Castel Nuovo. The largest ship, a carrack seen from the stern, bears Aragonese flags. (Source: The Morgan Library & Museum, New York, Ms. M.801)

which narrates deeds of the Hundred Years' War. The text refers to events that occurred in 1403 between the English and Breton naval forces. However, what really shows is the Franco-Breton fleet (united since the wedding of Charles VIII with Anne of Brittany in 1491) confronting the English, depicting late fifteenth and early sixteenth century ships and artillery (narrating events from the past with scenes from the present is something recurrent to miniaturists). The ships already have a great quantity of artillery located in the castles and the great French ship protagonist of the drawing—possibly another carrack—also has another cannon at the middle of the bridge, leaning over the gunwale and mounted on a two-wheeled carriage. The stern castle has four lidded gunports closed. Another piece appears at the port side on the hull from a lidded gunport (Fig. 13.7). All the pieces seem to be made of bronze because, like the Pastrana tapestries and many other artistic representations, the illuminator painted different materials with different colors. The large piece that appears through the bow gunport has concentric reinforcement rings, but it is not possible to think that it pretends to be a wrought-iron bombard. Bronze pieces also used concentric rings imitating those of large wrought-iron guns in which the rings were functional. The aforementioned Johan Herze's cannon (*vid supra*), have concentric rings on their chases. The fact that the barrel in the drawing has a great length does not have to be an error of the artist (Guérout 2017), since in

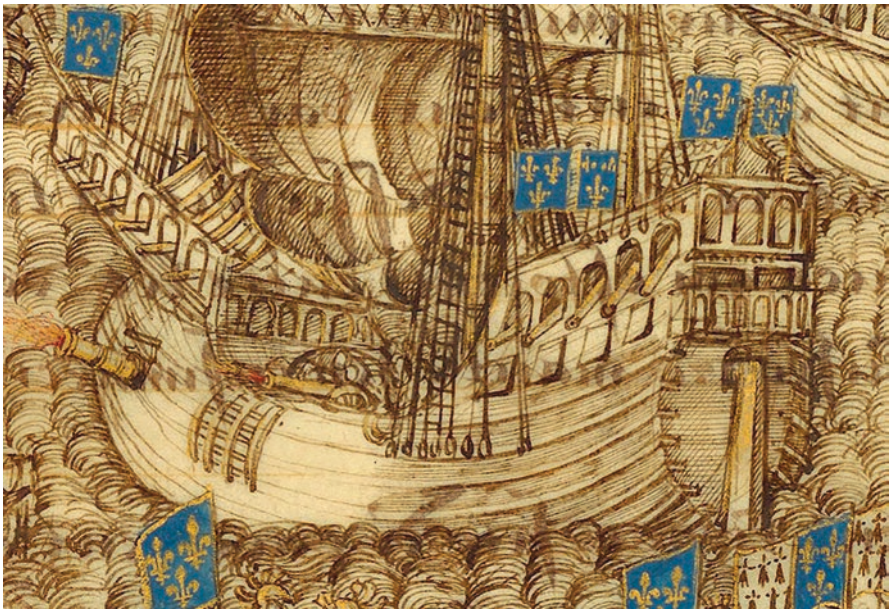

Fig. 13.7 *Chronique d'Enguerrand de Monstrelet, continuée par Mathieu d'Escouchy. Livre I: Années 1380–1432*. BnF, Ms. Français 20,360, 1510, fol. 35r (detail): "Comment Ladmiral de Bretaigne et autres seigneure combatirent les angloys sur la mer et de gilbert de frethun qui fait guerre au roy henry dangleterre." A great battle between the English and Breton naval forces. The carrack is heavily armed with at least 13 guns on the port side, while the stern castle has four lidded gunports closed. The bigger gun sticks out from a lidded gunport and the other is mounted on a wheeled carriage. (Source: gallica.bnf.fr/BnF)

1510, the date of the manuscript, the ship could occasionally assemble a piece of great length or great weight. Two serpentine siege cannons of 350 cm in length dated in 1514 and 1530 were recovered from the wreck of the *Kronan*, sunk in 1676 (López Martín 2011). Each carrack in Princess Joanna's fleet of 1496 also had: 15 arquebuses; 14 quintals of gunpowder (644 kg); 110 crossbows with 40 shots for each one (4400 projectiles, normally lead "*bodoques*"); 120 breastplates and 120 head protections ("*celadas*" or "*capacetes*"); 50 "*tablachinas*" (light shields); 5 quintals of tar (230 kg for caulking); 2000 thorns (stellate iron points to throw to the enemy); 150 spears; and 300 partisans.

The artillery of the fleet, which was made specifically for the ships, consisted of: 6 heavy bombards firing 50 pound stone balls with their chambers, carriages, irons, ropes and nails; 14 bombards of 25 pounds stone balls with three breeches each (42 breeches); 30 bombards of 12 pounds stone balls; 25 bombards of 6 pounds stone balls; 178 bombards of 1 pound stone; 182 "*pasavolantes*" that fire 2 pound iron and 3 pound lead balls, with 3 breeches each (546 chambers) with their carriages; 400 "*espingardas*"; 70 "*sacabuches*"; 10,500 2 pound iron projectiles; 23,446 half pound iron dices (used since the fourteenth century to make the harder projectiles or as shrapnel); 1100 3 pound lead pellets; 1500 lead balls for the "*sacabuches*";

20,000 balls for "*espingardas*"; 75 "*calçadores*" for the "*espingardas*"; 2000 stones for artillery; 2000 blocks for the bombards (to enter the bore before the shot and therefore it is the same amount as the stone projectiles); 230 quintals of gunpowder (10,580 kg), both "thin and for bombards"; and 50 quintals of lead (2300 kg). As bladed arms, they carried: 500 crossbows with 483 pulleys to tighten; 1874 "*carcaxadas*" (carjacs, cases for the crossbows); 220 pairs of cuirasses; 200 helmets ("*capacetes*"); 1000 spears for the cavalry; 3380 hand lances; 916 dozens of hand darts (10,992 darts); 2500 paveses, of which 1300 were large "*de barrera*"—for protection against other ships—and 1200 small ones as personal planks ("*tablachinas*").

This list gives an accurate idea of the weapons carried on board, weapons that were not a technological novelty since they were in use for a long time and are basically the same as those that appear, for example, in the work of Richard Beauchamp, Earl of Warwick. The artillery was forged in the ironworks of Guipuzcoa and Vizcaya and the pieces were tested before being shipped. Gunpowder and lead came from Andalusia, possibly from the arsenal that the Catholic Kings had established in Écija at the end of the Granada War. Nevertheless, the production did not arrive on time to cover the total number of pieces of greater caliber. For this reason, it was ordered to embark all the artillery that had returned from Naples within the fleets of the 1495 campaigns.

To sum up, these figures can be given for the artillery of the Princess fleet: 435 cannon plus the 200 guns from the two carracks make a total of 635 cannon (without "*sacabuches*" and "*espingardas*"). It is possible that the sacabuches were for the 20 pinnaces. With them, the total of pieces rises to 705. With respect to the "*pasavolantes,*" a memorial of 12 August 1497 of the armament of another carrack of the Crown commanded by Juan de Lezcano (also a veteran from the Granada war), quotes 12 "*pasavolantes*" for the prow castle (Ladero Quesada 2010), which offers its location within the carrack. To this firepower, we must add the 400 *espingardas*. It was certainly considerable firepower, although it must be taken into account that it was an escort fleet for the protection of a member of the royal family and not a war fleet.

When the Count of Trevento returned from Sicily in March 1497, Juan de Lezcano was ordered to take command of the royal carrack for trade crossings while the truce with France lasted. The carrack was at the anchor in the port of Cartagena where Lezcano had to hire the crew and embark for Perpignan artillery and 100 quintals of gunpowder. At the same time, two other Genoese carracks were hired. One was the *Fornuela*, 800 tons, which was at Cadiz, to carry 3000 quintals of "*bizcocho*" cake to the fleet in Naples and for which a crew of 250 men was hired. The other was the *Lomellina*, which was at Cartagena together with the royal carrack, and for which a crew of 300 men (crew plus men of war), a captain, and Francisco—or Franco—Lomelin as master, were hired. Two Genoese merchants, Pantaleon Ytalian and Martin Centurion, advanced the money to pay for the *Lomellina*.[1] In September they received payment for having also advanced 3500 ducats to pay

[1] Archivo General de Simancas, Libro 22, Cédulas Cámara de Castilla, f.324.

Fernandez de Córdoba's troops in Naples. The operation had been authorized by Batista Lomelin's bank thanks to a loan from the aforementioned merchant's Centurion and Ytalian. The transactions between these families and the Spanish Crown continue until well advanced the seventeenth century, showing that the links with Genoese banking were strong. When the hiring of the *Fornuela* and the *Lomellina* was closed, the negotiation for renting two other carracks that the ambassador Juan Manuel made in Genoa was suspended. One of these carracks was expected in Valencia, while the other was Rafael Negron's *Negrona*, anchored in Malaga and although "*es navío pesado*—said the Kings—*avemos savido que es elmejor que ay en los mares y muy alteroso*" (Ladero Quesada 2010). Along with these three carracks (the royal carrack, the *Fornuela,* and the *Lomellina*) other ships were hired: two *naos* (one 1000 tons, 100 sailors, 150 men of arms, newly built in Palamós, Gerona); three *naos* from Biscay (300 ton with 180 men each); a caravel (120 tons and 80 men), and two brigantines for mailings and a "balliner." A total of 3500 men embarked on these 12 ships, whose main purpose was to protect merchant traffic from corsair activities, especially French. The renting was for 2 months since they set sail, and Vicente Yáñez Pinzón (the captain of Columbus' *Niña*) was sent to spy on the navy that the Genoese had in the port of Toulon. The plan was that after 2 months the fleet would return to Malaga to victualling and receive new instructions. However, the fleet was sailing until the beginning of December, except the carrack, which in February 1498 was decided she had to go to Pasajes (San Sebastian's main port) to careen, stopping before in Malaga or Jerez for loading wheat for Guipuzcoa (Ladero Quesada 2010).

In Pasajes, a report was requested to know how much it would cost to careen the carrack or if it was preferable to make a new carrack of 1200 tons. The report was signed by several Crown officials, the two pilots of the carrack (Juan Martínez de Lequeitio and Joanot de Iquirizasu); the captain (García López de Arriarán, another veteran of the Granada war), and differently experienced shipwrighters, among them the shipwright of the carrack (García de Arriola) while other were *nao* masters and caulking masters. By the surnames, they were all Basques. The report was signed on board the royal carrack on 11 December 1498. To careen it was first necessary to disassemble the bow and stern castles and reassemble them once the hull was finished. The term to make a new carrack was 10 months and little wood from the original carrack could be used because it was very worn and damaged, as it had been built in 1487—the year in which the English ship *Regent* was built—, and had "sunk" twice in Naples. This reference to her sinking probably means the opening of waterways and not a complete collapse of the ship. It is also reported that a new carrack would last in the Mediterranean four years, without careening, and seven in the "seas of Spain"—the Atlantic—(probably in relation to the sea temperature), and could still withstand another three or four careen during its useful life. The careen would cost 2,539,600 maravedíes, instead of 3,833,900 maravedíes which would cost a new carrack.[2] Thus, carracks were very expensive ships, both their new construction and their maintenance.

[2] AGS, Escribanía Mayor de Rentas, leg.65.

Despite the truce with France and the safe arrival of Princess Joanna to Flanders, the problem of Naples was not over. Between 1499 and 1500 Louis XII, the new French king after the sudden death of his cousin Charles VIII made effective his military control over Milan and Genoa. The Treaty of Chambord-Granada established the partition of Naples between Louis XII and the Catholic Kings, and the war that Venice held against the Turks offered the perfect excuse for the Catholic Kings to have an operative naval force in the Mediterranean to contain the Muslim expansion in North Africa, avoiding attacks on Sicily and Naples. Thus, both the French presence in Milan and the Spanish presence in Naples could be seen as a guarantee of the freedom of Italy against the Turks. In that sense, the idea of a crusade was good enough for both France and Spain. Venice's main objective was to expel the Turkish threat from its trade routes, so it allied with France and Spain pursuing the same end. Even when a crusade was convenient for Christian powers, the collateral objectives were also important or in some cases, paramount. In this scenario, the Franco-Venetian fleet tried the assault on the strategic island of Kefalonia, occupied by the Turks, but the expedition proved a failure. The Venetian fleet sought refuge in Corfu and the French convoy, consisting of seven *naos* and some carracks, returned to Marseille. One of these carracks was the *Charente*. On 5 June 1500, a Spanish fleet sailed under the command of Gonzalo Fernández de Córdoba. It consisted of 55 ships: 26 *naos*, 19 caravels, four "*tafurcas,*" three galleys, and three large carracks: the *Forne* with 115 crewmen, the *Lerca* or *Lomellina* (1000 *toneles*, Princess Joanna's flag-carrack in 1496) with 120 crewmen, and the *Camila*, Fernández de Córdoba's flagship, with 120 crewmen. They embarked almost 8000 people (4182 crewmen) and 326 cannons: 63 made of bronze had been cast in Baza and Malaga and 263 wrought-iron guns were made in Vizcaya and Guipuzcoa. These cannons were added to those already on board the ships and to which had been transferred from Princess Juana's fleet upon their return to Spain.

The armament sent to the ships was different in each case, probably due to the mission that was expected for them, which shows great planning when it comes to assembling the fleet. Only 41 ships out of 55 received weapons and only 32 ships received cannon: the three carracks, 14 caravels, and 15 *naos*. From this, it can be inferred that they already had cannon on board. The number of pieces was also different in each case, regardless of the tonnage. For example, a 275-ton *nao* received 24 pieces of artillery, while another *nao* of 205 tons received only seven. 18 ships (nine ships and nine caravels) received 248 pieces of artillery, a little more than half of the total, either because they had a specific mission, or because they were commanded by high-rank soldiers. A *nao* was used as a powder keg, transporting 235 quintals of gunpowder (10,810 kg). This armament was separate from the one carried by the land troops.

The carracks *Lerca* (or *Lomellina*) and *Forne* only received a pair of bronze cannon each made in Malaga, which means that they were already armed. The *Lerca* (or *Lomellina*) already had 100 bombards (*vid supra*), while flagship *Camila* received: two bronze cannon from Malaga; two "*sanmigueles*" (possibly bronze pieces); five "*ribadoquinesmusquetes*" (bronze, made in Malaga); a "*prínçipe*" (bronze?); a large "*pasavolante*" (made in Villena, Valencia, probably a piece of wrought-iron);

180 paveses; 128 "*tablachinas*"; 138 crossbows; 34 iron harquebuses; 128 iron "*espingardas*"; 9410 iron dices; 1680 "*caxos*" of warehouse with 20 shots each (33,600 shots); 78 gunner's linstocks; 52 dozens of "*gorguces*" (624 short spears); 327 hand spears (for infantry); 176 heavy spears (for cavalry); 373 iron balls; seven quintals of balls for "*espingardas*" (322 kg); 99 lead balls (for the "*prinçipe*"); 600 lead balls for the "*ribadoquines musquetes*" (120 for each one); 60 lead balls for the "*sanmigueles*" (30 for each); and 22 quintals and two *arrobas* of gunpowder (1013 kg). Within the fleet also were carpenters, ax masters, blacksmiths, and gunfounders along with gunners, depending on the campaigns that were carried out. A large number of breastplates, harnesses, armor, cuirass, and mail jackets were purchased in Genoa, Milan, Rome, and Palermo. Others were taken from Spain (Ladero Quesada 2010).

The fleet sailed from Malaga and made stops in Ibiza, Messina, Corfu, Lepanto, and finally Zante (or Zakynthos). At the end of October, the Spanish fleet met in Zante with the Venetian fleet (now Spaniards' ally) under the command of Benedetto Pesaro, composed of 66 ships, mostly galleys, and galleass. The interests of Venice clashed with those of Spain, mainly with those of the crown of Aragon, but the alliance prevented attacks on Italian territories such as the one suffered in Otranto in 1480 (Hernando Sánchez 2015).

It seems that a carrack hired at the service of France and also called *Lomellina*, under the command of Viscount Ruan, René Prent, arrived in Zante with 600 reinforcement men, but she was paid only for 3 months and just remained 20 days to finish the rent, so she retired a few days later. The current state of the research does not allow to know if she is the same ship or a different one with the same name (the three carracks chartered by Spain were paid until 3 July). Future research should determine this fact. It seems that there were some ships with the same name, *Lomellina*. However, it is not possible that many ships from the Lomellin family have the same name during the same years. In 1499 a *Lomellina* and the *Bozella* were in the first assault on Kefalonia transporting reinforcements to the service of France.[3] It is quite possible that this *Lomellina* at the service of France was the same one that was in Cartagena in 1497, which was hired by Spain, and once the Spanish rental was completed, France hired the carrack. The *Camila*, for example, was dismissed by Spain in October 1501 (Ladero Quesada 2010) and it is unknown if she was rented. Little is known about the charter of large ships in the early sixteenth century. The other French carrack that also went to Zante, the *Bozella* or *Buzoque*, was damaged or lost along the way (Ladero Quesada 2010).

The Spanish-Venetian fleet, with about 10,000 men of war, assaulted the island of Kefalonia, which surrendered on 24 December 1500. Gonzalo Fernández de Córdoba gave it to Venice before returning with its fleet to his base in Syracuse (López de Gómara 2000). On 12 February 1501, the French king appointed the Flemish Philippe de Clèves, Lord of Ravestein, captain-general of the French navy of the Levant, and gave him full powers to go on the crusade to reconquer the

[3] Groupe de Recherche en Archéologie Navale http://www.archeonavale.org/lomellina/an/l_8a.html

territories taken by the Turks in Lepanto, Modon, and other Aegean islands. Clèves set out to command a "good, large and powerful army by sea" formed by ships from Normandy, Brittany, and Provence (Contamine 1980). Among those ships was again a *Lomellina*, Clèves' flagship, probably the same one that had anchored in Zante the previous year with the Viscount of Rouen. Clèves was accompanied by noblemen of the great Genoese families as well as other soldiers and knights, for example, John Stuart, Duke of Albany and nephew of the King of Scotland, and Jacques Galliot de Genouillac, seneschal of Armagnac and future captain-general of the artillery of Francis I. There were also two other carracks, the *Charente* and the *Cordelière*.

The *Charente* transported 1200 men (between crewmen and troops) and 200 firearms (between artillery and portable weapons), of which 14 were guns mounted in wheeled carriages and fired cast-iron projectiles (Fernández Duro 1893; Guérout 2012). La *Cordelière*, 600 ton, was a Breton carrack built in 1498 by order of Queen Anne of Brittany. She had about 40 mt. in length and 12 mt. in width. Among other weapons, she carried 16 large-caliber bronze cannons mounted on carriages and 14 bombards. An octagonal bronze falcon (MuseuMilitar, Lisbon, inv.S-1), probably cast at the end of the fifteenth century, has been preserved. At the half of its chase carries the arms of Anne of Brittany surrounded by the lace (*cordelière*) and above the vent-field a fleur-de-Lys. The ear was nailed and opened again. On the upper right side, has the weight chiseled in Roman numerals: *XIIII* quintals and *XXXV* pounds (ca. 660 kg). The cascabel ends in a rectangular appendix to facilitate its attachment to a carriage. Faceted cannon with a similar appendix has also been preserved. It is difficult to think that the Queen herself was free to order the casting of artillery if it were not for the Breton ships, and so with the consent of her husband, either Charles VIII or Louis XII, around 1498.

In June 1501 Clèves' fleet arrived in Genoa to join eight ships of the Republic: four ships, and four galleys (López de Gómara 2000). In July the French had already occupied their part of Naples under the Treaty of Chambord-Granada and the crusade against the Muslims was an excuse to maintain forces in the Mediterranean in case of any eventuality. In August Clèves arrived in Naples to support the land army of Robert Stewart, Lord of D'Aubigny, with four carracks, 10 galleys, 16 great ships, and 5000 men. Finally, in September a young and inexperienced Louis de Armagnac, Duke of Nemours, took over the supreme command of Naples as Viceroy of Louis XII. Lacking Cléves of a defined objective, the Genoese proposed to attack the island of Mytilene (Lesbos), where they met with the Venetians and with the fleet of the Knights of Saint John of Jerusalem. The Turks opposed great resistance and the assault was a failure. The fleet initiated the return but it was dispersed by bad weather and the *Lomellina* looked for refuge in the Greek island of Cythere. A storm pushed her towards the coast and on 25 November she sank with more than 500 men on board. However, the sixteenth-century Spanish historian de Gómara (2000) quotes the *Lomellina* as the *Messina*, referring probably to the same ship. Again, fresh research is needed to clarify these dark spots. Only a few survivors escaped from the wreck, among them Clèves, who was helped by Fernández de Córdoba to return to Genoa with the *Cordelière* and the *Charente*.

Fernández de Córdoba—already known as the Great Captain—had also begun in 1501 the occupation of the part of the kingdom of Naples in accordance with the clauses of the Treaty of Chambord-Granada. However, as some territories had not been well defined in the treaty, the peaceful understanding between France and Spain began to dissolve and by July both crowns were on the verge of breaking. The Catholic Monarchs doubled the military command in the Mediterranean, giving the Grand Captain the supreme command, but respecting Bernal de Vilamarí in the navy, which was under Lezcano's command. The official breaking of peace between Spain and France was declared on 13 September, when Clèves initiated the assault on Mytelene. After the rupture of the truce, Spanish possessions in Naples and Roussillon were threatened by France, while a war of blockades and defense of positions began in Italy, awaiting reinforcements from both sides.

After several decisive campaigns, the victories of the Great Captain allowed him to enter triumphantly in Naples on 16 May 1503. After the fall of Castel Nuovo by the Spanish army on 18 June, the Great Captain sailed from Naples to take Gaeta and finish the war. The Great Captain besieged the city on 1 July. However, the French still had a strong army there, with seven carracks, among them the *Charente* and the *Negrona*, four galleons, more than 20 galleys "and many other hulls." Great Captain's chronicle refers to the huge size of the *Charente* and the *Negrona* "*las mayores que en el agua se habían visto hasta aquella sazón*" (López de Gómara 2000). The *Negrona* was the same carrack that was at anchor in Malaga in 1497, which Spain did not hire because the *Fornuela* and the *Lomellina*were rented instead. It is evident that when Spain did not hire her the carrack was offered to France, or that France required a carrack to rent. The same can be said of the *Lomellina*. New research in ship rental and sale market at the beginning of the sixteenth century is needed.

The *Charente* went every day to attack the Spanish positions, firing a rain of balls when it went forward and repeated the discharges when returning from the stern. The chronicle of the Great Captain does not mention shots from her sides. It is true that the use of broadside gunnery was not yet necessary against a land target, being able to shoot only from the bow and stern, avoiding offering their flanks to enemy fire (Rodger 1996). However, the daily bombardment from a vessel to land positions indicates a certain degree of development in naval combat. To stop these naval skirmishes the Great Captain sent Ramón de Cardona (later viceroy of Naples), Bernal de Vilamarí, and Juan de Lezcano to fight against the carrack with 16 galleys from which they began to shoot the *Charente* from all sides but the carrack started to defend. The chronicle states that "she walked [*i.d.* sailed] among them [the galleys] like a great serpent among greyhounds." The galleys began to settle around the *Charente* and sailed so close to her "that wherever she wagged she wore them [the galleys] hanging from herself" approaching the carrack from everywhere as if the galleys were hunting dogs. Only a lucky windblown managed to disrupt her from the galleys. The attack was not easy since some galleys were lost and others were damaged, but it was worth the effort because the *Charente* never returned to visit the Spanish positions for fear of being captured. This passage shows how to harass and approach large carracks from the galleys.

Gaeta fell on 1 January 1504 together with the French presence in Naples, which for the second time escaping from France. The French capitulated to Fernández de Córdoba who captured all his army, including the *Negrona* and the *Charente*. However, he let the French take all their ships back as a merciful act. The high-ranking officers of the Catholic Kings and the members of the Council of War harshly criticized his decision and begged him not to return the galleys and keep some carracks, possibly those cited, but the Great Captain said that having achieved victory, they had to have mercy on the vanquished (Rodríguez Villa 1908). The *Charente* was lost for unknown reasons after careening in Villefranche in 1504. The *Cordelière* sank on 10 August 1512 fighting against the English *Regent* off the port of Brest. It is another example of the mobility of ships that fought in different scenarios.

The annexation of the Duchy of Brittany to France in 1491, Joanna's departure to Flanders in 1496, and the war in Naples, which ended in 1504, made it clear that a conflict in one part of Europe directly affected the other in political, military, economic and strategic terms. Likewise, that shipbuilding and warfare were not limited to specific and isolated areas, but that they crossed borders spreading knowledge. In the Naples war, large navies were used for operations that lasted for months or even years. A minimum of 150 ships sailing under the banners of the Catholic Kings between 1500 and 1504. In addition to the specific attacks against precise targets, the fleets transported troops, cavalry, and artillery, supported land armies, supplied garrisons, carried out surveillance tasks, and kept food supply corridors open, especially between the coast of Levant and Sicily and Roussillon. France did the same between the Gulf of Lion, the Ligurian sea, and Naples. Ship types—huge carracks (frequently rented to Genoa), galleys, galleass, caravels, fustas, or pinnaces—were conditioned by the type of operation that was going to be carried out.

There is no doubt that these confrontations changed naval combat techniques as well as cannon firing from ships, even when shipboard artillery was not in use. However, it opened the way to specific treaties on war, such as Philippe de Clèves'. He returned to the Low Countries probably in 1506 and wrote a treatise about warfare techniques he had learned (Paviot 1997). *Instruction de toutes manières de guerroyer tant par terre que par mer* was printed in Paris in 1558, but it was probably written around 1506 and amended between 1515 and 1516, hence, when Clèves served the Dukes of Burgundy and Kings of Spain, either Philip I the Fair or his son Charles. He dedicates a section to naval warfare offering details on the cannon placement onboard ships and fully recognizes that the sea war was changing, giving the artillery a fundamental role, as would Machiavelli shortly afterward. According to him, two cannons and a large culverin mounted on a wheeled carriage had to be placed in the middle of the bridge, in the space between the forecastle and the mainmast. Two other large culverins were to be mounted on each side of the mast, near the winch, which had to be fired forward, since "*pour leur grande longueur ne scaurioni tourner pour tirer de costé.*" If this is literally accepted, it can be inferred that the ship had no beam enough to allow the recoil of two guns placed in the same location on each side. However, Enguerrand de Monstrelet's chronicle (Fig. 13.7) shows a cannon firing from the side-mounted on a wheeled gun carriage. On the

same bridge—Clèves says—there should also be two large cannon on either side of the rudder, to fire back such as chase pieces or "*guardatimones.*" On the main deck smaller artillery was to fire forward, backward, and—again—towards the sides: "*tirant sur le devant et sur le derriere et les costés scellon que vostre navire sera.*" From this statement, it is not possible to know if the guns would be arranged in lidded gunports but, being placed on the main deck, it is clear that they had to have a type of opening and it is possible that Clèves refers to lidded gunports. On the top of the aft castle, "where people are to fight" could be placed falcons on wheels to shoot where necessary, and on the forecastle could be other five or six falcons or light pieces such as harquebuses and hand culverins. Finally, on the tops, another three or four harquebuses with more handguns could be placed. Other reserve weapons should be kept to help where necessary, as well as pikes, halberds, assault axes, bows, crossbows, bolts, darts, javelins, as well as tools for repair and the work of blacksmiths and carpenters. Clèves states that his text is written from experience when he states: "*Et en ay veu aulcunes* (ships) *que pour se mye[ulx] deffen dre avoyent ung pontdespuis le chasteau derriere jusques le chasteau devant, tout couvert comme lesditz chasteaulx pour pouvoyr secourir l'ung l'aultre*," although, he adds, that it is only done in "*grosses nefz ou carracques.*"

The first thing to do if the combat was between two fleets was the sending of two lightships to explore the sea ahead, just like Princess Joanna's pinnaces arriving at the English Channel. At the beginning of the battle, the ships had to regroup and use the artillery when the enemy was within range because it caused great damage. This did not imply the use of artillery on board, but just precise shots to sink the enemy. The experience had taught Clèves that sea-fights were won more in this way than with collision and boarding. Each man had to occupy his combat place on the ship and worry about closing the waterways caused by the artillery or the ramming of enemy ships and being careful to have the wind behind and try to prevent the enemy from cutting the cables that had been thrown to the enemy ship to board it. The experience of Clèves in the Mediterranean becomes clear again when he recommends a mixed fleet formed by galleys and ships since with good weather and calm sea the galleys could shoot to the enemy ships with their pieces close to the waterline, "*à fleur d'eau,*" he says. Galleys were also useful for removing damaged ships from the combat scene (Paviot 1997).

A great ship sank on 15 September 1516 in the bay of Villefranche-sur-mer (France) in a heavy storm. The wreck has been identified with a high probability, though without much historical basis, with a ship also called *Lomellina* (Guérout et al. 1989; Guérout 2017). It was discovered in 1979 and excavated in 1982. Thanks to archaeology, we know more about this ship, which is thought to have been a commercial transport of war material for the Italian campaigns. In the course of the excavations 15 artillery elements have been recovered, e.g., cannon, chambers, carriages, carriage wheels, ammunition, loading tools, 12 molds for ammunition and, 21 barrels of gunpowder (Cazenave de la Roche 2004). Some of the wheels are covered with an iron band which indicates they were made for land campaigns, while others are plain, typical for naval use. The ammunition is made of stone, cast-iron, lead or lead with iron dice inside it. Bullets and shrapnel made to destroy the

rigging were also recovered. The artillery pieces found are all wrought-iron breech-loading guns. Some were recovered and others left in situ. However, it is known that the ship was also armed with bronze cannon. Some were recovered by plunderers from Nice after the sinking and others were saved by the Genoese authorities in accordance with the directives sent by the City Council, which considered their recovery as a priority. In 1531 the captain of the castle of Nice rescued another 16 pieces: a bronze cannon that weighed 12 quintals, an iron bombard ["*trompe*"] with a length of ca. 323 cm., a great swivel-gun with iron bullets, six other swivel-guns, and seven big and small iron bombards. Finally, there were about 31 pieces retrieved. Officially the armament of the Genoese ships prior to 1498 consisted of wrought-iron bombards only, but in that year the armament was ordered to be reinforced with bronze pieces (Guérout 2017), presumably following in a similar way to French and Spanish ships. With high probability, the pieces recovered after the shipwreck and in 1531 were those bronze cannons. It is difficult to understand the clause within the contract of Princess Joanna's carracks on the six guns that were to be placed "*sotacubierta*" and that had to be acquired in Genoa, if they were made of wrought-iron since at that time there was that type of cannon available in Italy. However, it makes sense if the weapons were made of bronze, although there is nothing in the clause that clarifies it.

One of the most relevant aspects of the excavation of the *Lomellina* of Villefranche-sur-mer was the finding of two gunports. One was recovered and the other left underwater. The fact of having lidded gunports for artillery identifies the ship as a warship rather than a mere merchant, although it could also be a merchant adapted for war since it is difficult to think that a merchant ship has been provided with lidded gunports. Antonio de Beatis' diary of the trip made by cardinal Luigi of Aragon (from the Neapolitan branch of the Royal house of Aragon) between 1517 and 1518 on his way to meet Charles of Habsburg, refers to a shipwreck in Villefranche-sur-mer in the course of a great storm. Describing the port, Beatis says that "two years ago" a large Genoese ship sank with a large amount of artillery and a crew of about 300 men, who all died. Beatis was even able to see the top of the mainmast sticking out of the water. "The event—says Beatis—was considered by everyone to be a miracle, for the master and crew had long been evil-living pirates" (De Beatis 1979). Again it is difficult to understand that a mere transport had been chartered to a group of mercenaries.

Further news comes from the Milanese humanist Pietro Martired'Anghiera, counselor of the Catholic Kings, who left a superb collection of letters resulting from the relationship he had with different people since his arrival in Spain in 1488. Among these letters are two written on 15 July 1516 and 21 March 1517 from Madrid (Anglería 1957). These letters inform about a crucial incident that helps to determine the identity of the sunken ship in Villefranche-sur-mer on 15 September 1516: in July 1516 three Genoese carracks were at the port of Cartagena (Spain) loading Spanish wool for export. There were three other warships in search of a pirate, a Spaniard, who with a galleon had caused great damage to the Genoese merchants. The pirate was finally captured, but not by the Genoese, but by the Spanish royal fleet commanded by the Catalan Berenguer. Immediately, the Genoese

claimed their punishment. Berenguer refused to do so, claiming that Spain would judge him. However, the Genoese demanded it in accordance with the agreement signed with the Spanish Crown. Due to his tenacious and aggressive insistence, Berenguer ordered him to shoot to the Genoese carracks which, indignant by the attack, immediately threw to the water three boats armed with two guns each one that attacked Berenguer's fleet, leaving one galley struck and sinking the other. In reprisal, Berenguer ordered shoot the carracks from the coast and these responded with the discharge of "huge iron projectiles" on Cartagena, managing to tear down the tallest buildings in the city and causing a great commotion among the inhabitants, who saw projectiles of iron and stonefly over their houses. Such terror could not be expected even from the Turks—said Anghiera—who blamed the incident on Berenguer, who deserved no praise for having carried out an undeclared act of war. Immediately after the accident, Berenguer proclaimed an edict condemning to death all Genoese officers in command of the carracks that fired into the city. However, "the fortune was the one in charge of executing the sentence," since shortly after the "armed carracks that carried out the crime were anchored in the port of Villafranca Nicense-" (Villefranche-sur-mer), where unexpectedly a storm which "after shaking them and striking them violently, breaking the anchor moorings and snatching them in a whirlwind, sank them with about three hundred men, both sailors, and soldiers. Not one escaped." When this was known, the Spaniards assured that they would have preferred to impose the punishment "with their own hands better than with those of the Fortune."

Therefore, the ship sunk on 15 September 1516 in Villefranche-sur-mer is one that carried out the bombing of Cartagena before 15 July of that year, the date on which Anghiera sent the letter to his colleague and compatriot Luigi Marliani. The fact that two gunports were recovered from the wreck of the *Lomellina* confirms that she was a warship rather than a simple merchant, although, as demonstrated in this work, the great carracks also carried out transport crossings. The bombing of Cartagena, a port where the Genoese ships anchored assiduously, allows one to correctly interpret Antonio de Beatis' words when he calls the crew of the carrack "evil-living pirates." It can be concluded that the carracks that were in the port of Cartagena and sailed after the bombing of the city, to Villefranche-sur-mer could be the *Fornuela* and the *Lomellina*. In addition, as we have seen, the Genovese carracks used to carry the same crew and men of war. Specifically, the *Fornuela* carried 250 men and the *Lomellina* 300 men. This aims to serve as notes until waiting for more thorough research. The discovery of a gunport placed in situ on the first deck has allowed pointing, according to the characteristics of one of the recovered wrought-iron guns (CN10), to the firing conditions. The frame found in the excavation does not allow the barrel of the gun to protrude enough for the muzzle to go out at the time of the shooting, because the frame reaches the very end of the barrel. This leads to thinking about collateral problems at the time of the shot, especially with the dense cloud of smoke that would enter the ship and the danger of fire if sparks entered. However, it is quite possible that the bronze cannon recovered immediately after the sinking was actually those placed in the gunports instead of the wrought-iron guns found in the archaeological excavations.

From an artillery strict point of view, there was no difference between Mediterranean and Atlantic ships. These increased in size, the rigging was transformed with large sails, decks were widened to accommodate bronze artillery, hulls became robust to support all that heavyweight and ensure successful ocean navigation. For this, the use of the carvel technique became more appropriate. Artillery, however, remained the same for both areas.

6 Fleet Systems, Artillery Ordinances, Navigation Experts, and Ways to Fight

The remains of the oldest vessels found in America to date are the shipwrecks of Highborn Cay, Molasses Reef, and the Padre Island wreck. The latter is the only reliable dated, from the New Spain fleet of 1554. It is possible that these ships, with a powerful variety of weapons of war and with relatively small dimensions, were ships engaged in trade between New Spain and Cuba. Its dimensions did not allow to carry a large number of large guns. The first serious attacks on the Indies trade occurred in 1521 and 1522 in the vicinity of Andalusian and Portuguese coasts. The new war with France begun in 1521 increased the number of corsairs in the North Atlantic and the Caribbean. The attempt to curb their plunder forced the Spanish Crown to protect the merchant fleets with armed ships that regularly patrol the waters near Spain and Portugal, in the area between Cape San Vincent, the Canaries, and the Azores islands. The Caribbean extension between Cuba, Hispaniola, and the Bahamas was the most dangerous area. From the 1520s onwards, it was ordered to sail in a fleet or "*en conserva,*" to offer greater resistance against attacks, as was already done on the route to Flanders. There was no clear difference in ship types used, which were still all merchantmen, armed for combat with cannon cast by the crown, which maintained guns ownership. Guns had to be delivered to the artillery steward at the end of the trip. There were no big rental carracks on the Indies route. The main problem even in such empty waters was that the ships had few guns, which use was impeded by a cargo excess because the purpose of the ships was trade, not war. Spanish galleons were not hunting ships, but merchant transport that had to defend themselves from plunder attacks. This fear of plundering forced the formation in 1522 of the first fleet composed of eight merchant ships and two escort warships (Caballero Juárez 1997; Mira Caballos 2006). In July a series of ordinances relating to the Indies navigation was issued. It established that the 100-ton ships would carry four heavy iron guns and 16 "*pasavolantes,*" eight per band. It was also forbidden for ships to sail alone to America. However, though the ships sailed together, they were not yet subordinated to the single command or a flagship. In 1533 it was decided that the officers of the Casa de la Contratación, together with a group of experts in the navigation to the Indies, would establish rules for safe navigation. The result was the Ordinance of 28 September 1534 in which the officers from the Casa were also ordered to visit the ship about to sail in order to carry out a pre-loading inspection, verifying necessary repairs were made to the hull, which

was properly armed and—at least—with the minimum crew required. The guns had to be placed where the visitor indicated on his first visit, before receiving the cargo, according to the *Recopilación de las Leyes de Indias* (1841, p. 46).[4] The cargo, victuals, and merchandise had to be placed on the orlop and main decks, where most of the guns were placed, had to be left clear of bundles to allow free access to the artillery. *Naos* could store cargo under the quarterdeck as long as one free space was left in each band of the bulwark to place a heavy piece of artillery. On the quarterdeck should not go merchandise, nor bundles, nor serons (1841). According to this Ordinance, ships of between 100 and 170 tons had to carry two gunners to serve the following firearms: 20 quintals bronze sacre (920 kg) with 30 balls; a 12 quintals bronze falcon (552 kg) with 50 balls; six great iron pieces with two chambers and 20 iron and stone balls each; 12 iron or bronze swivel-guns, with two chambers and 30 balls each; 12 arquebuses. Ships of between 170 and 220 tons needed four gunners for the following firearms: a 30 quintals bronze half culverin (1380 kg) with 30 balls; a 12 quintals bronze falcon (552 kg) with 50 balls; eight iron bombards with two chambers and 20 iron and stone balls each; 18 iron or bronze swivel-guns, with two servers and 30 balls each; 20 arquebuses. The *nao* between 220 and 270 tons had six gunners for a half culverin of 30–32 quintals, or a cannon of 40–42 quintals (1840–1932 kg); two sacres of 14–20 quintals (644–920 kg) with 30 balls each; a 12 quintals falcon (552 kg) with 50 balls; 10 great bombardas or "*pasamuros,*" four of which had to shoot iron ball; 24 swivel-guns, with two chambers and 30 balls each; and 30 arquebuses.

What emerges from these listings is that in the Carrera de Indias the wrought-iron artillery still prevailed over the bronze, which was only used in the first discharges because of its greater range. However, despite what was stipulated in the Ordinance, it was the merchants themselves who in many cases avoided adequately arming the ships in order to gain extra space for the cargo since their greatest fear was not the pirates or privateers and cannon fire, but the storms against which they could do nothing. The officers ("*visitadores*") from the Casa de la Contratación decided the number and type of arms that the ship should carry based on its tonnage and who should monitor its correct disposal on the decks. In 1534, a second Ordinance stipulated that the artillery should be adequately mounted on its carriages, with tools and the molds for ammunition with iron dices. It also specifies that the ship "should carry the gunports with their hinged doors and hoops to lift them and make them strong inside" (1841). The Ordinance states that gunports use was officially regulated.

A gunport was retrieved in 1979 from the *Warwick*, an armed supply English galleon wrecked in Bermuda in 1619. It had a rectangular shape with measures of 43.2 × 54.6 cm. and 6 cm. in thickness, the same thickness as the first layer of the ship's outer planking. It had a large iron ring on the inboard face to open and close the lid and it hung on two vertical hinges, just as the 1534 Ordinance specifies, which implies that warfare technology was used throughout Europe for a long

[4] Archivo General de Indias, Indiferente General, 1961, leg.3, f.164v-168)

period of time was almost the same. It also had a fitting for a rope on the outboard face, perhaps to secure the lid while open. A gunport lid retrieved from the sixteenth-century wreck off Alderney Island presents similar features (Chíobháin 2011). In fact, these features are visible in Biagiod'Antonio's*The Betrothal of Jason and Medea* (Fig. 13.3).

To date, a cannon cast in Spain (not within Spanish possessions) from the first third of the sixteenth century has not been recovered from a shipwreck. However, the theoretical number of pieces and their arrangement on a ship are known. *Quatri partitu en cosmografíapráctica, y por otro nombre, Espejo de navegantes* was composed ca. 1537 by Alonso de Chaves,[5] cosmographer and senior pilot of the Casa de la Contratación. It is an exceptional nautical treatise unique in its kind that continues the work begun in Alphonse X's *Partidas*, but also informs the number and position of the guns on a ship at a moment of change for tactics and artillery. Like other nautical and military treatises written by Spanish authors, Chaves was jealously kept to avoid spreading valuable knowledge of navigation to America. It has been studied from different points of view, especially those of navigation, cartography, and cosmography, but never from a strict artillery context. Like artillery treaties, Spanish and Portuguese navigation works were the first and most complete writings published almost during the entire sixteenth century. However, during the first half of the century, there were no specific artillery treaties, but they were included in others dealing with fortification or, as in Chaves' case, navigation. All artillery and fortification treaties have in common that they are the result of the experience obtained by the author on the battlefield—such as Clèves' *Instruction*—and were written with the purpose of training the new generations. In the same way, Chaves' work is a compilation of information obtained by him during his trips to America in order to train new pilots of the Casa de Contratación. Therefore the indications on the number of guns to be carried by the commercial vessels and their position within them, as well as the information that it includes on armament, and the way in which a naval battle was to be conducted, also come from Chaves direct experience at sea about 1534.

The second chapter (*De la gente y bastimentos que deve aver en la nao i de las armas i municiones* f.63r) of the third Treaty, deals with the artillery for a 200-ton ship: six thick bombards mounted in carriages, with two chambers and 20 stone balls each; four "*pasamuros*" mounted in carriages,with two chambers and 20 cast-iron balls each; 40 swivel-guns on the gunwale and the castles, with 20 lead balls each and "iron dices inside them"; and 24 harquebuses "at least," and 24 lead balls for each along with their molds to make more bullets. Chaves included incendiary weapons, which used a kind of flammable chemical compounds that were ignited and thrown to the enemy, such as clay jars filled with tar and gunpowder or with soap with oil (to make slip), hollow stick grenades "with their harpoons and feathers to fire and to throw to the sails and burn them," "tubes for artificial fire impregnated with tar, gunpowder or camphor to throw them on and burn the enemy and the

[5] Museo Naval de Madrid, Ms. 9/2791

rigging of their ship," as well as a whole collection of harpoons, "*alacranes*" (twisted hooks) and "*píldoras*" (tow balls) throwed by hand. The ship also had to carry a good assortment of swords and knives, crossbows, spears, scythes used to cut the enemy's rigging, a lot of thorns with quills and blades, stones and darts to throw from the deck and from the topsails, paveses or shields to raise barriers on the rail and topsails, and shields to use them for self-defense "at the time of the fight." These offensive and defensive artifacts were not new and are also already observed in the aforementioned manuscript of the Earl of Warwick. From this point of view, the war was still tied to medieval practices, using the ship as a floating castle.

According to Alonso de Chaves a ship of 200 tons prepared around 1538 for the battle had to carry at least 10 cannons. Six of them had to be large wrought-iron breech-loading bombards with two chambers and stone balls. The other four were also breech-loading guns called "*pasamuros*" but since they used cast-iron ammunition, they should be made of bronze. The 40 swivel-guns fired lead bullets, so they would probably be wrought-iron, and were mounted on spikes that allowed to adjust the aim in height and direction. The total ammunition for them raised up to 800 balls, which makes swivel-guns Chaves' preferred arm for combat. All the balls had to go with iron dice inside them, as already indicated by the Ordinance of 1534 and it has been verified in archaeological excavations. Finally, firearms were completed with 24 shotguns and arquebuses. Even though its number is smaller than that of the swivel-guns, Chaves highlighted the importance of his ammunition reiterating it bluntly: "two dozen balls of lead, and more lead, and more lead." The swivelguns are the most numerous armament of the oldest wrecks found in America. From Highborn Cay 13 swivel-guns were recovered, and 16 from the Molasses Reef wreck. The *Santa Maria de Yciar*, from the Padre Island wrecks, was supposedly armed with 32 swivel-guns. She was the smallest vessel of the 1554 fleet.

For a total of 74 firearms listed for a 200-ton ship, at least six quintals (276 kg) of gunpowder were needed. The gunpowder was on the first deck near the bow and had to be well secured in their barrels. Chaves' experience becomes evident again when he warns that chambers had to load in the orlop deck and once loaded, they had to go up covered and kept off the fire to prevent an accident. Chaves advises to distribute the heavy bombards and "*pasamuros*" in prow, stern, and on the bridge, but adds that a pair of them had to be placed "to the gunports at the sides of the *nao.*" Thus, the 10 great pieces should be located two forward, two aft, two at the lowest gunports, and four in the first deck (presumably two on each side). Some of the 40 overlapping swivelguns were mounted by the quarterdeck and the castles. Finally, Chaves defines the gunports, or "*portanones,*" as "windows that are made on the sides near the water where some shots are placed in time of war."[6] Chaves confirms the Ordinance of 1534 on the gunports, emphasizing that since they were close to the waterline, they had to be provided with lids or lifting doors to prevent the free entry of water, otherwise the ship would be flooded and sink easily. This is confirmed by Chaves himself later.

[6] Alonso de Chaves, ca. 1538 *Quatri partitu en cosmografía práctica*, *Espejo de Navegantes*. Museo Naval de Madrid, Ms. 9/2791, 60r.

The way of conducting a battle between two ships is dealt in the fifth chapter. As soon as a ship was visible, the first thing to do was to open the lidded gunports of the lower deck and place two large bronze pieces in position to engage in long-distance battle, ship to ship. Likewise, some wheeled carriage guns had to be moved from one side to the other, depending on where the enemy was. Afterward, men of war had to "go up to the tops and put more weapons there and have ready to throw darts, stones, grenades and clay jars filled with gunpowder, tar, oil or lime to blind the enemy." The soldiers had to be divided into the bow and stern castles with the muskets ready, while the gunners helped by the assistants had to have ready the guns and place a powder keg covered with wet clothes at the foot of the mainmast. The carpenter and caulker masters also had to be ready to repair a gap in the hull. With all the crew alert and ready, the battle began with the shoot of the largest pieces located in the bow, the side or the stern, depending on whether the ship was on the hunt or pursued by the enemy. The first shot should try to hit the mainmast. If the gunner thought he could not hit the enemy, then he had to aim to the sides, trying that the shots were not high and miss, to not waste ammunition, and secondly to avoid the enemy was emboldened to see that the first and more powerful shots fired by the larger pieces were lost. If, on the contrary, the first shots were successful, then it produced a great fear to the enemy, leading him to think that if by distance and with the first shots they received such damage, the harm when both ships were close would be greater. The pieces located in the orlop deck gunports should only be fired when both boats were side by side, close to each other and had to be fired to the waterline—"*à fleur d'eau*" as Philippe de Clèves says—because even if the ball did not fully pass the hull, "would splinter it and blow the tow through the air and the ship can quickly be flooded there."[7]

In a fleets battle, it was necessary to put ships windward so that the smoke of the discharged artillery blinded the enemy ships. The fleet had to form in a wing, with the larger ships in the center and the lighter ones on the sides of the battle, and try to envelop the enemy. The battle began with the signal of the captain raising a flag or with an artillery signal, and the flagship played a trumpet. After approaching, big caliber guns should be fired and the swivelguns would be used until boarding when incendiary weapons were used against sails and rigging, while the entire crew began to shout at once and trumpets sounded. The sound was a very important part of the fight because the orders were given by wind instruments, but also the dissonant music together with the smoke and the first instant confusion increased the fear and the uncertainty. The Genoese carracks of Princess Joanna carried 16 trumpeters that were dressed in purple velvet and Venetian crimson, and Jean Colombe's *Faits des Romains* shows people playing musical instruments located above the bow and sterncastles while the boarding begins, and the same musicians are shown in Olivier de La Marche's *Le chevalier délibéré*, in the bow and in the top of the mainmast. Trumpeters also appear in the *Tavola Strozzi* in the prows of two of the central galleys, playing long "*añafiles,*" Moorish musical instruments about 80 cm long. This

[7] Chaves, Quatri partitu…., MNM, Ms. 9/2791, 69v and 70r.

type of trumpet, already mentioned in the thirteenth-century Alfonso X's *Partidas*, can be seen in the Pastrana tapestries. Musical instruments have also been recovered from the *Mary Rose*.

It would not be a surprise that Alonso de Chaves had participated in the drafting of the Ordinance of 1534. However, there is no novelty regarding naval warfare. The only novelty implicit in Chaves' text is the express mention of the use of artillery attacking the sides of enemy ships, firing at the waterline, a technique which Philip de Clèves already mentions after his Mediterranean experience. Shooting at the enemy ships when they were side by side, and the movement of wheeled carriage guns from one side to the other shows the absence of broadside gunnery. The only novelty in the conduct of sea war is the little gun increase firing from lidded gunports, no matter the range. The rest of the battle, however, remained closely linked to fifteenth-century practices and it is a remarkable similarity—in strict terms of warfare—to Clèves' text. The archaeological material recovered from the wreck of the *Mary Rose* fits pretty good Chaves' text, highlighting, once again, the veracity of the speech of the cosmographer.

In England, the construction of ships intensified both in number and in size at the end of the fifteenth century. Henry VII consolidated his power through the construction of large ships (Adams 2013). The crown had begun to build with the carvel technique around the 1480s, at the same time with France, the Dutch provinces of the Low Countries, andprobably Spain. Ships such as the *Regent*, the *Henry Grace à Dieu*, the *Sovereign,* or the Scottish *Michael* seem that had no lidded gunports. John Stuart, Duke of Albany and Scottish King's nephew, had been on board the *Lomellina* with Clèves in 1501 and was able to see the technological innovations on war, being able to see great carracks provided with gunports. Henry VIII inherited these great ships from his father and when in 1509 he acceded to the crown began the construction of the *Mary Rose* and the *Peter Pomegranate*. The former was launched in 1511 and in 1535 began the modification to accommodate large cannons. Some of its lidded gunports were new since dendrochronological analysis of one of the ports in the midship area provides a *terminus ante quem* of 1541, so at least some of the gunports were cut and provided with lids sometime after her construction (Hildred 2005). As it has been seen, the opening oflidded gunports had to be necessarily related to the ship structure and its capacity to withstand an increase in the weight of its artillery, so the original construction of 1511 could not have contemplated a large number of cannons in lidded gunports on its sides. The artillery retrieved from the *Mary Rose* does not correspond to pieces of the early sixteenth century, but are the result of the evolution occurred in gun manufacture during the first quarter of the sixteenth century. As a result of the wreck excavation it is known that the 14 largest cannons were positioned alternately in the main deck, in lidded gunports. This reflects the diversity and gun alternation, but it is something that is already observed in the Pastrana tapestries of 1471–1490.

The joint study of the pieces of the *Mary Rose* and Chaves' text allows observing the number of pieces that carried large warships and how little the type of armament had changed during the first quarter of the sixteenth century. Combat between ships or between fleets had not varied much during most of the century. It is true that the

number of guns increased and their use from lidded gunports became common, but the use of shipboard gunnery was not yet in use. Even when artillery had the potential to penetrate with great precision the ship hull, artillery was not used profusely for ship-to-ship distance fighting. It was preferable to wait until the enemy was nearby to unload a great rain of shots, bullets and incendiary weapons before boarding. Cannon, as a weapon of war, had the ability to destroy and even sink an enemy ship in the same way that it demolished the fortresses in the land sieges. Perhaps existed an inability to understand a new form of war at sea. Nevertheless, it is necessary to stress that the main pursuit of the enemy was the booty and they needed to board and capture the ship fighting with a sword in hand to get it. It was a catastrophe if the ship sank.

In barely 20 years, the armament remained basically the same: wrought-iron cannon alternated with other of bronze, two technologies supposedly opposed in the sense of antiquity and modernity, since it has been thought that bronze cannon were the main cause of the disappearance of wrought-iron guns. Despite its fundamental importance, the point is not in the use of both types of guns, since both were effective in combat—albeit with differences in loading speed, range, and penetration—but in the use of the manufacturing technology. The question was to decide between a technology that followed an artisanal method, which shaped the iron manually by hammering in the forge, and another that quickly allowed the casting of identical pieces by the use of molds. However, this method was more expensive due to the complexity of the process, the number of people involved, and the progressive price increase. In the meantime, bronze casting cannon was safer and had greater range, power, and precision. When this process could be cheapened, the cast-iron artillery could finally arm the ships with an endless number of pieces manufactured cheaply and quickly.

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