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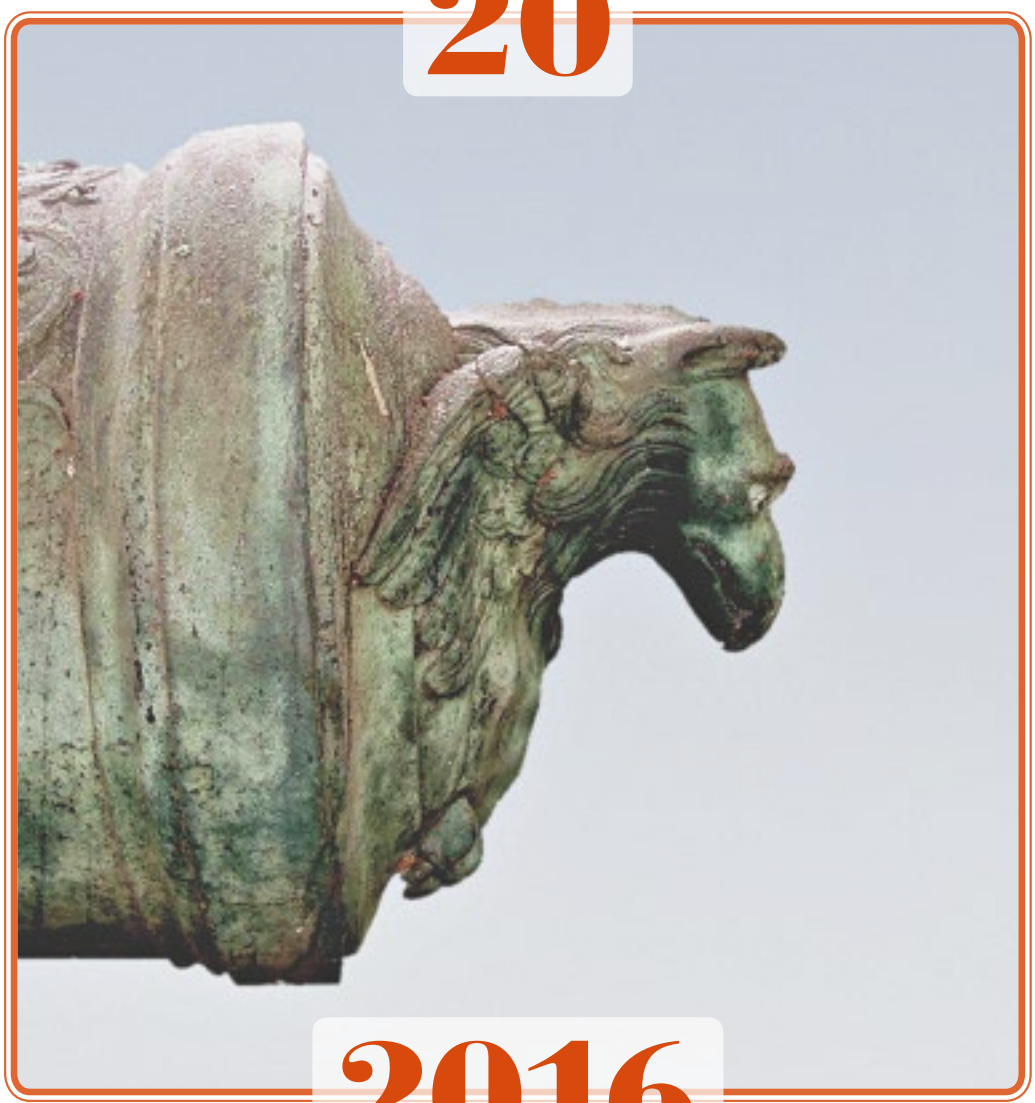

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All'Insegna del Giglio

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Indice

The Cadiz-Delta II wreck: the "San Giorgio", a Genoese merchantman sunk by Francis Drake in 1587

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1. Introduction

This paper concerns the research conducted on the shipwreck known as Delta II[1], found and excavated in the Port of Cadiz (Spain) during construction work to build a new container terminal (*fig.* 1), and the methodology used to achieve the results.
Identifying a shipwreck in the Bay of Cadiz is a challenge. The city, founded 3,000 years ago in the era of the Phoenicians, was a port connecting Africa and Europe; starting in 1492 it also became one of the most important ports connecting the Old and the New Worlds. This means that ships docking there were enormously varied in terms of their provenance and cargo.
The excavation of the Delta II wreck provided a large quantity and variety of archaeological items and information which will be discussed in future publications. However, the first stage of the study focused on establishing a timeline.
Information on naval architecture was of great importance in this process: the surviving structure is estimated to be 24 m long by 8 m wide, and is practically horizontal on the seabed. The wreck corresponds to a three-masted ship. Noteworthy elements of the construction system are the main mast carling, which was fundamental in identifying the ship as having been built in the Mediterranean tradition of the 16th century (Higueras-Milena, Gallardo 2016, pp. 878-879). It should also be noted that there are parallels with the Villefranche wreck, discovered in 1979 and identified as a Genoese ship belonging to the Lomellini family, which sank in 1516 during a storm in the bay of Villefranche-sur-Mer (France) (Guerout, Rieth, Gassend 1989, pp. 133-146).
The other vital source of information was the artillery the ship was carrying on board: seven bronze cannon immediately recognized as 16th-century Genoese products; two of these pieces were identified as *Petrieri* (muzzle-loading stone-throwers), with one located at the stern of the ship and the other towards the centre (one of which was loaded with a stone shot); the remaining five cannon were stowed between bulkheads in the hold. From the earliest phase of the study, the information provided by these pieces placed them in the second half of the 16th century, establishing the possibility of the ship being of Genoese origin.
Since they were certainly made in the 16th century, the cannon suggested a huge range of possibilities: the wreck could have been a Spanish ship that transported goods to America, a merchant vessel or warship, or any of the other ships that came to Cadiz from the rest of Europe. It was necessary to date the cannon more precisely, as in the absence of other evidence this would be the only way of finding a chronological frame of reference with which to narrow the years of interest for the documentary search. As we will see below, the inscriptions revealed that the cannon were cast mainly by members of the Genoese Gioardi family. A parallel was found with a similar cannon (*fig.* 24) currently installed at the Castillo de la Mota in San Sebastián (Spain), which came from one of the *naos* of the so-called "Invincible Armada", with which Philip II intended to invade England in 1588 (Ridella 2011, pp. 49-50). This detail provided an important chronological point of reference. The fact that a stone shot was preserved inside one of the two *Petrieri* mentioned above means it was loaded when the ship sank; and this was not an unusual occurrence as in those times the cannon were always kept loaded, both aboard ships and on fortifications, owing to the long operations required to load them. However, as the other one

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[1] The wreck was so named because the new terminal was to be built on the space previously occupied by a degasification plant named Planta Delta.

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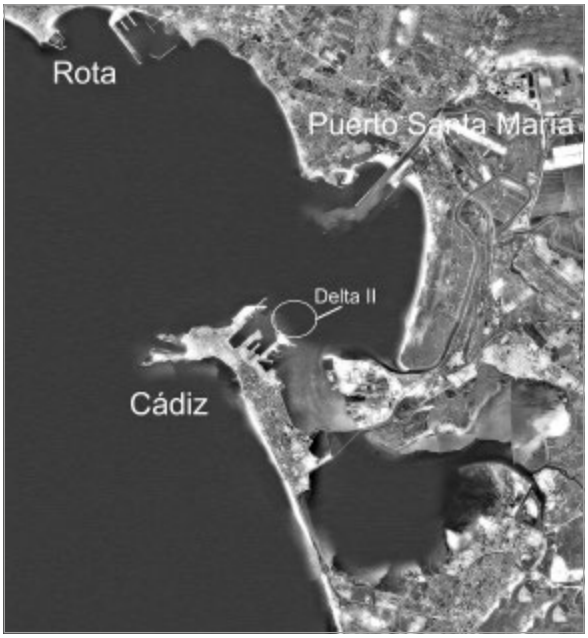

fig. 1 – *Area of placing of the Delta II wreck at the entrance to the Bay of Cadiz (Port of Cádiz. New container terminal. Instituto de Estadística y Cartografía. Junta de Andalucía).*

was found empty of shot, we may conclude that it had fired just before the sinking and consequently we can deduce that the shipwreck took place during combat. This greatly assisted the documentary search, as we were able to focus on attacks on the bay in the latter years of the 16th century. Battles are usually documented in chronicles and it is even possible to find maps and illustrations of an event that would have generated much comment at the time.

The location of the wreck is also important: a battle at a port like Cadiz which, on account of its intense commercial traffic, constantly received large numbers of ships, would without a doubt have involved many of these ships. The ship concerned was not deep within the bay, but at its entrance, facing the city quay. This may indicate that the attack was unexpected, as the ship had not had time to protect itself by moving to a more sheltered position.

The Genoese manufacture of the cannon suggests that the ship was Genoese; however, cannon are known to have passed between ships of different nationalities for a range of reasons (purchase, capture in battle, etc.) so this was not conclusive. To further narrow the possibilities, it was necessary to conduct a study into the cargo the ship was carrying. Jars containing olives in brine, clearly an Andalusian product, indicated that loading would have occurred in Cadiz. Consequently, the ship could not have come from the West Indies, where this product did not exist. This made it possible to rule out a large number of candidate ships from the investigation. The ship could still have been departing for America, however.

Nonetheless, a red-coloured substance found in the hold, even without confirmation from biological analysis, brought to mind cochineal, a highly valuable dye originating from Mexico and almost certainly from the Oaxaca region.

The rest of the ship's cargo (diverse pottery from Italy and Seville, lignum vitae wood, etc.) marked the ship as being a trade vessel, confirming that these were the remains of a merchant vessel from the second half of the 16th century, possibly of Genoese origin, with Genoese cannon, situated at the entrance to the bay, carrying cargo from Andalusia and New Spain. Her route therefore would have followed the coasts of Europe.

From these initial premises, we began parallel investigations in Spanish and Italian archives, arriving at the full identification of the ship (name, owner, year and place of construction, voyages undertaken and the circumstances surrounding her sinking).

2. Report on the discovery of the Delta II wreck and the diagnostic artefacts recovered from it

The Delta II wreck was uncovered during infrastructure work undertaken by the Port Authority of the Bay of Cadiz as part of a projectto build a new container terminal at the Port of Cadiz. As the site is located inside an area declared an Archaeological Easement Zone, the "Bay of Cadiz Subaquatic Space" (Order of 20th April 2009. BOJA 101), and, as a small part of the manoeuvring area is located inside a space registered with Archaeological Zone protection status, denominated the "Port of Cadiz Access Canal" (Decree 285/2009, dated 17th June 2009. BOJA 129), the Regional Department of Culture of the Self-governing Region of Andalusia (Comunidad Autónoma de Andalucía) implemented the corresponding archaeological precautionary measures to protect the archaeological heritage that the area was likely to contain.

In 2010 and 2011, in compliance with the measures established by the Regional Department of Culture, described in the Environmental Impact Assessment, geophysical surveying was performed, with the subsequent review of anomalies; a campaign of mechanical and manual probing was also

undertaken. All of these surveys yielded negative results. Nonetheless, when dredging began in the area in early 2012, teams of archaeologists began 24-hour monitoring on board the dredgers. After a -7 m layer of very compact sediment had been removed, the teams detected two historical shipwrecks, including the one which was eventually named Delta II (Higueras-Milena, Gallardo, Ruiz 2013, p. 257).

The initial dives took place following the discovery, revealing the structure of a ship 24 m long by 8 m wide at a depth of between 12 and 16 m. The first finds were a bronze cannon and various intact ceramic vessels in the first layers of silt sediment.

Following a decision by the Regional Department of Culture, work began on excavations to enable the identification, investigation and recovery of the wreckage.

The work took place in an area made up of a sediment of silt and clayey mud, which in specific areas of the excavation was very solid and hindered the archaeologists' work.

Additionally, building work on the new terminal was not halted at any time, meaning that the excavation had to be carried out simultaneously with the terminal work (dredgers working nearby, the offloading of rocks to build the embankment, the placement of caissons for the front of the new wharf, etc.). All these circumstances hindered and slowed the excavations, with the constant movements of dredgers and other boats in the surrounding area reducing visibility underwater.

This poor visibility made it impossible to establish a proper visual record; only on certain days did the combination of prevailing winds, tide (rising or receding) and the stoppage of dredging works allow occasional images to be taken of the excavation work. While it was not possible to carry out acceptable serialised photographic work to produce a photomosaic, we were able to take serialised photographs to create 3D reconstructions of specific structures of the Delta II wreck (Higueras-Milena, Gallardo, Ruiz 2013, p. 261).

The excavated material was composed of a top layer of very fine, almost sterile sediment, covering practically the entire shipwreck. Under this first layer, depending on the area of the wreck, was clayey mud, a very hard, compacted mud, and small-to-medium grain gravel and pebbles, which made up part of the main ballast of the wreck.

The ship is positioned practically horizontally on the seabed, listing slightly to the port side. The conserved structure corresponds to the orlop deck and first hold; part of the stern had been lost, leaving the wreck around 24 m long.

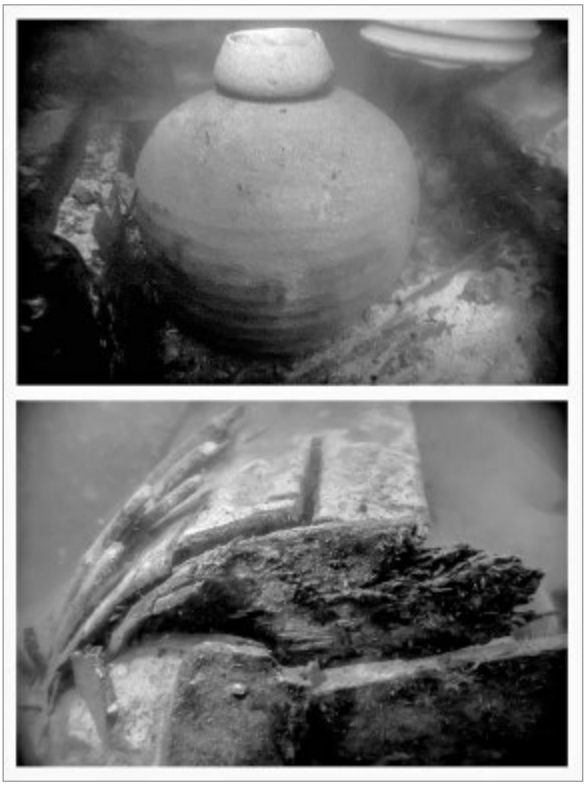

fig. 2 – *Some of the artefacts found in the wreck: an olive jar (above) and a wooden barrel (photos:* Tanit *Gestión* Arqueológica).

In the central part of the hold were stowed a set of five bronze cannon, an iron bombard and two iron anchors. From this point towards the bow of the ship, the list to port had caused a greater density of cargo on that side of the ship.

The archaeological elements were many and diverse: jars of olives, barrels of cochineal, boxes of agricultural produce, a variety of ceramic vessels, tropical woods (*lignum vitae*), dividers for navigation, leather shoe soles, bone remains (Bernáldez *et al.* 2013, pp. 1095-1108).

The olive jars were the most numerous object (*fig.* 2). In many cases, they were found with cork stoppers in place, which had preserved the content of the jars: several varieties of olives conserved in brine. Some of the jars conserved a covering of plant matter intended to protect them from breakage; mats of woven plant matter could also be observed between the jars and the floor timbers to protect them from impact.

The barrels were resting on the port side of the hold; a total of ten of these, some of which were full, were documented. The barrels were around a

metre tall with lids of around 60 cm diameter; they were wrapped with braided rings of half-rounds of flexible wood to reinforce the staves (*fig.* 2). We began to realise during the excavation that much of the clay covering the staves was stained an intense red. Once we reached the content of the barrels, it was not the stained clay but the dense, compact substance itself was turning the water red (Higueras-Milena, Gallardo 2016, p. 880). We considered from an early stage the possibility that this substance was cochineal and, in fact, once the necessary analyses had been run[2], it was confirmed that the substance in the barrels was indeed cochineal, the natural dye from the species *Dactylopious coccus*. Starting in the 16th century, trade in cochineal took on a huge importance, particularly due to its application in textiles in Europe. The product eventually occupied a position in commercial transport with the Americas that was surpassed only by the trade in silver and gold.

3. Identification of the ship and reconstruction of her story through archival documents

The objective evidence offered by the Delta II wreck, represented by the organization of her wooden structure and by the goods and equipment she carried, described above, was immediately essential to the research which led to the identification of the ship.

As has already been mentioned, the initial theory was that the ship was sunk in an unexpected attack. For this reason, a study was conducted on attacks on the Bay of Cadiz in the latter half of the 16th century.

Through this approach, it was possible to verify that there were two significant attacks on Cadiz during that period: one by the English in 1587 and one by the English and the Dutch in 1596.

Cesário Fernández Duro's work *La Armada Invencible* describes the attack of 29th and 30th April 1587 and lists the ships sunk and captured by the commander of the English squadron, Francis Drake. The list is taken from a collection of documents on the Spanish navy from the General Archive of Simancas (Valladolid, Spain), compiled by Juan Sanz Barutell. The list contains the following note concerningthe ships sunk: «*Una nave levantisca de 600 toneladas, que echó a fondo, y estaba cargando para Italia cochinilla, cuero, lanas y otras mercaderías. Valdría cuarenta mil ducados*»[3] (Fernández Duro 1884, pp. 334-335). The term "*levantisca*"[4] refers to the fact that the ship originated in the Levant (the East), reflecting Genoa's position in relation to Cadiz. The phrase "*echó a fondo*"[5] ("sent down") distinguishes her from other ships which were burned, indicating that she was sunk by cannon fire.

What happened on 29th April 1587? It is important to take historical background into account when explaining the attack, which was the consequence of the bitter confrontation between Elizabeth I of England and Philip II of Spain. English corsairs would plunder the overseas possessions of the Spanish Crown and its ships, with the licence and funding of the Queen. They had for decades been stealing large shipments travelling from the West Indies, which produced more than enough gold, silver, pearls, dyes, etc., to motivate these attacks. Drake began his career as a corsair in 1567 with his cousin Hawkins, and continued an obsessive campaign against the Spanish until his death from dysentery in Panama in 1596. He led successive attacks on San Juan de Ulúa (Mexico), Nombre de Dios (Panama), La Española, Cartagena de Indias, Florida, the entire stretch of the Pacific coast between Magallanes and California, twice attacking Galicia in northern Spain, capturing individual ships and fleets; he circumnavigated the globe in 1577-1580 (the second person to do this, after Sebastián Elcano), and was a key participant against the Spanish Armada in 1588, etc. He truly was the scourge of the Spaniards. Not all his actions were successful, however, his failures, together with the heated religious confrontation against the "papist" Catholics, seemed to serve as justification to renew his enterprises as a corsair, which also enriched him and brought enormous benefit to the English Crown.

Philip II had intended to take control of England through his marriage (1554-1558) to Elizabeth's predecessor, her half-sister Mary. When Mary died heirless, Elizabeth rose to the throne, frustrating Philip's ambitions. They were later resumed when the Pope proposed a conspiracy to the Spanish

[2] Analyses carried out by Dra. Borges of the Chemical Engineering Department of the University of La Laguna, Tenerife – Spain.

[3] «*A levanter ship of 600 toneladas (552 metric tons), which foundered, and was bound for Italy carrying cochineal, leather, wool and other goods. The value would be forty thousand ducats*». The Spanish *tonelada* composed of 20 quintales was equivalent to 929.18 kg.

[4] N. del T.: "*levantisca*"

[5] N del T.: "*echó a fondo*"

King to assassinate the heretic Elizabeth and install her cousin Mary Queen of Scots, a Catholic, on the throne. However, Mary was imprisoned by Elizabeth and beheaded twenty years later, on 8th February 1587. If Philip II needed any other motive, this was the deciding factor in his decision to assemble a great fleet to invade England.

The strategy consisted in organising the largest naval force ever known, under the command of Álvaro de Bazán, the first Marquis of Santa Cruz, an experienced sailor who had won great victories, such as the one in Lepanto. The armada would meet Alexander Farnese's land army in Flanders; together, they would invade England and lay siege to London. The fleet was to assemble in Lisbon (Portugal had effectively belonged to the Spanish Crown since 1580); it can therefore be deduced that Delta II's Genoese cannon were destined to be part of the Spanish Armada's artillery, as preparations were being made for forced marches by April of 1587. In fact, large amounts of military material and provisions from various sources were being gathered in Cadiz for transport to Lisbon (Tanturri 2012, p. 86).

Through her spies, Queen Elizabeth was perfectly aware of these preparations, which, regardless, would not have gone unnoticed, given their magnitude. She, too, decided to prepare for war, amassing a significant fleet under the command of Francis Drake, whose service record more than proved his worth as a sailor and his obsession with the Spanish.

Abbé Antoine François Prévost gives a clear description of events in his 1746 work *Histoire générale des voyages*, although he does not cite the source of the story:

Tan pronto fue informada la reina Isabel de que la Corte de Madrid equipaba una poderosa flota con el designio de atacar inmediatamente Inglaterra, no perdió un instante en reunir todas sus fuerzas. El caballero Francis Drake, cuyo valor y habilidad ya se había dado a conocer brillantemente, fue mandado para mandar una escuadra de treinta naves que fueron equipadas en Plymouth. Se designan por su nombre cuatro de un tamaño y fuerzas extraordinarios: el Bonaventure en el que Drake debía embarcar; el Lyon, al mando de William Borough; el Dreadnought, al mando de Thomas Venner, y el Rainbow, al de Henry Bellingham. Los otros, aunque menos considerables estaban en condiciones de servir para toda clase de expediciones expediciones[6]. (Pinedo 1991, p. 178).

[6] *No sooner was Queen Elizabeth informed that the Spanish Crown was equipping a powerful fleet with designs for an immediate attack on England, she wasted no time in uniting all her forces. Sir Francis Drake, whose valor and ability were already most well-known, was commissioned to lead a squadron of thirty ships, which were equipped in Plymouth. Four of these were extraordinarily large and powerful: the "Bonaventure", the ship Drake boarded; the "Lyon", under the captaincy of William Borough; the "Dreadnought", under the captaincy of Thomas Venner; and the "Rainbow", under the captaincy of Henry Bellingham. The others, while more modest, were in good order to serve in any manner of expedition.*

The same information is reflected in the letter from William Borough, captain of the *Golden Lyon*, to his general, Drake:

…for that by information the King of Spain is preparing a great army by sea, part at Lisbon, other in Andalucia, and within the Straits, all which was judged should meet at Lisbon, and the same to come for England, or some part of her Majesty's dominions: her Majesty's pleasure is, by advice of her Majesty's Council, that you, with these ships now under your charge, should come hither to this Cape, and upon this coast, and seek by all the best means you can to impeach their purpose and stop their meeting at Lisbon, if it might be; whereof the manner how is referred to your discretion (Corbett 1898, pp. 126-127).

The Spanish ambassador to France, Bernardino de Mendoza, who had also been in England until his expulsion in 1584, wrote to the Spanish Crown from Paris to warn of a squadron being assembled on the Isle of Wight, in the English Channel itself, made up of Queen's ships and merchantmen. Given the quantity of bronze cannon mounted on the ships, this could only be an enterprise aiming to raid and to cause the greatest possible damage. Similarly, Spanish spies and informers sent word from London of 34 ships setting sail, some of great size, including details of the weapons on board and their intention to attack Cadiz, a city the English considered rich and poorly defended. Did the letters not arrive on time? The General Archive of Simancas contains at least thirteen of these letters, dated between 11th March and 25th April and written in England, France and Portugal; the information they contained eventually proved to be fairly accurate.

When Drake was executing his orders, he received a highly valuable piece of information from the crew of two ships from Middelburg, Dutch Flanders, which had come across the fleet en route from Cadiz on 26th April:

El 16[7] *de dicho mes, en latitud 40 grados, encontramos dos naves de Middleborough que venían de Cádiz, de quienes*

[7] An important point should be made with respect to the documentation from the time. Information from English sources (both direct and indirect) indicates that the attack took place on 19th April, while Spanish sources place it on 29th April. This ten-day difference is due to the use of the Gregorian calendar in Catholic countries (Spain, Italy, France, etc.) starting in 1582. As the English did not accept this calendar and continued to follow

supimos que se hacía gran cantidad de pertrechos de guerra en la parte de Cádiz, que estaban listos para ser llevados a Lisboa. Con esta nueva nuestro general, a la mayor prisa posible, se dirigió hacia allá para destruir dichas naves y pertrechos, y el 19 de abril entró con su flota en la bahía de Cádiz, donde fuimos atacados desde nuestra llegada, a la vista de la ciudad, por cinco galeras, que luego al poco tiempo se retiraron bajo la fortaleza[8]. (Calvar Gross *et al.* 1988-1993, Vol. III, Tomo II: 829. Doc. 2477).

There was only one uncertainty in the warnings that reached Philip II: whether or not Drake thought to disembark in Cadiz. What could not be doubted was that he would try to sink, steal and plunder as many ships as he could, then continue up the Portuguese coast with the same objective for Lisbon and the Spanish Armada. If en route he were to find fleets returning from the West Indies, this would offer the additional opportunity to capture significant treasure and do great damage to Philip II. This operation presented no great difficulty and rewarded the English with rich spoils; they met resistance only from one ship, which they were obliged to sink without an opportunity to seize its cargo. Regarding this, one of the reports says: *cominciorono a battere una nave d'un tale Vassallo Genovese con circa cinquanta mille scuti di mercantia e la buttorno al fondo*[9] (Tanturri 2012, p. 84).

Findings from Genoese sources

Before the discovery of the wreck, in the Genoese archives written evidence had already been found, describing a merchant ship sailing in those times, owned and captained by people with the surname Vassallo. As we will demonstrate below, this was positively identified as the ship corresponding to the Delta II wreck; her story is outlined in the following passages. As her name is never quoted in the Genoese records, we will call her, for now, *Vassalla piccola*. This was the custom in Genoa, Venice and in Ragusa in those times, with ships taking the name of the owner or captain (ex. *Lomellina*, *Parissona*, *Ratta* etc.). Of course, ships also had official names, generally that of the Madonna (the Virgin Mary) or saints. The adjective *piccola* (small) is added to distinguish her from another, larger ship owned by the same person.

She was built and launched in December 1573 at Portofino, not far from Genoa, which at the time was a small village of fishermen and sailors and is now a well-known tourist destination. One might wonder where there was space to arrange a shipyard in such a location, surrounded by rocks and facing the sea. The answer can be found in an 18th century map (*fig.* 3), in which the built-up area is much smaller than it is today, with a beach measuring 50 m wide by 70 long. As we will see, this would be more than sufficient space to build a ship which archaeological work and archive information have found to be approximately 30 m long. The record, which also deals with her launching, contains some testimonies given during a legal dispute in which the owner requested reimbursement of the payment he had made to a Genoese carpenter who had supplied him with an apparently defective bilge pump (ASGe, CM, f. 1, 19.VI.1578).

The owner, Pietro Paolo Vassallo, son of Cristoforo, would have been a relatively wealthy person among the inhabitants of Portofino and sometimes appears as a godfather in the register of baptisms at the parish of San Martino (APSMP, *Liber Baptesimorum*, 7.IV.1561, 21.X.1565). From this source, we also know he had a brother, Nicolò, and a sister, Giulia. Besides this, we have no additional information from this period and, above all, we lack the shipbuilding contract, which is lost among the tens of thousands of deeds drawn up by the Genoese notaries of the period. This has not been found despite extensive research work; however, there is potential evidence of the financing of this enterprise having been funded through certain loans obtained by Pietro Paolo Vassallo's brother Nicolò (ASGe, NC, f. 3965, *not. Bartolomeo Castello*, 2.III.1570; f. 3966, 29.III.1571).

To return to the record just mentioned (*fig.* 4), we found among the witnesses a certain Clemente Vassallo, son of Delfino: not Pietro Paolo's brother, but possibly a relative of his. His testimony is of great importance to our story as it provides useful information as six year later Clemente Vassallo became the captain of the *Vassalla piccola* holding the command until her sinking. It is therefore appropriate to transcribe here the translation of the testimony:

the Julian calendar until 1752, one must always pay attention to this ten-day chronological deviation between sources. This inconvenience has an advantage, however; it serves to make us aware of the origins of the information we are dealing with.

[8] *On the sixteenth of that month we] met, in the Latitude of forty Degrees, with two Ships of Middleborough, which came from Cadiz. By these we understood, that there was great Store of warlike Provision at Cadiz, and thereabout, ready to depart for Lisbon. Upon this Information the General hastened thither with all Speed possible, and on the nineteenth entered the Harbor of Cadiz with his Fleet, which were immediately attacked, over against the Town, by six Galleys; but they quickly gave it over, and retired under the Fortress.*

[9] *They began to batter a ship of a certain Vassallo from Genoa, having on board about 50,000 escudos of merchandise, and sank her.*

On Thursday 19th June 1578 / Clemente Vassallo of the late Delfino / witness as above accepted and exacted / at the request of Pietro Paolo / having been warned he swore / by his own oath touching the sacred writings /witnessing he said so. At the time / the ship of the said Mr. Pietro Paolo / Vassallo was launched, from which / about five years could have been passed, / the said Pietro Paolo did cut / a good and very suitable tree / to make a bilge pump for the said / ship at Portofino and brought it / to Genoa and gave it to master Raffaele / Boggi who had to make for him / a bilge pump that was suitable for / bailing; the said Raffaele promised him to make it but / Mr. Raffaele spoiled the said / wood as he made a pump that was not suited for bailing, for this / reason the said Mr. Pietro Paolo gave it / back to him and the said Raffaele gave him / another one saying him: – you will use / this one until I will have made /one with wood similar to yours – and it / was used little or nothing and then the said / Raffaele made him no other /pump.
[Clemente Vassallo] *understood from Mr. Pietro Paolo he had given / the said Raffaele 18* scudi *for / the making of two pumps / and I say this is the truth.*

He answered: because I have ever / been with the ship and helped in its launching / as then like now I was and I am its pennese *(vice-pilot) / and because I am interested and have heard / what I said above.*
He is about 44 years old / and has goods for 100 scudi *and more.*

From this statement, we can understand that Clemente Vassallo had joined the crew of the ship as soon as she was launched, and that he was not an ordinary seaman, but had a specialized task. The term *pennese*, the man in charge of the proper stowage of cargo, does not have an exact equivalent in English; however, as the pilot (*nocchiere*) also had the general responsibility of the ship's stability, we may translate the term as vice-pilot. In 1578, the year of the document, he was 44 years old; he was therefore born in 1534 and would have been 39 when he was enrolled in the crew of the *Vassalla piccola*. In the quoted register of baptisms at Portofino, we find his daughter Angeletta, baptised on 26th June 1556, who was probably his first child. A boy, born in 1565 (*fig.* 5), was given his grandfather's name, Delfino (APSMP, *Liber Baptesimorum*, I, 26.VI.1556, 12.VIII.1565). The entries also show that their mother, Clemente's wife, was Maria Vassallo, daughter of Germano. Unfortunately, this is the only available registry data from the parish archives, as the books of the dead and of marriages dating from the second half of the 16th to the early 17th century were lost.
According to other witnesses, the ship sailed directly to Spain after her launch, under the command of her owner Pietro Paolo Vassallo. Many of these witnesses were members of the crew of this first voyage, including the pilot (*nocchiere*) Simone Ansaldo, the pilot's assistant (*aiuto del nocchiere*) Bartolomeo Griffo, the Portuguese gunner (*bombardiere*) Pietro Pirano and the sailmaker (*scalco*) Giovanni Ravenna. Following this, there is a gap in the documentary information on the ship from 1573 to 1576, after which we are able to create a fairly complete reconstruction of the *Vassalla piccola*'s trade activities for the following ten years (*fig.* 6).
We found the earliest information in an archival record, with Clemente Vassallo testifying that on 16th April 1576 the sailor Giacomo di Avi received an engagement award of 50 Genoese lire for his enlistment aboard the ship, which was departing to Sicily (ASGe, NA, f. 2679, *not. Francesco Carexeto*, 30.I.1578).
Later, in May 1578, Pietro Paolo Vassallo is charged customs duties on goods carried by his ship to Genoa from the Spanish ports of Cartagena and Alicante (probably the last stops). The goods consisted of soda, wool, sugar, lead, olives, barrels of tuna, almonds, *lignum vitae* wood and cochineal, these last two products from the West Indies and probably loaded in Cadiz. The ship's tonnage is recorded as 2,800 *salme*[10], equivalent to 530 metric tons, and her purser is listed as Geronimo Assereto (ASGe, SG, S. 14, n. 1286, *Venute Occidentis*, 2.V.1578). In the following month, the *Vassalla piccola* sailed again, after her port taxes had been paid (ASCGe, PC, n. 70m, 19.VI.1578), voyaging to Sicily, where she took aboard a load of 2,500 *salme* (475 metric tons) of wheat, to carry to Genoa via Reggio Calabria, from the loading point of Siculiana (ASGe, NA, f. 3153, *not. Domenico Tinello*, 31.X.1578). Sailing once more for Spain, she returned to Genoa in September, arriving from Alicante with a load of wool, soda and saffron. This time her tonnage is estimated at 3,500 salme (660 metric tons) and the position of purser had been assigned to Stefano Massone in place of Geronimo Assereto, who had become her temporary captain (ASGe, SG, S. 14, n. 1286, *Venute Occidentis*, 30.IX.1578).
Early in the following year, she arrived once more in Genoa from Alicante, carrying wool, lead, barrels of tuna and zibibbo wine, with her tonnage registered as 3,300 *salme*. This entry includes the

[10] The *salma* (plural *salme*) was a unit of volume used in Sicily to measure wheat. It corresponded roughly to 0.275 m^3 and was considered equivalent in weight to 4 Genoese Cantara (190.6 kg). In the 16th century, it became the standard unit to define the tonnage of Genoese merchant ships, whose main activity at the time was the transport of Sicilian grains (Gatti 1999, p. 86).

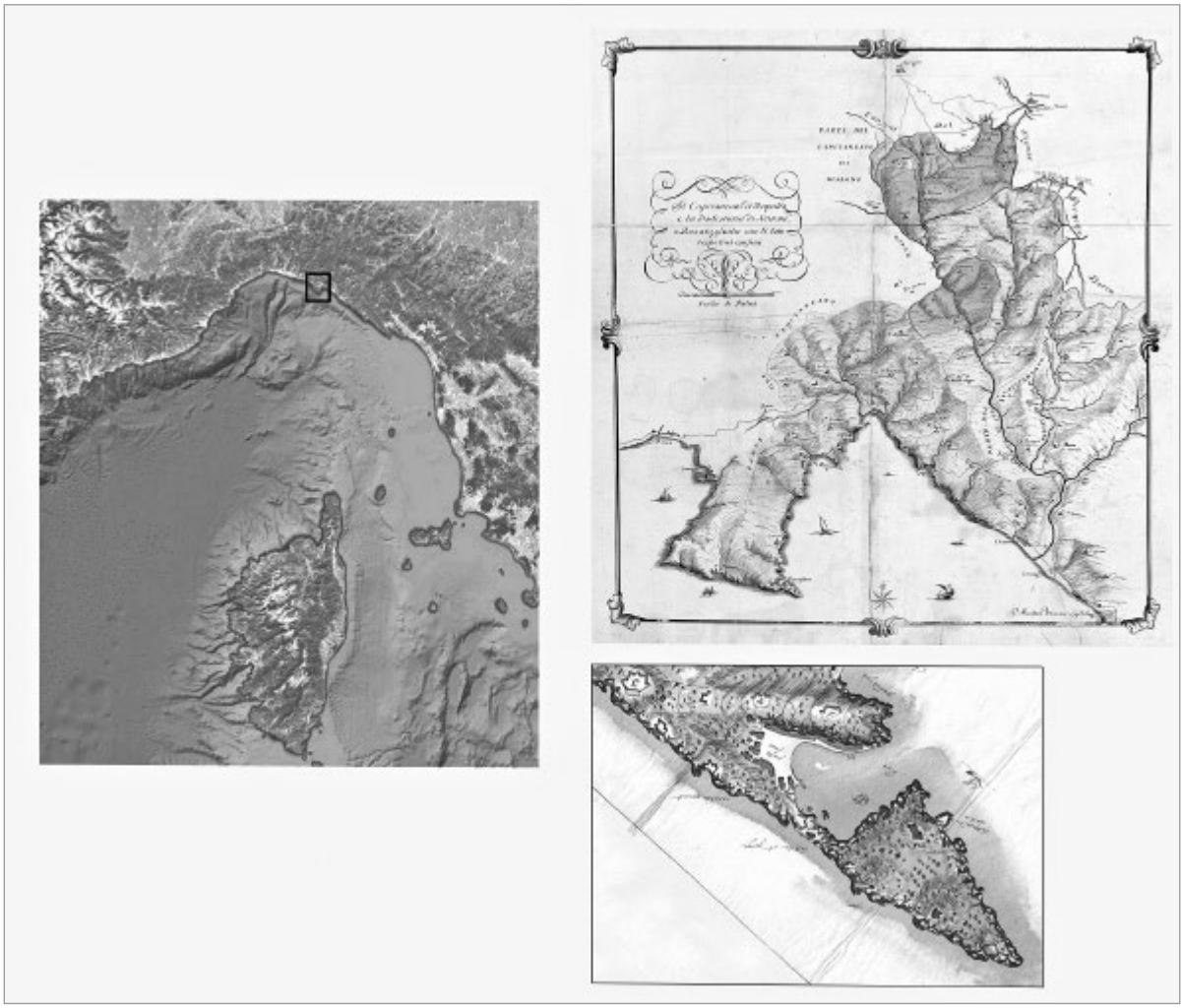

fig. 3 – The aspect of the promontory and cove of Portofino as shown in 18th-century cartography (permission from the Archivio di Stato di Genova N. 5/17 – Prot. 1398 cl. 28.28.00/1).

important news that Clemente Vassallo had taken command (ASGe, SG, S. 14, n. 1287, *Venute Occidentis*, 9.III.1579). The ship then departed once more (ASCGe, PC, n. 71m, 22.IV.1579), probably to Sicily, although we have no information on her return voyage from there; we do, however, know of a further arrival from Spain (Cartagena), carrying wool and soda (ASGe, SG, S. 14, n. 1287, *Venute Occidentis*, 17.VII.1579).

For the following two years, 1580-1581, we only have data about voyages made between Genoa and Sicily[11], owing to gaps in the archival documentation; however, it is very probable that the Spanish trade route would also have been maintained. A very important document from this period is in the State Archives of Palermo, preserved in the fund of the *Maestro Portulano*, the magistracy that authorised the collection of wheat from loading points on the island, which was then owned by the Spanish. The document is a licence dated 7th March 1581 (ASPa, MP, n. 23, 7.III.1581), issued to Pietro Paolo Vassallo, to load 3,000 *salme* of wheat from the depots in Sciacca on Sicily's southwestern coast, taking precedence over the other ships that had arrived before him, citing the feeble excuse that the *Vassalla piccola* could be in danger of having to sail through the winter period, as though the other ships were not similarly affected. This licence may have been issued due to a bribe, but it is more likely that it was made easier by the control exercised over the Sicilian wheat trade by Genoese merchants

[11] These voyages are documented by the following records: ASCGe, PC, n. 72m, 26.III.1580; n. 74m, 20.II.1581; n. 74c, 5.VI.1581; n. 74m, 17.XI.1581; ASGe, SG, S. 14, n. 1477, *Venute Orientis*, 26.IV.1581, 2.IX.1581.

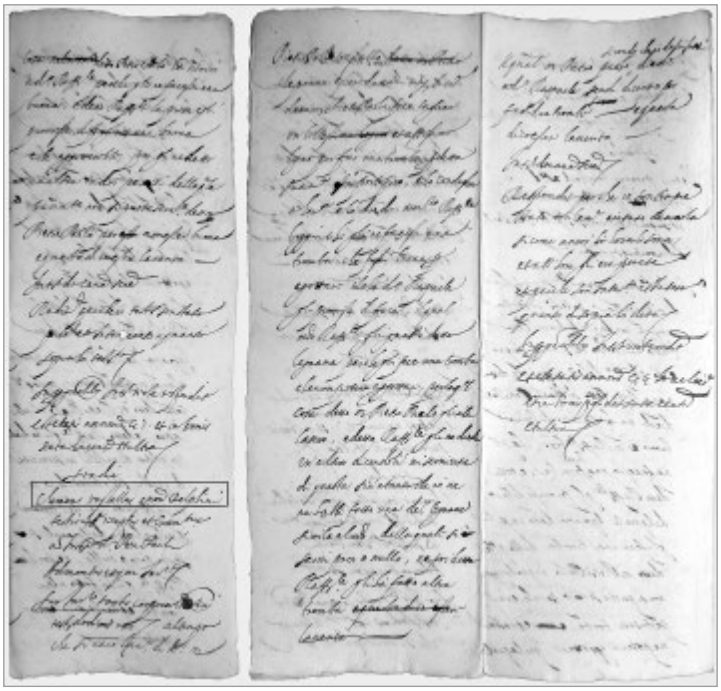

fig. 4 – *The record containing Clemente Vassallo's testimony (permission from the Archivio di Stato di Genova N. 5/17 – Prot. 1398 cl. 28.28.00/1).*

fig. 5 – *Baptism recording of Clemente Vassallo's son, Delfino (12 Aug. 1565), in a register at the parish of San Martino, Portofino (photo: Renato G. Ridella).*

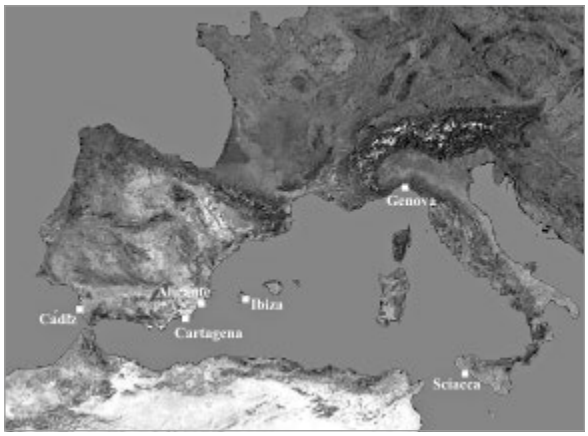

fig. 6 – *The western Mediterranean Sea with the ports called at by the Vassalla piccola during her fourteen-years trade activity ended with her sinking off Cadiz (arrangement: Renato G. Ridella).*

and financiers, who at times held the directorship of the *Maestro Portulano*[12]. In addition to this, we learn that Pietro Paolo Vassallo was captaining his ship again and that her transport capacity exceeded 3,000 *salme*, with a total tonnage, also cited in subsequent documents, of around 3,300 *salme* (630 metric tons/910 m³).

From 1582, we once more have information on arrivals from Spain. For example, in February (ASGe,

[12] For example, the Genoese nobleman Ottavio Spinola held the office of *Maestro Portulano* for the first time in the 1550s, then until 1572 (Cancila 1999, p. 25).

SG, S. 14, n. 1288, *Venute Occidentis*, 8.II.1582) of that year, we see that the ship docked at Genoa coming from Alicante and Ibiza, the smallest of the Balearic Islands, which was highly frequented by maritime traffic at the time because of the extensive production of its saltworks. In the following June, she arrives again from Ibiza, probably loaded mainly with salt (ASCGe, PC, n. 75m, 6.VI, 1582), while at the end of that summer and again in May 1583 there are records of her return from Sicily (ASCGe, PC, n. 75m, 10.IX, 1582; n. 77c, 18.V.1583). We know that on his next voyage to that island, Pietro Paolo Vassallo had also taken aboard two horses for delivery in Palermo, being paid 250 *scudi*, which almost certainly comprehended also the expenses for their maintenance and for that of their attendant (ASGe, NA, f. 2689, *not. Francesco Carexeto*, 4.VII.1583).
At the beginning of 1584, Clemente Vassallo definitively takes the command of the ship, captaining her during a voyage from Sicily to Genoa (ASGe, NA, f. 3029, *not. Gio. Francesco Valdetaro*, 21.I.1584. ASCGe, PC, n. 78m, 16.II, 1584), while in the summer we find Pietro Paolo participating, as one of the Genoese ship-owners, in the election of their representative on the council of the *Conservatori del Mare* (in Latin *Conservatores Navium*, "Curators of the Seas") a magistracy dealing with everything concerning commercial sailing (ASGe, CM, f. 23, 20.VII.1584). From a later testimony given by the gunner Francesco Carrega, from Monaco, we know that the ship's barber Giovanni Mino had died on 29th August 1584 during *Vassalla piccola*'s return voyage from Spain (ASGe, NA, f. 3839, *not. Lazzaro Conforto*, 12.VI.1586).
Information from Genoese archives regarding the ship's movements in the following two years, 1585-1586, mentions only Spain, although it is more than likely that the transport of wheat from Sicily would have continued, as the maritime trade in the western Mediterranean was also based on this important product, as will be explained in more detail below. In a notary's deed from the period, the Genoese trader Gregorio Garbarino, engaged in the trade of Sicilian wheat, Spanish wool and Balearic salt (ASGe, NA, f. 2683, *not. Francesco Carexeto*, 22.VI.1580; f. 2685, 23.IX.1581; f. 2688, 3.I.1583), acknowledges a debt to Clemente Vassallo of 9,000 Italian gold *Scudi*[13], which an agent of Garbarino would pay him within one month *in loco Alicantere seu Cartagenie* (at Alicante or Cartagena). This is surely evidence of the fees he had to pay for the transportation of his merchandise by the *Vassalla piccola* (ASGe, NA, f. 2692, *not. Francesco Carexeto*, 15.I.1585).
The lastdeparture of the *Vassalla piccola* from Genoa for her final destiny is registered among the port taxes at the end of July 1586 (ASCGe, PC, n. 80m, 30.VII, 1586).

Findings from Spanish and English sources

From a documentary point of view, no new information has been located on the ship before Wednesday 29th April 1587. It is important to note that the majority of the documents shown below were located through the study of the five volumes comprising the work *La batalla del Mar Océano* ("The battle of the Ocean Sea") from which we gathered a valuable, broad and varied range of documentation relating to the confrontations between England and Spain between 1568 and 1588.
As described above, on 29th April 1587 the *Vassalla piccola* was anchored in the Bay of Cadiz, specifically in the port area of the city, while work was being carried out to load and unload various products.
According to the documentation consulted, Francis Drake, commanding 28-30 ships, entered the Port and the Bay of Cadiz between five and six o'clock that afternoon.
Upon entering the Bay, the English fleet was attacked by six galleys and a galiot under the captaincy of Pedro de Acuña, a knight of the Orden de San Juan, which were in the bay en route to Cape St. Vincent. This is the version of events recounted by Acuña himself to the Adelantado of Castile, in a letter located at the General Archive of Simancas (AGS):

El tiempo me ha detenido y creo que ha sido milagro de Nuestro Señor, porque acabando de llegar de la puente de Zuaço venía un gran golpe de naves hasta la cantidad de veinte y ocho nabíos, los diez y seis grandes; y en viéndolos bien lejos dije son ingleses, y zarpé con mis galeras y la galeota; y no salió falsa mi imaginación porque es Draquez; y esto lo sé de una lancha que les tomé con mi galera, en que se tomaron cinco ingleses bibos, y no saben decir la cantidad de la gente[14]. (Calvar Gross *et al.* 1988-1993, Vol. III, Tomo I: 233. Doc. 1563. Archive: AGS, GA, Sec. M y T., Leg. 198-10).

[13] According to the record, a *Scudo* was equivalent to 425 Spanish *Maravedis*.

[14] *The weather has detained me and I believe it has been a miracle of our Lord, because moments after I arrived at the Zuazo bridge, a large group of ships, as many as twenty-eight, sixteen of these large, was sailing towards us. Seeing them from a distance, I said they were English and I set sail with my galleys and the galiot; my imagination did not fool me, for it was Drake; I know this because of a launch I took with my galley, where five Englishmen were taken alive, and they did not know the number of people.*

No alarm was raised by the entry of the English fleet into the bay. They had already been seen at around midday approximately 8 miles from Cadiz, but as they were flying French and Flemish flags, they were able to enter without raising suspicions, appearing not to be enemy ships.

En el año 87, en 29 de abril, entró en la bahía de Cádiz Francisco Draque con veinticinco navíos de armada, entre ellos seis galeones de estado de la Reina, y los demás eran de particulares, todos medianos, y traían las banderas francesas y flamencas para que, al entrar en la bahía, se entendiese en dicha Cádiz ser navíos de aquellas partes y de mercaderes, y no de ingleses de armada…[15]. (Calvar Gross *et al.* 1988-1993, Vol. III, Tomo II: 635. Doc. 2205. Archive: MN, Ms-496, Col. FN, t.XXX, doc. 277; proc. CDA)

Once they were detected by Acuña's squadron, they raised their true flag, the English flag, and commenced firing on the ships anchored in the Bay and Port of Cadiz. They crossed the centre of the bay and began to plunder, burn and sink the ships they came across. They foundered a Genoese *nao*, burned four merchantmen from Cadiz which were loading up to sail for the West Indies and a large galleon loading up for New Spain (owned by Álvaro de Bazán, the Marquis of Santa Cruz), sank a large *nao* from Biscay, burned three cargo ships carrying supplies for Lisbon and inflicted more damage on other ships. In total, they sank and/ burned 18 and stole 6.

…encontramos diversos navíos grandes, algunos totalmente cargados, otros cargados a medias, y otros listos para ser cargados con las provisiones del Rey para la jornada de Inglaterra[16]. (Calvar Gross *et al.* 1993, Vol. III, Tomo I: 284. Doc. 1646. Archive: SP, CC. 46)

As the invaders had the wind in their favour, Acuña returned to the port with his ship undamaged, despite briefly having sustained cannon fire. The Spanish galleys inspired great respect in the English, however there was no other option, given the wind against them and against a fleet of such a size. Among the English sources is a drawing by the second-in-command of Drake's squadron, William Borough, showing the positions of the ships they found anchored in the bay (*fig.* 7). The place where the Delta II wreck was sunk may be either the one marked "E", corresponding to a group of "*carucuyles and small barkes*", or the spot marked "F", where they found "*Ships, Aragozia, Biscayns hulkes*". The presence of all these ships in this position, in front of the port of Cadiz but not inside it, is explained by the fact that in the 16th century, port installations had been developed beyond a pier surrounded by shallow water. It was therefore common for large merchant ships landing in Cadiz to anchor facing the port and to send a fleet of small boats to and from the port to load and unload the cargo. The element of surprise in the attack and the specific features of the Bay (its shallow waters) made it difficult for the anchored ships to find refuge.

While this was occurring at sea, part of the population of the city of Cadiz was distracted, attending two spectacles: a performance at the open-air theatre and an acrobatic display in the main square. The attack therefore took the city's people by surprise (Tanturri 2012, p. 72). They became aware that the English had entered the Bay of Cadiz when the bells sounded, announcing an imminent enemy attack. At this moment, the city was overcome with a great commotion and confusion. People ran in terror and women and children were sent to the castle and to the city bishop's office, but there was such chaos among people attempting to enter the fortress that between 19 and 27 women and children were asphyxiated or crushed. The governor and the city's main noblemen organised the men to protect the town, stationing them in the areas most vulnerable to English sailors disembarking.

Although the Spanish calculated that Drake was travelling with around four thousand men and were convinced they would disembark, the English did not attempt this. The population remained at arms all night and organised themselves to protect the length of the coast, informing nearby populations and requesting reinforcements. The following day, 30th April, over six thousand men had been gathered with the assistance of the Duke of Medina Sidonia, whose properties stretched across the coast of Cadiz, obliging him to protect them.

As can be seen in the Spanish documentation analysed, the first and only ship sunk by English cannon fire was a Genoese ship which was either loading products for the return voyage to Italy or was already prepared to depart. Nonetheless, Italian sources give a very different account of the English attack, suggesting that Drake's ships had intended

[15] *In the year of 87, on 29 April, Francis Drake entered the Bay of Cadiz with twenty-five navy ships, among these six galleons of the Queen's State, the rest privateers, all medium in size, flying French and Flemish flags in order that upon entering the bay, they would be understood in Cadiz to be ships from those places and owned by merchants, not English navy ships.*

[16] *…We found several large ships, some fully loaded, others partly loaded and others ready for loading with the King's provisions for the voyage to England.*

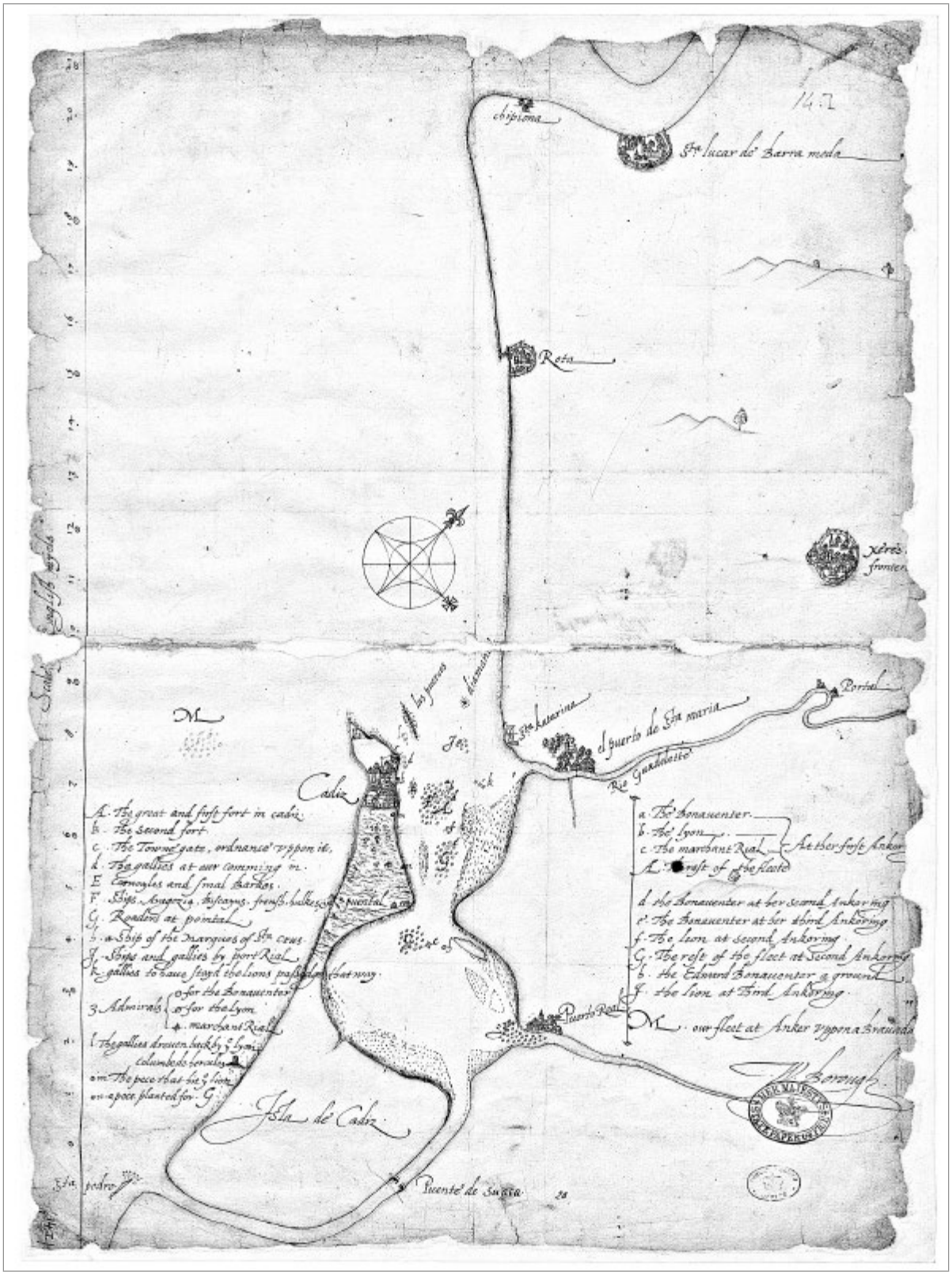

fig. 7 – Borough's map of Drake's attack on Cádiz (United Kingdom – The National Archives, permission MPF 1/318).

to take the Zuazo bridge, the only link between the mainland and the isthmus where Cadiz stood, and therefore the overland entry point for the city's supplies. They would therefore have intended to disembark and take the city by land. Near the Zuazo bridge, however, two galleys were careening, in other words they were without crew or artillery. Having seen the galleys, the English appear not to have dared continue their course towards the bridge, forcing them to discard their attempt to take the city. This large setback provoked Drake, making him want to cause as much damage as possible to the ships anchored in the port. According to Tanturri, … *of these, a Genoese galleon from the Levant stood out for her size. The ship was loaded with goods worth 50,000 escudos and ready to set sail for Italy* (Tanturri 2012, pp. 73-74).

It may appear strange that an English ship would attack a Genoese vessel, taking into account that at that time there was a period of peace between England and the Republic of Genoa. So we can infer that the English sources speak of a ship from Ragusa (*Aragozia*) and not from Genoa thus implying, very probably, a deliberate misidentification intended to excuse Drake for this action. Nonetheless, the attack did take place, perhaps because, as shown in the various documents consulted, the ship could have been very heavily armed. The number of cannon cited in English sources may have been inflated due to Drake's desire to provide information that would increase the value of his victory.

Había en la bahía 60 navíos, y otras varias embarcaciones pequeñas próximas a la fortaleza; unas 20 naves francesas huyeron a Puerto Real, así como algunas embarcaciones pequeñas españolas que pudieron pasar por los bajos. Al poco tiempo de nuestra llegada echamos a fondo con nuestra artillería a un buque de Ragusa de unas 1000 toneladas, armado con 40 piezas de bronce y que tenía una carga muy valiosa[17]. (Calvar Gross *et al.* 1993, Vol. III, Tomo II: 829. Doc. 2477).

However, the version of events recounted by Thomas Fenner (commander of the vessel *Dreadnought*) to Francis Walsyngham (secretary to Queen Elizabeth I of England), cites a smaller number of cannon on the Italian ship, indicating that she was armed with 30 bronze cannon:

A nuestra llegada echamos a fondo con nuestros disparos un navío de transporte de unas 1000 toneladas que llevaba 30 piezas de artillería de bronce e iba cargado muy ricamente[18]. (Corbett 1898, p. 113).

Similarly, an account was given by an anonymous witness in September 1587 of the events that caused the sinking of the Genoese ship:

Antes que este día cerrase con la noche, entraron en la bahía todos los navíos y surgieron sobre el Puntal y Matagorda. Cuando iban entrando, como pasaban cerca de las naos que estaban surtas las iban cañoneando; la primera de ellas, que fue a fondo, era una grande y buena nao genovesa que estaba cargada con cochinilla, cueros, azúcar y otras mercaderías con que ya quería partirse para Italia, que se estimó toda ella en más de setenta mil ducados; y aunque el enemigo la conoció por las armas que tenía, no se abstuvo en ofenderla, antes se presumió puso diligencia en perderla, primero que se le pudiese dar plática de cómo era de la Señoría de Génova, con quien Inglaterra tenía paz y contratación, o porque dejándola libre, tuviera recelo de ser ofendido de ella porque estaba bien pertrechada y artillada, y con echarla a pique se aseguró de uno y otro peligro, sin peligro de romper la amistad[19]. (Calvar Gross *et al.* 1993, Vol. III, Tomo II: 1149. Doc. 2968).

However, it is highly likely that Drake would have been aware of the load the ship was carrying and that that the Spanish Crown was using the Genoese merchant ship to transport various provisions intended to supply the Armada in Lisbon. This theory is supported by information found on the protection provided by the Crown over certain Genoese merchants, including the owner of the *Vassalla piccola*, Pietro Paolo Vasallo. Vasallo was imprisoned in Monaco by order of the Lord of Monaco, Carlo II Grimaldi, who intended to exercise a series of rights in his ports. This circumstance led to protest by the Genoese, who requested the intervention of the King himself through the Spanish ambassador in Genoa.

A record in the Archive of Simancas indicates clearly that Pietro Paolo Vasallo had:

[17] *There were 60 vessels in the bay, as well as a number of smaller boats near the fortress. Around 20 French ships fled to Puerto Real, as did some small Spanish boats which were able to slip by. Shortly after our arriving, we fired on and sank a Ragusa vessel of 1000 toneladas (920 metric tons), armed with 40 bronze pieces and carrying very valuable cargo.*

[18] *Upon arriving, our shot sank a transport vessel of around 1000 toneladas (920 metric tons), which carried 30 bronze artillery pieces and a very valuable cargo.*

[19] *Before night fell, all the ships entered the bay and appeared over El Puntal and Matagorda. As they entered the bay they passed close by the ships anchored there and fired upon them with their cannon. The first of these, which was sank, was a large, fine Genoese nao loaded with cochineal, leather, sugar and other goods, with which she was prepared to set sail for Italy, thought to be worth over seventy thousand ducats. Although the enemy knew of the weapons she carried on board, they did not abstain from attacking. Rather, they were diligent in sinking her, before the ship could express its belonging to the Genoese state, with whom England was at peace and traded, or because they suspected that leaving her be, she may attack them, as she was well provisioned and armed, and by sending her down they were saved from both dangers, with no risk of breaking the friendship.*

servido bien en esta jornada de su Majestad la emperatriz[20], *he escrito en su recomendación dos veces y últimamente a instancia de esta señoría habiéndome con dos senadores hecho entender que en ello recibían agravio y por ser Vasallo y debajo del amparo de Vuestra Majestad el dicho señor de Monago no se resentían de lo hecho y tenían por bien proceder con el con todo comedimiento pero me pedían que yo le escribiese (como lo he hecho) pidiéndole que muestre sus privilegios y con que titulo se mueve ha hacer lo que hace porque si sus privilegios le conceden que pueda hacerse pagar los daños que el pretende se pasara aquí por ello y yo lo procurare y cuando no tenga tan fundada su pretensión véase remediarlo con el tiempo y con gusto que de otro modo aquí no pasaran por ello ni Vuestra Majestad gustara que esta Republica que esta debajo de su protección y que quiere y ama tanto reciva agravios de nadie y mas de personas dependientes y arrimadas a su real amparo*[21] (AGS, ES, Leg, 1416, 29).

As has already been mentioned, the Genoese ship was being employed to transport not only various commercial goods, but also indispensable elements for arming the ships that were to participate in the attempt to land on English soil. Key elements among these materials are the anchors and artillery, which were to be unloaded in Cadiz for subsequent transport to the city of Lisbon.

According to the documentation consulted, the *Vassalla piccola* had arrived at the port of Cartagena, like many ships voyaging from Italy. At that time, Cartagena was not only a military port, but also acted as the *Proveeduría de Armas y Fronteras* ("Provider of Arms and Frontiers)", meaning it was one of the ports which, among other products, received artillery and ammunition from Italy for storage. Upon arrival in Cartagena, the ship was charged with an important mission: transporting artillery from there to Cadiz.

As explained above, during the archaeological excavation that was carried out, the hold of the ship was found to contain five bronze cannon, one iron bombard and two iron anchors, all perfectly stowed; these were subsequently analysed.

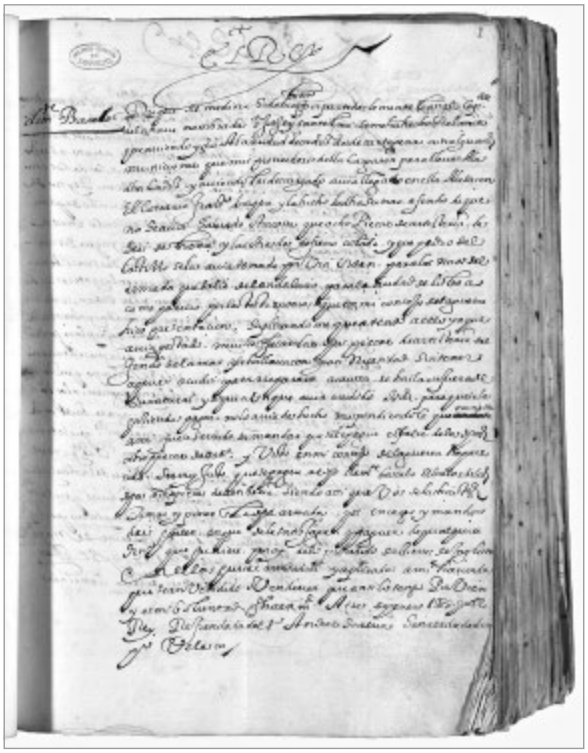

fig. 8 – *Record dated 3rd January 1588 in which the King of Spain orders Clemente Bassalo (Vassallo), captain of the San Jorge y San Telmo (San Giorgio e Sant'Elmo), has to be paid for the guns recovered from his ship foundered by Drake (Spain – Ministry of Education, Culture and Sport. Archivo General de Simancas. GYM, LIB, 49, 1).*

The documentary information once more yielded important data on the presence of these pieces of artillery in the ship, as well as providing the true name of the ship then captained by Clemente Vassallo: *San Giorgio e Sant'Elmo* in Italian

Therefore, on 3rd January 1588, King Philip II ordered the Duke of Medina Sidonia to pay for artillery pieces which were recovered from a ship sunk in Cadiz during Drake's attack and taken by the armada (*fig.* 8):

Duque de Medina Sidonia, primo. Por parte de Clemente Bassalo, capitán de la nave nombrada San Jorge y San Telmo, se me ha hecho relación que habiendo ido a la ciudad de Cádiz, desde Cartagena, con algunas municiones que mis proveedores della cargaron para llevar a la dicha Cádiz, y habiéndolas descargado, avía llegado en ella a la sazón el corsario Francisco Draque y la echó la dicha su nao a fondo, de que no se havía otra cosa que ocho piezas de artillería, las seis de bronce y las otras dos de hierro colado; y que Pedro del Castillo se las había tomado por una orden para las naos dél, como pareció por los testimonios que en mi Consejo de Guerra hizo presentación, suplicándome que atento a ello y a que

[20] She was Maria de Austria (1528-1603), sister of the King of Spain Felipe II and wife of the the emperor Maximilian II.

[21] *Served well on this day of her Majesty the Empress. I have written twice recommending him and finally, at the request of the ruler, having been made to understand by two senators that they considered this a grievance, and that as Vasallo is under the protection of Your Majesty, the Lord of Monaco held no resentment for his deeds. They explained that their intent was to proceed with him with all moderation, however they requested that I write to him (as I have done) to request that he show his credentials and under what title he acts, because if his credentials grant him the damages he claims should be paid to him and that I should procure. If his claim is not founded, his deeds shall be corrected in time and with pleasure, that such treatment should never take place here; neither should it please Your Majesty that this Republic, under your protection, which loves you so, should receive grievances from anybody, particularly people who depend upon your royal protection.*

había gastado mucho en sacar las dichas piezas de artillería del fondo de la mar y se hallaba con gran necesidad sin tener a quien acudir para repararse, a causa de hallarse fuera de su natural y a mí, fuese servido de mandar que se le pague el valor de las dichas ocho piezas de artillería. Y visto en mi Consejo de la Guerra ha parecido ser muy justo que se pague el dicho Clemente Bassalo el valor de las dichas ocho piezas de artillería, siendo así que vos se las hicisteis tomar y poner en la dicha armada; y os encargo y mando deis orden en que se les satisfagan y paguen de cualquier dinero que hubiere por ahí, de lo procedido de bienes ingleses o de las urcas arrestadas y aplicadas a mi hacienda que se han vendido.
o bien dieren, que ansí lo tengo por bien y es mi voluntad.

La de la nao del Marqués de Santa Cruz,	
que son ocho pieças de bronce y seis de hierro colado	*14 pieças*
En la Puente, seis pieças de hierro colado	*6 pieças*
Rafael Boquín, diez pieças, seis de hierro colado	
y cuatro de bronze	*10 pieças*
En la playa de Cádiz ay otras diez pieças	
de hierro colado	*10 pieças*
De la nao genovesa, que tiene diez pieças de bronze	
y ocho de hierro colado, se han sacado hasta ahora	
tres pieças; entiéndese se sacarán las demás	*18 pieças*
Total	*58 pieças*

Fecha en Madrid, a tres de enero 1588. Yo el Rey. Refrendada del secretario Andrés de Alva; señalada de don Pedro Velasco[22] (Calvar Gross *et al.* 1988-1993, Vol. III, Tomo III: 1661. Doc. 3666. Archive: AGS, GA, L. r. 49, p. 1).

Following Drake's attack and the loss not only of the ships but also of many pieces of artillery, orders were given to recover as many cannons as possible from underwater where the battle took place. On 16th May 1587, the Duke of Medina Sidonia forwarded a list, shown here, of the number of bronze and cast iron artillery pieces, recovered from ships sunk in the bay by Drake, which were available in Cadiz for the Armada being assembled in Lisbon (Calvar *et al.* 1993, Vol. III, Tomo I: 245. Doc. 1583. Archive: AGS, GA. Sec. M y T., Leg. 221-35).

Drake was able to take a good quantity of wheat, wine, raisins, cochineal, various other goods, 2,000 *quintales* of biscuit and 200 muskets that had been destined for the Spanish Armada. According to an account sent to Philip II by the House of Trade, he sank the Genoese ship, apparently in a fit of rage after being unable to invade the city. The losses were calculated at 172,000 ducats. Drake did not leave Cadiz carrying the treasure of a fleet from the West Indies, however he did doubtless inflict great damage which would have a heavy impact on the usefulness of the armada with which Philip II intended to invade England.
Word was immediately sent to Lisbon and the overseas territories to prepare their defences in order to prevent further attacks by this or by other squadrons. Drake ascended first the coast of Huelva and then the coast of Portugal, attacking fortresses, such as the castle of Sagres, and even simple fishing boats. He ultimately arrived at Lisbon, where he exchanged several rounds of artillery fire with the Spanish, but decided not to give battle. He decided to sail for the Azores to await the fleets from the West Indies, although he encountered only a Portuguese carrack returning from Brazil. Her cargo of gold, spices and silk, worth 108,000 pounds, compensated his failure to invade the ports or to destroy the armada in Lisbon. Queen Elizabeth (who had a 50% share of the proceeds) saw her coffers filled and struck a heavy blow against Philip II, as in addition to the damage inflicted, she obtained information on the defences of Cadiz and the Portuguese coasts and the armada being prepared against her. Drake, who was entitled to 10% of the loot, would also surely have considered himself fortunate.
The death of the Marquis of Santa Cruz several months afterwards was said to have been caused by the grief brought on by this English attack. The Duke of Medina Sidonia, unexperienced at sea, was occupied with his position as the commander of the Spanish Armada, while the losses caused by Drake involved increased spending and the delay of the fleet's departure until August 1588. The outcome of Felipe II's "Great and Most Fortunate Navy" (*Grande y Felicísima Armada*) was tragic due to the combination of several circumstances, but there is no doubt that Drake played an important part in the defeat, not only for his distinguished participation in the battle, but also for this attack on Cadiz a year earlier.

[22] *Duke of Medina Sidonia, my cousin. I have been told by Clemente Bassalo, Captain of the ship named San Jorge y San Telmo, that having travelled from Cartagena to Cadiz with certain munitions loaded by my suppliers Della for transport to Cadiz, and having unloaded these, the corsair Francis Drake arrived and foundered said nao, which carried none other than eight pieces of artillery, six in bronze and another two in cast iron. Pedro del Castillo had been ordered to take these to his naos, according to testimonies he made before my War Council. He asked me that on account of this and due to having had to recover the artillery pieces from the sea bed, at great cost to him, he was in great need and had nobody from whom to seek reparation as he was outside of his native land; I decided to order that he be paid the value of said eight artillery pieces. Given that my War Council considered it most just for Clemente Bassalo to be paid the value of said eight artillery pieces, and it having been you who ordered they be taken and put in said armada, I commission and order that you order that he be satisfied for them and paid whatever money there may be, proceeding from English assets or from the cargo ships seized and transferred to my fortune that have been sold or given. This is my decision and my will. Dated the third January 1588, Madrid. I, the King. Endorsed by the secretary Andrés de Ávila, bearing the sign of Pedro Velasco.*

4. The bronze ordnance and wrought iron bombard recovered from the wreck

The chapter on the excavation of the wreck already explained how seven bronze cannon were found and recovered. Two of these (CNN 1-2) were placed at the stern of the ship, while the other five were stowed in a block in the centre of the hold, together with a wrought iron bombard. Two anchors were placed above these guns and the whole ensemble was packaged inside the wooden planks at the bottom of the hull, with part of the ballast stones having formed a concretion with the lower pieces (*fig.* 9).

These positions mean the bronze pieces labelled CNN 1 and CNN 2 represented elements of the ship's artillery equipment, while the others (CNN 3 – CNN 7), all of the long barrel type, belonged to the ship's cargo and were simply being transported. The bombard was given the identification numbers CNN 8 to CNN 10, as this weapon was composed of a barrel and two removable powder chambers.

Some of the archival records examined in the previous chapter informed us that, in the period immediately following the sinking of the *San Giorgio* / *Vassalla piccola*, the Spanish authorities in Cadiz thought they could recover 18 pieces of artillery, 10 bronze and 8 cast iron, from her wreck. These guns, together with a further 40 pieces recovered from other ships sunk during Drake's raid, had to be sent to Lisbon to add to the Armada's armaments, with the owners being refunded for their value. Besides, from another archive we knew that Clemente Vassallo was reimbursed only for the 6 bronze cannon and 2 cast iron ones that were actually recovered, meaning the quoted 18 pieces represented the ship's equipment of which the aforementioned two *Petrieri* (CNN 1 and 2) appear to be the only specimens.

All the bronze guns found in the Delta II wreck were immediately recognisable as belonging to a Genoese production. They show some characteristics typical of a number of pieces cast in Genoa during the 16th century, such as, for example, the breech mouldings ending in a globular button with central ribbing and a small hemispherical protrusion at the rear. In addition, two squared holes are clearly visible in the base-rings of all the pieces found in the wreck; these represent the prints of an iron handle, an extension of a crown-piece that

fig. 9 – *The stowed bronze cannons and anchors recovered from the wreck in an unique block containing also pebbles of ballast (photos:* Tanit *Gestión* Arqueológica).

fig. 10 – *Iron handles protruding from the baserings of 16th-century cannons (above) and their prints left on a Genoese exemplar after their disintegration (arrangement: Renato G. Ridella).*

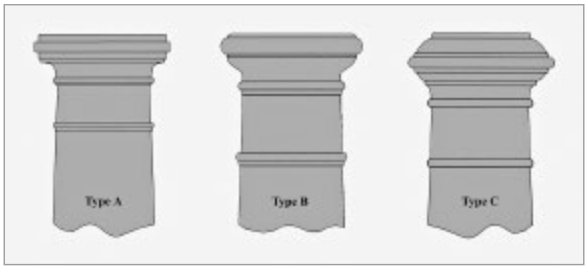

fig. 11 – *The evolution in the shape of the Genoese muzzle mouldings during the 16th century (drawing: Renato G. Ridella).*

held the bore mould still during casting, which was used also as a rear sight. This has been fully corroded by the salt water in the pieces recovered from the sea, while in those which remained on dry ground, the holes still contain only rusty bulges, and in a very few cases the whole handle (*fig.* 10). Also, the general appearance articulated on a single reinforce and the shape of the muzzle mouldings confirm this attribution[23].

Regarding the muzzle mouldings, that is, the swell of the barrel at its front end, intended not only for aesthetics but also to strengthen it where its walls are thinner, we consider it necessary here to discuss these in further detail. Among our seven cannon, two different shapes of mouldings are present, and this can be useful in dating them. In published works concerning 16th-century Genoese bronze artillery, in which the particular muzzle mouldings were found to represent an element by which to identify pieces with this provenance (Ridella 2004, pp. 29-30 and 2011, p. 48), two types of shape have been recognised. The older one, which from here on will be referred to as Type A, should have been introduced in Genoese guns at the beginning of their production in the late 15th century and probably persisted until the 1550s. It is characterised by a shape resembling a simple capital with a sharp-edged profile, characterised in the heavier pieces by a fillet protruding at mid height from the abacus (*fig.* 11, A). Up to now, the more recent pieces showing this feature are datable with a certain reliability to the late 1550s or early 1560s (*fig.* 12).

This type seems to have been replaced by a model of muzzle moulding with a more complex, rounded shape, labelled here as Type C (Fig 11, C) (by-passing Type B; this will be explained shortly). Its adoption could be the result of foreign influences, represented for example by the shapes of mouldings in pieces produced at least from the early 1540s in the German and Flemish areas by renowned founders like Gregor Löffler and Remy de Halut, respectively (Egg 1961, pp. 128-157; Roosens 1978, pp. 183-197). Some pieces with Type C mouldings can be dated with certainty, as they bear their casting years, marking the period of the introduction of this new shape. The earliest is represented by a Demi Cannon (*fig.* 13) cast in 1565 by the Genoese founder Giacomo Merello when he was working in the service of the Duke of Savoy, Emanuele Filiberto, in the foundry of Montmellian (Ridella 2014, p. 28). It is also possible that this form was adopted slightly later by Genoese founders working at home, as it first appears in pieces cast by Dorino II Gioardi in 1570 for the equipment of the Catalan merchant ship *La Juliana* (850 metric tons), embargoed and enrolled in the Levanter (Mediterranean) Squadron of the Spanish Armada and sunk in Sligo Bay (Ireland) on 26th September 1588 (Birch 1998, 4. *La Juliana*: 40). Eight of these bronze guns (*fig.* 14) bearing a D on their touchhole, Dorino's initial letter, were recovered from this wreck in 1985 and 2015 (McElvogue 2002; Ridella 2004; Moore *et al.* 2015).

[23] As ways to recognize the Genoese bronze cannon, they have been discussed in more detail in other works (Ridella 2004 and 2011).

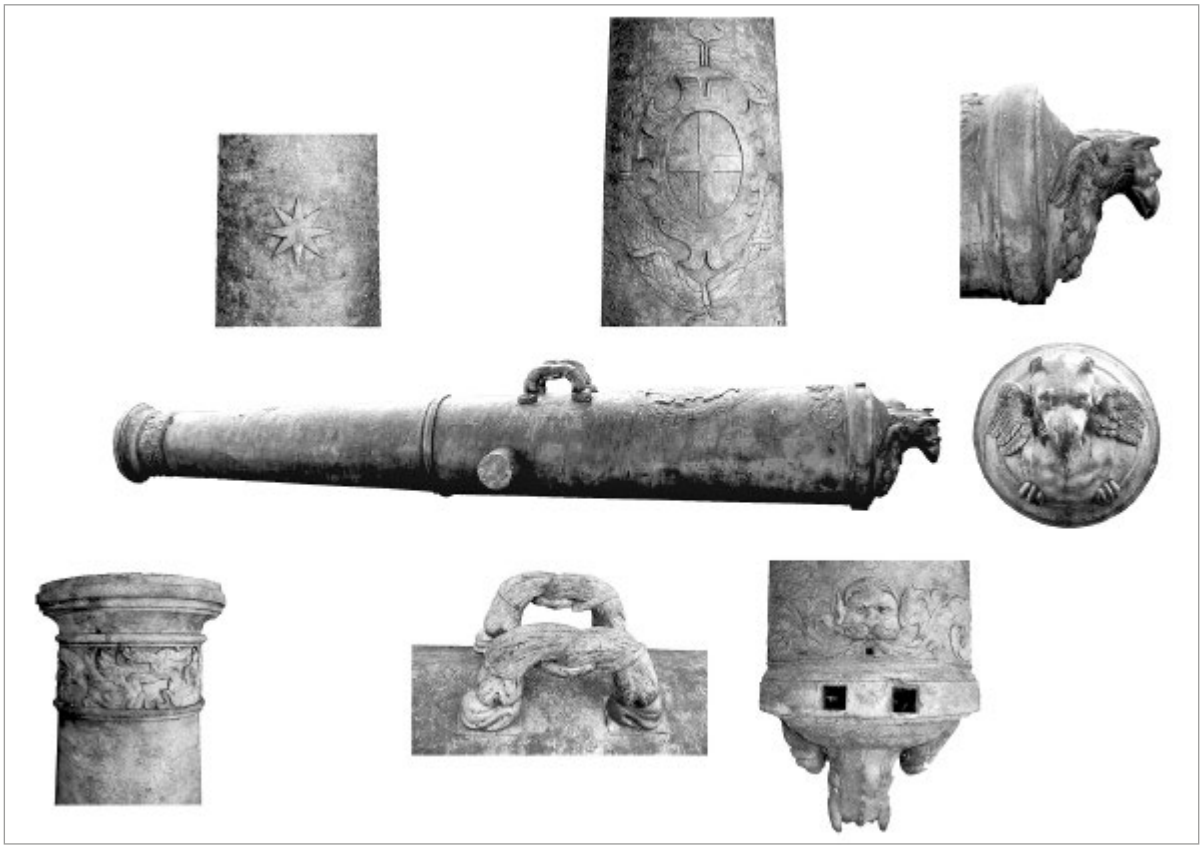

fig. 12 – *A Genoese battery Cannon cast late in the 1550s showing Tipe A muzzle mouldings. It was kept in the now closed Royal Artillery Museum at Woolwich (GB) and was attributed to the founder Gregorio II Gioardi (from* Ridella *2006).*

fig. 13 – *Demi Cannon, cast in 1565 by the Genoese Giacomo Merello for the Duke of Savoy Emanuele Filiberto, now in the Venetian fort of Koules at Heraklion Up to now it represents the oldest piece with Type C muzzle mouldings (photos: Carlo Beltrame).*

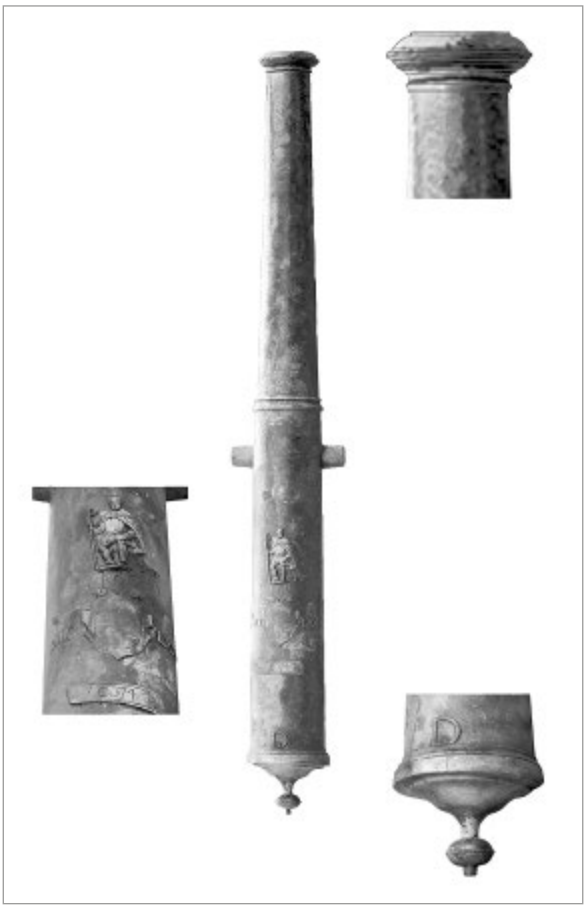

fig. 14 – *One of the pieces recovered in July-August 2015 from the wreck of La Juliana in the Sligo Bay (Ireland). It bears the D of Dorino II Gioardi, the casting year 1570 and Type C muzzle mouldings (from* Moore *et al. 2015).*

Continuing to speak of the Type C muzzle mouldings, we can observe that it remained a practically unchanged characteristic also in the Genoese bronze cannon of the following two centuries.
Until a short time ago, only the two types of Genoese muzzle mouldings (A and C) cited above appeared to exist; however, recently recognised pieces, including some from the Delta II wreck, have a different form, with elements common to both types. This consists in an astragal followed by a sector with a cyma-reversa (or ogee) profile, followed by a small groove and a wide astragal (torus) between two slightly curved fillets. This transitional shape suggests that its chronology is intermediate with respect to the other two, for which reason we could call it Type B (*fig.* 11, B). There are currently no elements for the precise dating of this shape, but based on what we have just said, we can generically place it in the 1560s and with a higher probability in the first half of that decade.

Let us now describe and analyse in detail each of these cannon, aiming to date them and to identify their makers. Lay readers are advised to look at the respective drawings (*fig.* 15) in order that they may more easily understand the terminology and the references to the dimensions of said pieces.

Pieces CNN 1-CNN 2 (*fig.* 16)

These two cannon are practically identical, having the same shape and similar dimensions and weights. They have a rather stubby structure, being roughly two metres long and having a bore diameter of 162-164 mm, meaning a length in conventional terms of about 11 bores, a typical feature of a class of short barrelled pieces. These pieces are those called *Petrieri* ("stone-throwers") in Italian, as they usually fired a stone ball or a metallic basket (*lanterna*) filled with lead shot. Another characteristic of these guns was the narrower diameter of the powder chamber (the portion of the bore that housed the firing charge) compared to the part of the bore where the stone shot was loaded and then launched. This solution, derived from the old bombards, allowed for thicker barrel walls in the area where firing gases were at higher pressure, with thinner walls in the remaining part, enabling relatively lighter pieces to be built. Such a compact structure was particularly suited to guns which had to be used in narrow spaces, like the casemates of bastions or inside ships; although at a rather short range, *Petrieri* could be very effective, especially as anti-personnel weapons. For this reason, they were extensively used in a defensive role aboard Mediterranean merchantmen, and it is very probable they were placed in the lower deck, firing through the gun ports, as the location of the two in the *San Giorgio* wreck would suggest.
As in that period, the main threat for commercial navigation in this sea were the flotillas of Barbary fast oared ships, foists or galliots; their task was to batter these from short range, just before their attempt to board, aiming to hit their attacking crew with their stone or canister shot.
In the second half of the 16th century, *Petrieri* became a typical type of Genoese artillery (Ridella 2011, pp. 50-51), having been produced in large amounts by Genoese founders for ship-owners not only from Genoa but also from Spain and Ragusa (present-day Dubrovnik). One example is the Catalan merchantman cited above, *La Juliana*. Additional evidence of this is represented by two of these pieces (*fig.* 17), cast in Genoa very probably

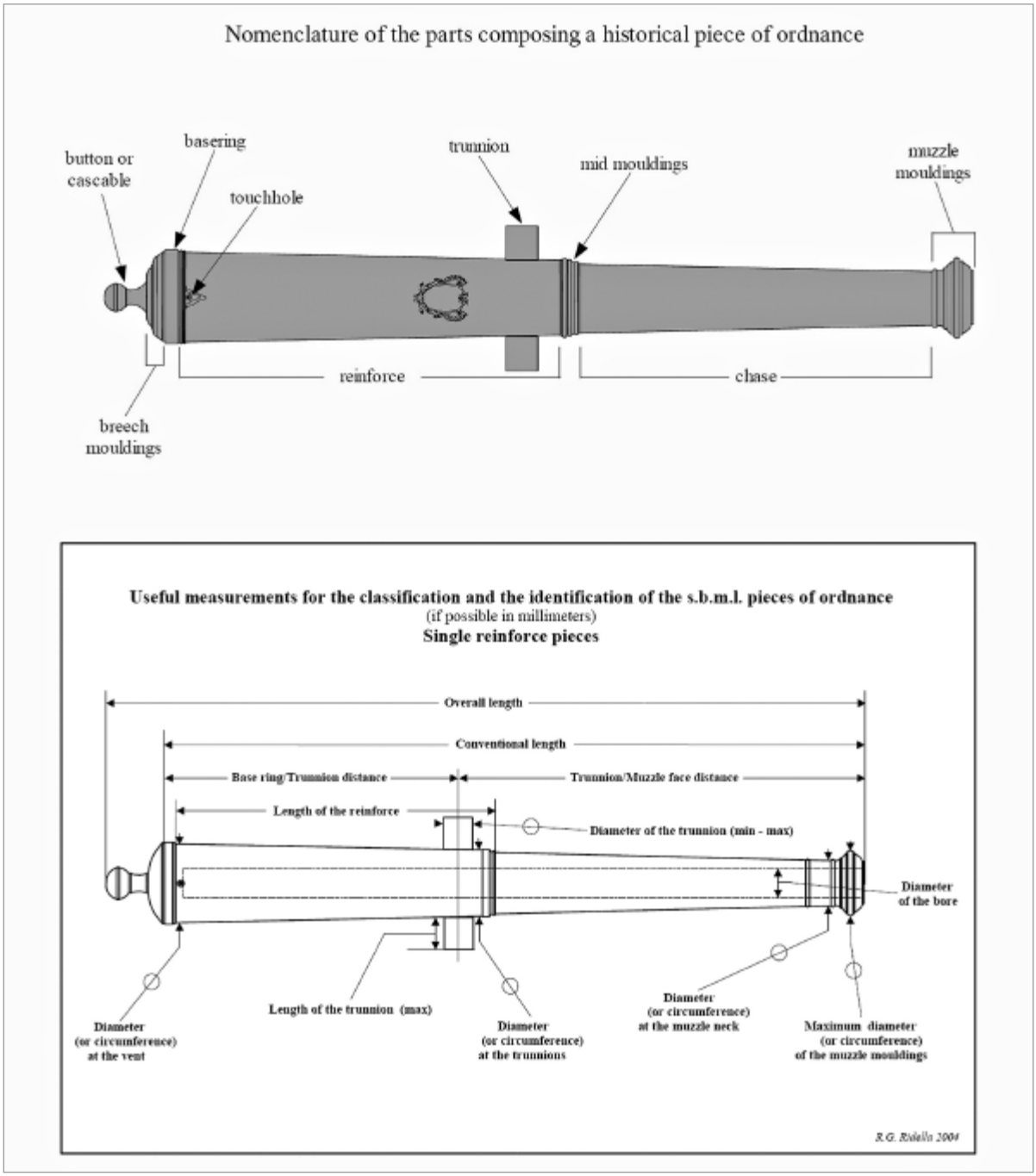

fig. 15 – *The terminology currently used to describe a 16th-17th-century cannon with a single reinforce and its fundamental measuring (drawing: Renato G. Ridella).*

by Francesco Sommariva in the last decades of the 16th century, recovered from a wreck off the islet of Grebeni (Radić Rossi 2011, p. 67), near the Adriatic island of Vis (Croatia). This geographic position may suggest the corresponding ship came from Ragusa; additionally, some archival records confirm the use of Genoese *Petrieri* aboard Ragusan ships. In fact, the inventory, dated 5 December 1578, of the merchantman *Santa Maria della Croce* (900 metric tons) owned by Florio di Florio (Cvieto Cvietić), lists two of these guns among 12 bronze and 5 cast iron pieces, in addition to 10 wrought-iron swivel guns. These *Petrieri*, like the other 10 bronze pieces, present weight marks expressed in Genoese

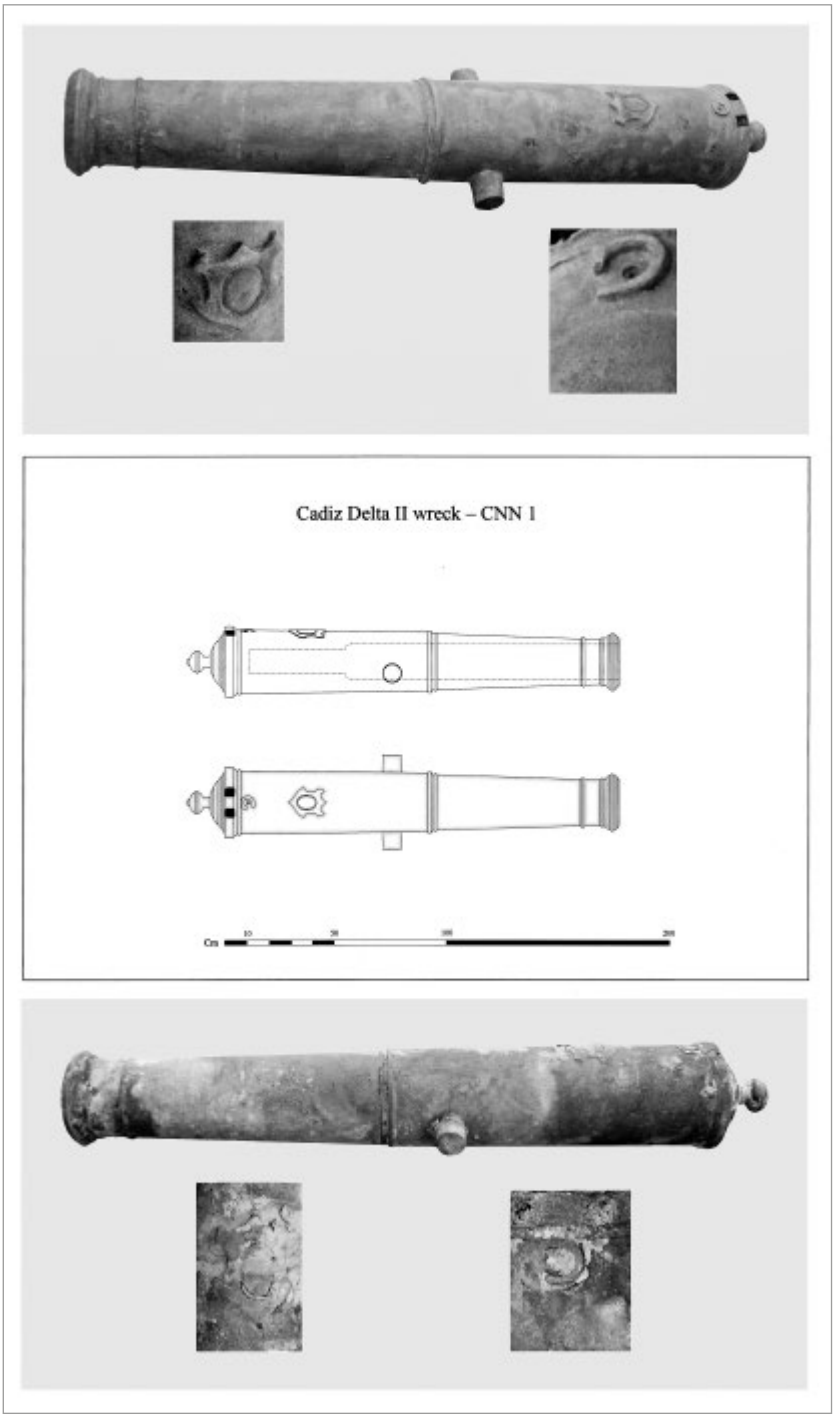

fig. 16 – *The two Petrieri with the G of Gregorio II Gioardi on their touch-holes recovered from the Delta II wreck (photos: José M. Higueras – drawing Renato G. Ridella).*

units (8.62 *cantara* and 8.98 *cantara*, equivalent to 411 and 428kg, respectively), a sign they were all produced in Genoa (ASGe, NA, f. 2680, *not. Francesco Carexeto*, 5.XII.1578). Furthermore, the register of expenses of the Ragusan ship *Santa Maria Maddalena* (400 metric tons) informs us that when she arrived in Genoa in July 1581, her captain Gio. Simone de Menze strengthened her artillery equipment, purchasing two bronze *pedreri grossi* (large *petreri*) and two swivel guns from the local founder Gregorio II Gioardi (DADU, *Libro delle spese della nave Santa Maria Maddalena*, 1.VII.1581). This name should be noted because, as will be better explained below, he was almost certainly the creator

fig. 17 – *A pair of late 16th-century Petrieri, cast in Genoa by Francesco Sommariva, recovered from a wreck off a Croatian island in the Adriatic Sea (from* Ridella *2011).*

of the similar pieces concerned here. This archival information is of great interest, as it demonstrates that navigation in the western Mediterranean was more perilous that in the Adriatic sea, where this ship had always sailed before.
Returning to the two *Petrieri*, in addition to the special feautures, described briefly above, that signal them as Genoese, we can also observe the presence of a stylized G in shallow relief, aligned with their touchholes. This is the initial letter of the name of the craftsman who cast both of them; we find it again on piece CNN 6. As we have just asserted, this would be the Genoese founder Gregorio II Gioardi, and the G does not refer to his surname but to his first name, a use which has been better defined elsewhere (Ridella 2007, pp. 14-15) and which is confirmed in the other bronze guns recovered from the wreck.
Further forward and again on the reinforce, a very simple crest is visible, also produced in the casting process and comprising a smooth oval shield inside an essential cartouche motive. It is the typical mute coat-of-arms (*scudo liscio*) present on the Genoese bronze guns produced to equip private merchant ships; we occasionally find letters and symbols engraved on them, as in piece CNN 5, recalling the ship-owner or the trade company.
These cannon do not show any weight mark, but their mass has been measured and quantified at 562 and 575 kg respectively, roughly equivalent to 12 Genoese *cantara*; this evidence allows us to place them in an intermediate category between the medium and the heavy weapons of this class (Ridella 2011, p. 50). Their bore diameters which measure 162 and 164 mm, corresponding to the use of stone shot weighing 13-14 Genoese pounds (4.200 kg), also lead to this conclusion.
Looking at the front end of these pieces, we can immediately recognise that their muzzle mouldings belong to the above described type C.

The longbarrel pieces CNN 3-CNN 7

We have already seen that the other five bronze cannon were not placed in a combat position, but simply stowed in the ship's hull. At first sight, they appeared all to belong to the category of long barrel pieces devoted to long range firing, which would certainly include some of the others installed on the *Vassalla piccola* and which were recovered, as we have seen, shortly after her sinking. This detail confirms the hypothesis that the longer guns had to be placed on the main deck, as their length, added to that of the wooden carriage, which amounts to more than four metres in the heavier examples, made them difficult to load and operate even on deck[24], let alone on lower deck, which in a merchantman would also have been cluttered with goods. This could explain the reason for which the two *Petrieri* (CNN1 and CNN 2) could not be raised from the *San Giorgio* soon after her sinking in 1587: being placed in her interior, they could not be reached and engaged by the hooks used for the recovery. Indeed, we must consider that, accounting for the depth and turbidity of the water, no human underwater operator of the time would have been able to accomplish such a task.
In general terms, long range cannon equipping merchant ships and reasonably placed on their main deck were used to hit, or at least to keep away, corsair or pirate vessels attempting to approach and board the merchantmen. To fulfil this function effectively, they had to fire the highest possible number of their cast iron shots before the enemies could approach, starting from the time they were sighted. It therefore seems unnecessary to explain the importance of quick handling of the guns, when there was a very serious risk of sailors losing not only the ship and its cargo but also their freedom, with the possible consequence of becoming an article for sale in a slave market in Algiers or Tunis.
After this indispensable premise, let us study and briefly describe each of these guns, taking into account that, being under restoration, their bore diameters could not accurately be measured owing to the incrustations occupying their bore.

CNN 3 (*fig.* 18)

The conventional length (c. 245 cm) and approximate bore diameter (c. 90mm) of this gun put it in the category of the Sakers, in this case employing

[24] Martin & Parker 1988, pp. 198-201.

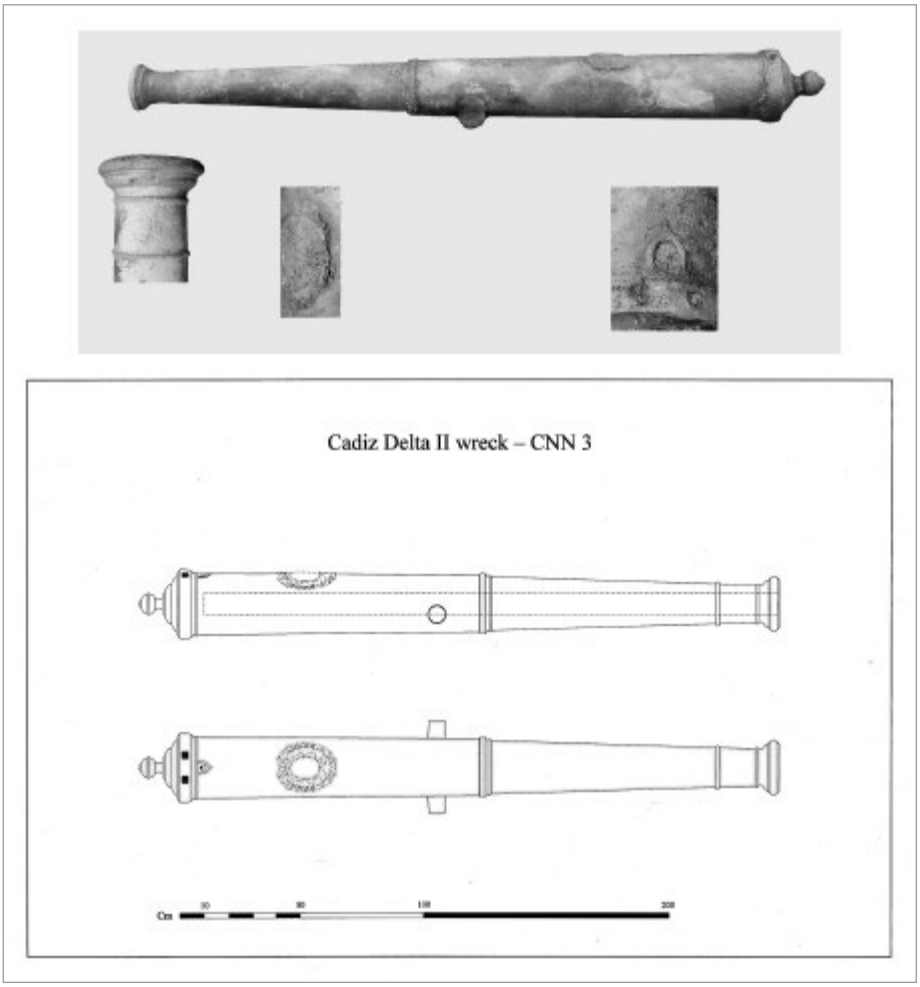

fig. 18 – *The CNN 3 Saker of a not yet identified Genoese founder (photos: José M. Higueras – drawing Renato G. Ridella).*

cast iron shot of 7 Genoese *libbre*, roughly equivalent to 5 Spanish *libras* (2.300 kg)[25]. This spherical shot, taking the value 7.0 as a reasonable specific gravity, would have had a diameter of 84.5 and 86 mm respectively. Among the different Spanish shot diameters represented in a drawing at the Archivo General de Simancas, the 5 *libras* shot measures 86 mm (AGS, MPD, 51, 005). The theoretical bore diameter of a gun employing 7 Genoese *libbre* shot, according to the treatise of Luis Collado (1586, c. 54r), which sets this value at 21/20 of the shot diameter, should have been 89 mm. The difference between these two sizes, called windage, and in this case amounting to 4.5 mm, was necessary to avoid the jamming of imperfect shots inside the bore. Furthermore, we can perceive that the ratio between the conventional length (2,452 mm) of this piece and the quoted calculated shot diameter (84.5 mm) is almost exactly 29, a value well within the range of values for long barrel cannon, which ranged from 28 to 32, and as much as 35 in some cases.

Having made these essential considerations, which can also be extended generally to the other pieces described below, let us briefly consider the few distinctive characteristics of CNN 3. The button, breech mouldings and base-ring are quite similar to those described above and to the following examples; however in this piece, the initial on the touchhole that should refer to the founder appears as a pointed U, or perhaps a V. The coat-of-arms placed on the reinforce is not easily legible because of the concretions covering it, but its shape shows an articulation which could be close to that of piece CNN 5; this will be described in detail ahead. Before this element, no weight mark appears engraved

[25] This difference is due to the fact that the 12-ounce Genoese *libbra* is equivalent to 317.66 grams, while the 16-ounce Spanish *libra* is equivalent to 460 grams.

in the bronze, unlike three of the other guns. However, a weight-volume calculation compared with the dimensions and weight of the marked pieces, in which the specific gravity[26] of their alloy is shown in relief, equal to 8.64, puts the weight of the gun at 672 kg, very close to that of CNN 5, which is marked with a weight of 14.04 *cantara*, equivalent to 670 kg. These values are quite appropriate for medium-weight Genoese Sakers, whose external diameter near the touchhole measured three times the shot diameter (254 mm from calculation, against the 252 measured on the piece).
The rest of the reinforce and the chase do not show other distinguishing features, as they completely lack inscriptions and decoration with the exception of an astragal placed around 20 cm before the muzzle mouldings. The mouldings, rather different from those on the pieces previously seen (CNN 1 and CNN 2), are composed of another astragal followed by an element with a cyma-reversa (ogee) profile. Then, after a small groove, we find a wide astragal (torus) between two slightly curved fillets. As for the shape of its muzzle mouldings, these can be categorised under Type B.
Finally, the craftsman who cast this piece is more difficult to identify, as no founder whose first name began with V was active in Genoa in the period we have attributed to guns with Type B muzzle mouldings (first half of the 1560s). Vincenzo Sommariva had moved to work in Middelburg, then in Spanish Zealand, perhaps early that decade, dying there in 1569 (Ridella 2009, p. 37), while Vincenzo II Gioardi, nephew of Gregorio, cited above, would at that time have been little more than a boy (Ridella 2009, p. 33). This problem has arisen in the past, as at least five other surviving Genoese cannon with a V on their touchholes were known before this one; however, up until now, a convincing answer has not yet been found.

CNN 4 (*fig.* 19)

This piece is of a lower category than the one discussed above. Indeed, its bore diameter (74 mm) and length (220cm) are smaller, suggesting it could be classifiable as a Falcon, which could fire 4 Genoese *libbre* cast iron shot (1.270 kg) with a theoretical diameter of 69 mm, giving a quite reasonable windage of 5 mm. This hypothesis is confirmed by the fact that the shot diameter multiplied by 32 gives a value (2,208 mm) practically equal to the conventional length of the piece. As well as the size, the shape of this gun is perfectly similar to that of the previous one, but showing a simple mute coat-of-arms similar to those seen on the two *Petrieri* CNN 1 and CNN 2; like those guns, this Falcon has Type C muzzle mouldings.
As it lacks a weight mark, its mass had to be calculated; using the previously described procedure; we arrived at a result of 417 kilograms, equivalent to 8.75 Genoese *cantara*, typical for medium Falcons. To give an example, a Genoese piece of this category recovered from the wreck of *La Juliana*, specifically the one bearing the figure of Saint Sebastian, is marked 8.54 *cantara* (407 kg). In our case, the external diameter measured at the touchhole (216 mm) is slightly in excess of three times the shot diameter (207 mm).
In this piece we can observe a founder's mark, composed of a B with a vertical line protruding upward, suggesting the presence of an I. This monogram has been attributed to Giovanni Battista Gandolfo, representing the initials of his first names, *Iohannes Baptista* in Latin (Ridella 2009, p. 32).

CNN 5 (*fig.* 20)

This exemplar, another Saker, is very similar to CNN 3 both in shape and dimensions; therefore, as regards its structural and functional aspects, we can refer to the description of CNN 3, with which it also shares the Type B shape of muzzle mouldings. This piece, unlike the other ones, presents a slightly more elaborate coat-of-arms, which in its twin CNN 3 could only be perceived beneath the concretion. Indeed, its usual oval shield inside cartouches is encircled and enriched by a laurel wreath and shows a carved monogram composed of a P over a B, both sharing the same vertical line. We have already seen that these letters and symbols referred to the private owner or owners of the cannon, generally represented by one or more of the financers who shared the ownership of the merchantman. Purely as a hypothesis, we could tentatively attribute these initials to the Genoese captain Paolo Bozomo who, early in the 1580s commanded, and possibly owned shares in, the *Santa Maria Annunziata*[27], at the time engaged in the same trade, already mentioned, as the *San*

[26] In an 18th century treatise (Muller 1780, p. 3) the specific gravity of cannon bronze (10% tin) is given equal to 8784 ounces/cubic foot, equivalent to 8.76 kilograms/cubic decimetre.

[27] We have archival information about this merchant ship for 1581 (ASGe, SG, S 14, n. 1477 – *Venute Orientis*, 22.III.1581; *ibid.* n. 1288, 9.VI.1581 and 1.VII.1581.ASCGe, PC, n. 74m, 2.V.1581, 18.XI.1581), after which she disappears from records, perhaps due to decommissioning.

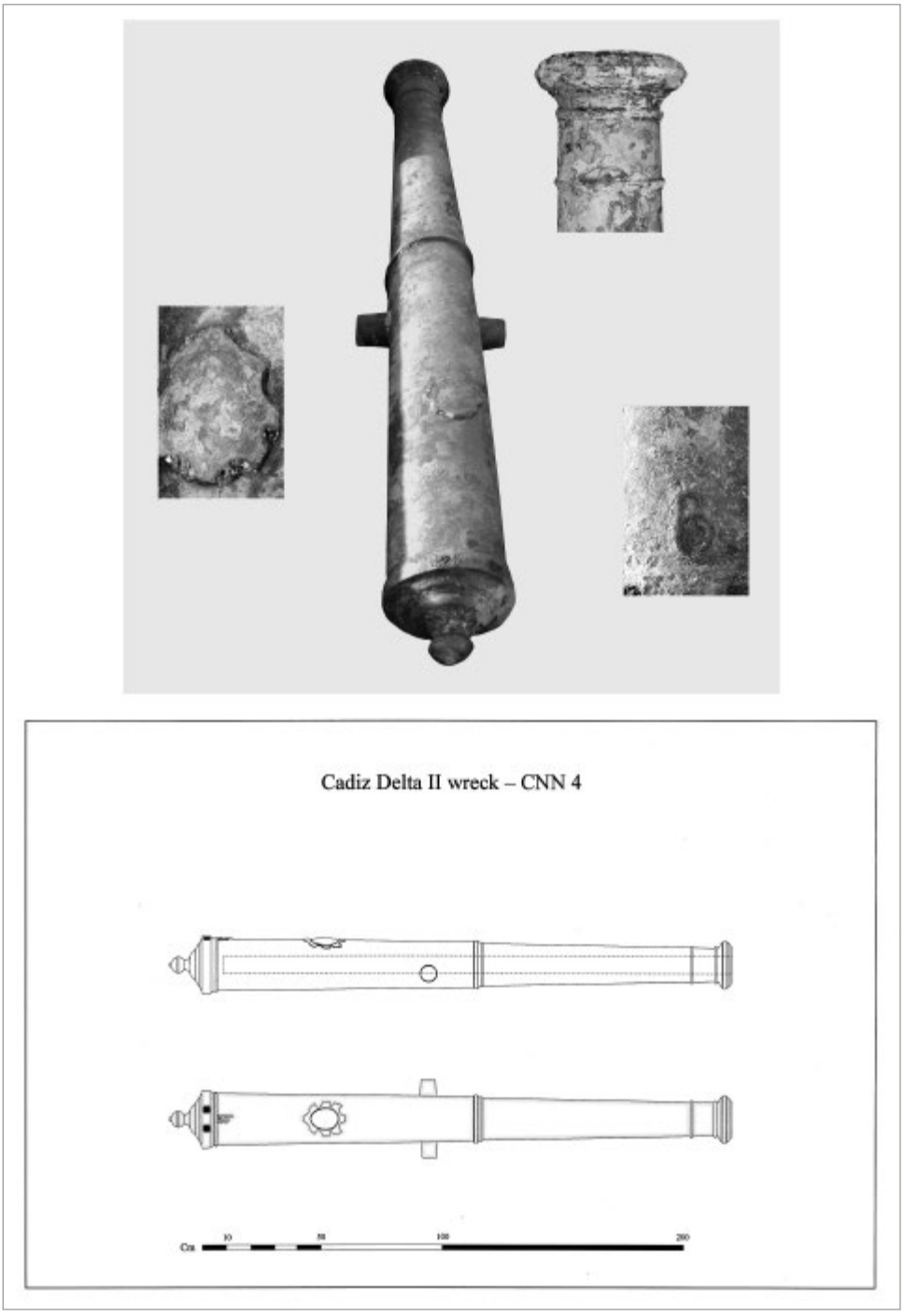

fig. 19 – *The CNN 4 Falcon with the IB of Gio Battista Gandolfo on its touchhole (photos: José M. Higueras – drawing Renato G. Ridella).*

Giorgio / *Vassalla piccola*, from Sicily to Spain via Genoa. Only in passing, we can mention that a probable relative of his, Giacomo Bozomo, also a ship's captain, was a son-in-law of the gunfounder Giacomo Merello (ASGe, NA, f. 2905, *not. Gio. Gerolamo Fiesco Paxero*, 13.II.1582).

As for the possibility that the CNN 5 had already belonged to the equipment of the *SantaMaria Annunziata*, we can observe that this, like the other four pieces carried by the *Vassalla piccola* to supply the Armada, would most probably have been purchased by Spanish agents on the private market for merchantman artillery, stocked by guns from decommissioned ships.

Returning to the other features of this piece, we note that just forward of the previously cited weight

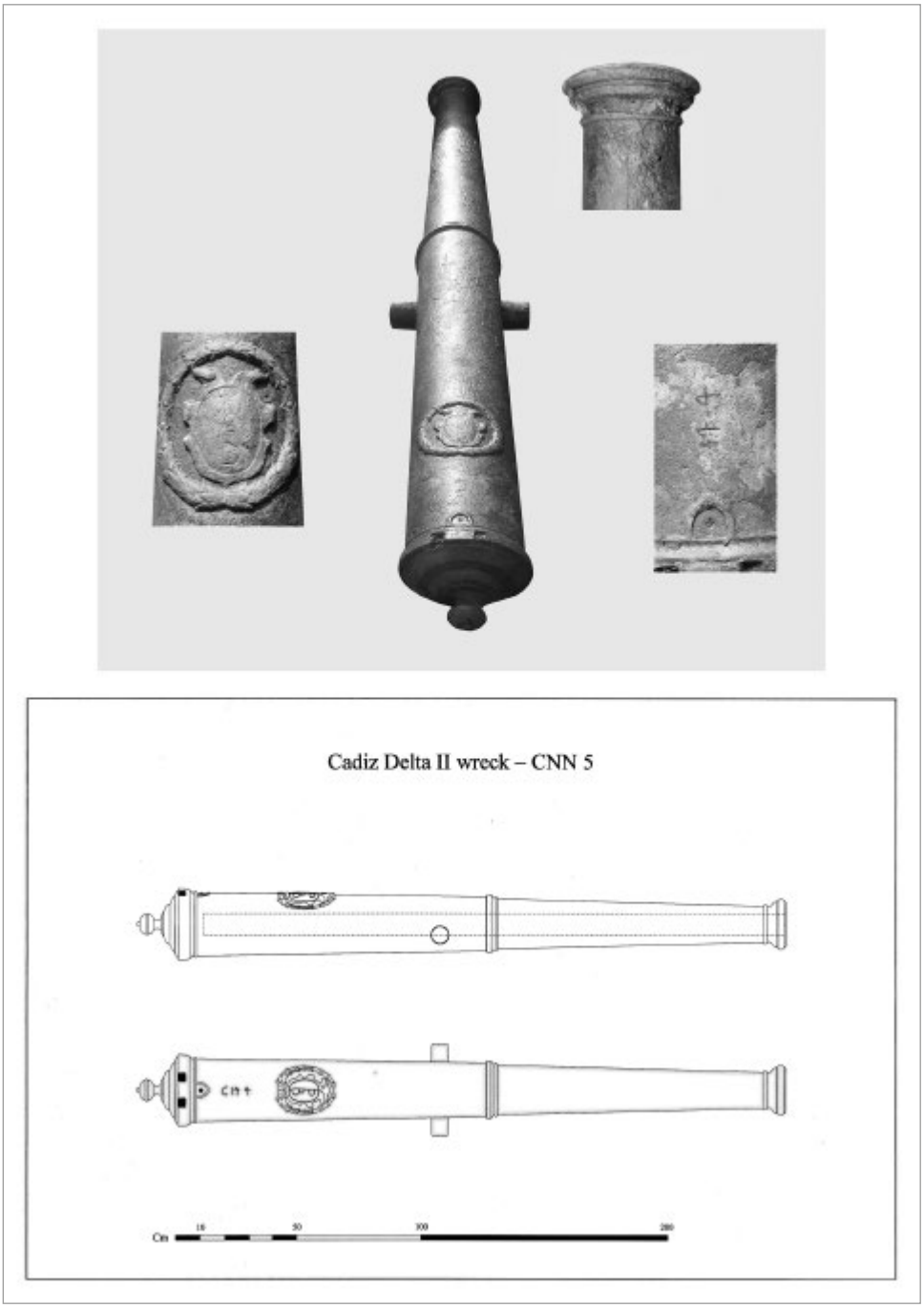

fig. 20 – *The CNN 5 Saker tentatively attributed to Dorino II Gioardi (photos: José M. Higueras – drawing Renato G. Ridella).*

mark of 14.04 *cantara* (670kg), there is an initial on the touchhole which, in its twin piece CNN 3, resembled a pointed U or a V, for which the reference was as yet unclear. However, in this case the letter seems slightly flatter and more closed at the bottom, coming almost to represent a D rotated 90°. If this interpretation were reliable, we could connect this initial to the founder Dorino II Gioardi, whose known surviving cannon, of which there are at least 10 to date, bear the D in the normal orientation. For these reasons, we can propose this attribution only as a hypothesis, until proven otherwise.

CNN 6 (*fig.* 21)

This piece is the heaviest among the bronze ordnance found in the Delta II wreck, being marked 19.30 *cantara* (920 kg); because of this weight

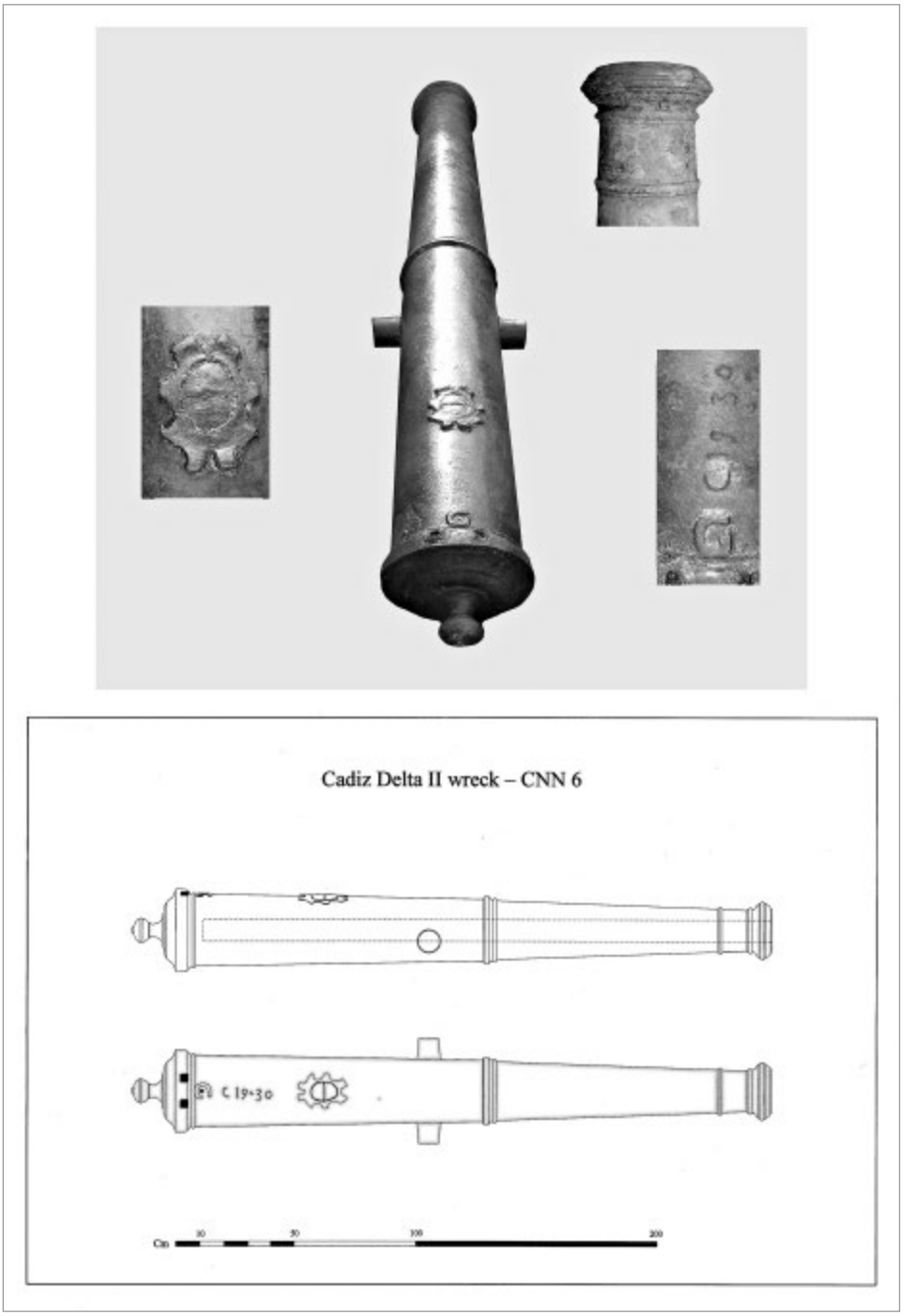

fig. 21 – *The CNN 6 bastard Demi Culverin with the G of Gregorio II Gioardi on its touchhole (photos: José M. Higueras – drawing Renato G. Ridella).*

and its dimensions, it appears to belong to a higher category than that of the two Sakers just described. Indeed, even though its bore diameter is not yet well defined, due to concretions, and was provisionally estimated as measuring 90 mm, its external diameter at the touchhole, 299 mm, reasonably implies it would have fired heavier iron shot than the 7 *libbre* of said Sakers. Assuming that this diameter amounts to three times the diameter of the shot used in it, the shot would have been about 99.5 mm, precisely that of the 12 *libbre* shot (3.800 kg) usually fired by Genoese Demi-Culverins; if this is the case, we would be, in fact, dealing with one of these weapons. As the ratio of conventional length (248 cm) to said shot diameter is close to 25, CNN 6 can only be a bastard Demi-Culverin. This sort of ordnance was the most powerful normally employed aboard Genoese

merchantmen in the second half of the 16th century to defend them from pirates and privateers. The additional term "bastard" means they were shorter than the equivalent pieces used to equip field armies or fortifications, which measured, in conventional length, 28-32 times the diameter of their shot (300-350 cm); thanks to their compactness, bastard Demi-Culverins were easier to load and handle in the narrow spaces of a ship.
Referring to piece CNN 6 in particular, we can observe its overall shape does not differ substantially from that of the other cannon, showing only certain particularities such as the oval shield in its coat-of-arms being divided by a horizontal line, Type C muzzle mouldings and the G of Gregorio II Gioardi on the touchhole, as found in the two *Petrieri* (CNN 1 and CNN 2).

CNN 7 (*fig.* 22)

The same description of the general form common to all the seven bronze cannon recovered from our wreck can also apply to the last of them, once again a 7 *libbre* Saker. It has a conventional length (261 cm) very close to that of the other two (CNN 3 and CNN 5), but the barrel walls are thicker than in these by around one centimetre, as its external diameter at the touchhole is 278 mm, compared to 252 and 258 mm, respectively. This structural strengthening, which allowed for greater resistance to repeated fire, is reflected in the greater weight of this piece, at around 100 kg more than the others, as confirmed by its weight mark, 16.15 *cantara* (770 kg).
Like CNN 4, it is identifiable as a product of Gio. Battista Gandolfo's work by the presence of the monogram I-B on its touchhole; however, as it bears Type B muzzle mouldings, it would have been cast in the first years of his career as an independent founder. Indeed, this period, datable through records to the first half of the 1560s, as we will see in more detail in his biographical profile, coincides with the chronology proposed for this typology of mouldings.

The gunfounders

After having described in detail and discussed every piece of bronze ordnance found in the wreck of the *Vassalla piccolo*, we consider it essential to give a brief biographical profile of the founders who produced them, including the two positively identified and the third, Dorino II Gioardi, who is only a reasonable assumption. We will start with the latter, precisely because he is the oldest of the three and is very representative of bronze artillery production in Genoa during the period in question, due to the many archival records concerning him and the relatively large number of surviving guns manufactured by him.

Dorino II Gioardi

Dorino was born in 1519 to Luchino II Gioardi, a member of the most famous family of Genoese cannon founders, according to an archive document from 1569 which refers to his then being fifty (ASGe, NA, f. 1873, not. *Pantaleone Lomellino Fazio*, 26.VIII.1569).
The first evidence of his activity is represented by a heavy Demi-Culverin marked 41.70 *cantara* (1,987kg), which he cast in 1542 for the defence of Ajaccio on the island of Corsica, then a Genoese colony, managed by the private company Saint George's Bank (ASGe, SG, S. 34, n. 593/1368, 29.VIII.1542). The following decade, he collaborated with his father, his cousin Alessandro Gioardi and his brother-in-law Battista Merello, producing pieces for the Corsican installations and for private ship-owners and the Spanish viceroyalty of Sicily (ASGe, NA, f. 2355, *not. Domenico Conforto*, 16.III.1546; *ibid.* 2358, 28.IV.1550; *ibid.* f. 2360, 12XII.1552; *ibid.* f. 2361, 31.X.1553. ASGe, SG, S. 34, n. 593/1582, 8.XI.1552, 15.IV.1554).
The invasion of Corsica in September 1554 by a French army supported by a Turkish fleet, followed by the subsequent Genoese counter-offensive supported by Spanish allies, caused a strong demand for siege and defence artillery, which gave a lot of work to local founders. Among them, Dorino was also engaged during that almost five-year war, which ended with the return of the island to the Republic of Genoa in 1559 (Ridella 2014, pp. 29-31). Precisely in that year, having formed a company with his cousin Gregorio II Gioardi and the brothers Battista and Giacomo Merello, he began to work with them in Milan, producing 142 pieces of different types, requested by the authorities of Spanish Lombardy (Ridella 2005, pp. 105-108).
For the 1560s, we have information concerning the supply of light- and medium-weight pieces to centres on the Western Ligurian Riviera, such as Alassio and Taggia, to defend them against raids by Barbary corsairs, and to some ship-owners for installation on their ships (ASGe, NA, f. 2550, *not. Agostino Cibo Peirano*, 27.IV.1564, 7.VI.1564, 15.VII.1564. ASGe, NA, f. 2288, *not. Antonio*

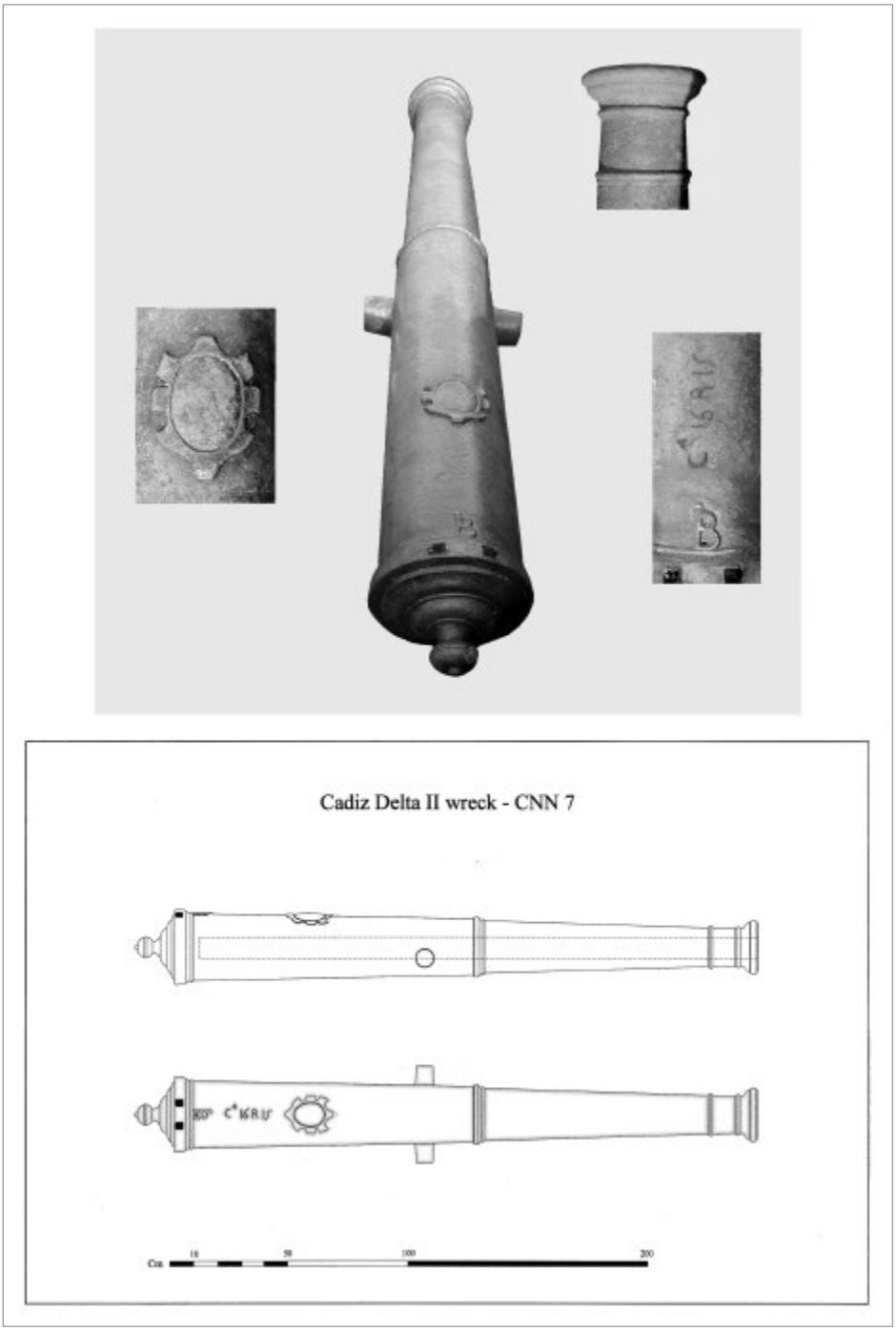

fig. 22 – *The CNN 7 Saker with the IB of Gio Battista Gandolfo on its touchhole (photos: José M. Higueras – drawing Renato G. Ridella).*

Tinello, 18.V.1565). In 1568, his income allowed him to build himself a tomb under the floor of the Genoese church of the Santissima Annunziata. The marble gravestone, bearing his name and coat-of-arms, was still legible early in the 18th century (*fig.* 23). Today the location of the tomb is identifiable but the gravestone, erased by centuries of treading, was definitively broken by aerial bombing during World War II (Ridella 2014, p. 31, f. 10). For the year following the construction of the tomb, there is important information which can be connected with his supply of bronze ordnance to the aforementioned Catalan merchantman *La Juliana*. In the summer of 1569, he gave a detailed analysis of the prices of his finished cannon on the request of Francisco Reul from Barcelona (ASGe,

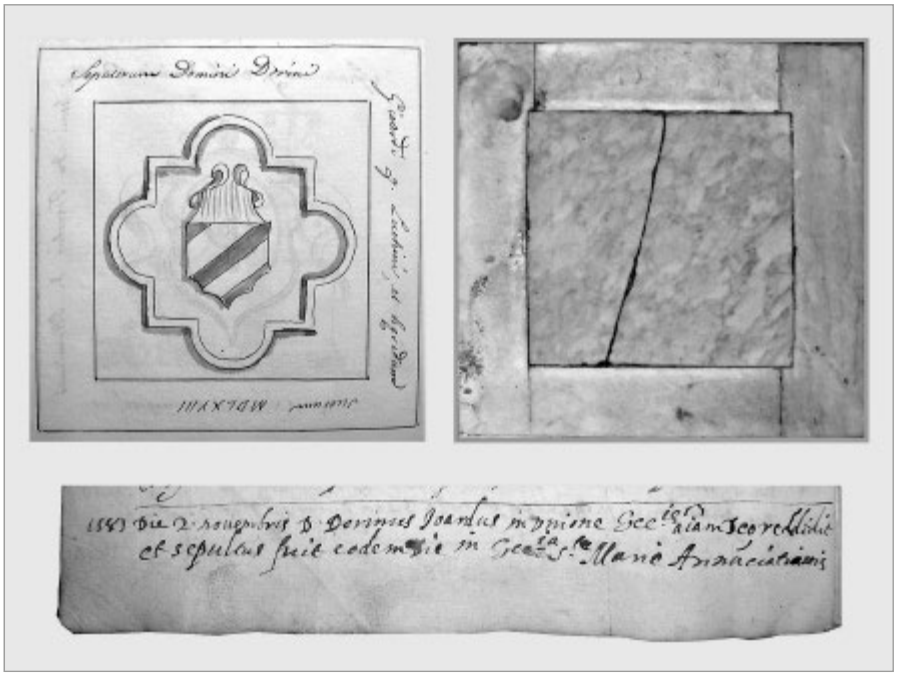

fig. 23 – *18th-century drawing and a current view of Dorino II Giardi's marble gravestone in the Genoese church of the Santissima Annunziata (from* Ridella *2014). Below the record of his death on 2nd November 1587 (APSCDG).*

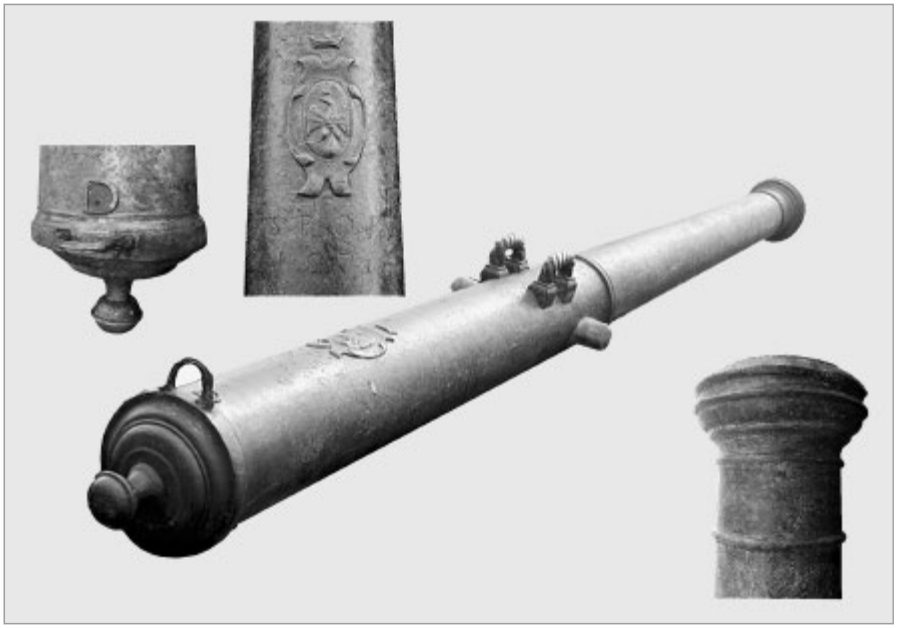

fig. 24 – *Heavy Saker cast in 1576 by Dorino II Gioardi for the city walls of Palermo, Sicily, now on display in San Sebastian / Donostia, Spain (from* Ridella *2011).*

NA, f. 1873, *not. Pantaleone Lomellino Fazio*, 26.VIII.1569). It should be recalled that the pieces with the letter D on their touchholes, recovered from the ship's wreck in Sligo Bay, Ireland, bear the year of casting 1570, the same year the ship was launched (*fig.* 14).

Shortly afterwards, in the spring of 1571, Genoese founders were involved in the manufacture of complete equipment with ordnance (130 pieces) of the new squadron of Naples, comprising 10 galleys (Barbero 2010, p. 646), while the Christian allies of the Holy League were preparing their galleys to face the Turkish fleet, before defeating them in the Epochal Battle of Lepanto. Of course, Dorino also participated in this operation: a note of his recounts that he cast *four pieces of cannon that were given to the Serene Giovanni D'Austria*, the Christian fleet's commander (ASGe, CGF, f. 457, *Atti non*

Category	Cast. year or period	Marked weight	Muzzle mouldings	Particular features	Year, wreck Place of finding	Reference
Bastard Demi Culverin	early 1560s	*C.ra* 25.7?	Type B	Lion head on the breech	1972, undefined wreck off the Tower of Fornells, Menorca (SP)	Ridella 2011
Heavy Saker	1570	*C.ra* 23.61	Type C modified	Coat-of-arms of Palermo	ever held on the dry land Museo San Telmo San Sebastian (SP)	Ridella 2011
Heavy Saker	1570	*C.ra* 20.82	Type C	St. Severo on the reinforce	1985, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	McElvogue 2002
Heavy Saker	1570	*C.ra* 19.??	Type C	St. Giovanni Battista on the reinforce	2015, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	Moore *et al.* 2015
Heavy Falcon	1570	*C.ra* 11.12	Type C	St. Matrona on the reinforce	2015, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	Moore *et al.* 2015
Heavy Falcon	1570	*C.ra* 10.74	Type C	St. Ilaria on the reinforce	2015, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	Moore et al. 2015
Medium Falcon	1570	*C.ra* 8.54	Type C	St. Sebastiano on the reinforce	2015, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	Moore *et al.* 2015
Medium Falcon	1570	*C.ra* ?.74	Type C	St. Rocco on the reinforce	2015, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	Moore *et al.* 2015
Medium Falcon	1550s	no mark	Type A	Letters B & D possibly cast with Battista Merello	1992, wreck of the *San Juan/Parissona grossa* off Sciacca, Sicily (I)	Ridella 2009
Falconet	1570	*C.ra* 3.88	Type C	St. Giovanni on the reinforce	2015, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	Moore *et al.* 2015
Medium *Petriere*	1570?	no mark	Type C	Undetermined female saint on the reinforce	1985, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	McElvogue 2002
Medium *Petriere*	1570?	no mark			1985, wreck of *La Juliana* Streedagh Strand Sligo Bay (IRL)	McElvogue 2002
Medium *Petriere*	1570s ante 1581	no mark	Type C	Very rough pointed shield	1992, wreck of the *San Juan/Parissona grossa* off Sciacca, Sicily (I)	Ridella 2009

tab. 1 – Survived bronze guns cast by Dorino II Gioardi (excluded those from the Delta II wreck).

spediti, 1587). Through the 1570s, besides a certain number of guns he had produced for installation on private merchant ships and anti-Barbary towers, he took part in another important supply to the Spanish viceroyalty of Sicily. Of 22 heavy Battery Cannon cast for this purpose in 1575, four listed in the inventory are marked by his D on their touchhole (ASPa, TRP, *Numerazione Provvisoria*, n. 2382, 1575-76). In addition to these, pieces of lower categories were also produced, such as DemiCannon, Demi-Culverins, Sakers and *Petrieri* (ASGe, NA, f. 3150, *not. Domenico Tinello*, 30.III.1575, 2.V.1575, 4.V.1575, 26.V.1575, 17.VI.1575, 3.VIII.1575). The work appears also to have continued in the following year: a surviving heavy Saker of his, now at the Museo San Telmo in San Sebastian/Donostia, northern Spain (*fig.* 24), bears the D and the coat-of-arms of the Sicilian capital Palermo, as well as the year of casting, 1576 (Ridella 2011, pp. 49-50).

The following eleven years, the last of his life, do not present any intense involvement comparable to those mentioned above; his activity continues with the usual supplies for ships and anti-Barbary defences. The only interesting news from this period concerns a Saker marked 15.48 *cantara*, cast by him for a trader in 1581 and later purchased by the Spaniard Pedro Gonzales, from Majorca (ASGe, *Notai Antichi*, f. 3156, *not. Domenico Tinello*, 3.I.1582, 13.III.1582). Unfortunately, his earthly adventure ends quite sadly, with imprisonment for bankruptcy in 1587 due to bad investments and a halter contract he had signed with the Genoese state (ASGe, CGF, f. 457, *Atti non spediti*, 1587). He died in the jail of *Malapaga* ("bad payment") on 2nd November of the same year and was buried in his tomb inside the church of the Santissima Annunziata (APSCDG, *Liber Baptesimorum, Matrimoniorum et Mortuorum*, I, 1565-1615, c. 86v, 2.IX.1587).

As we have already said, Dorino II Gioardi's surviving pieces are the most numerous from a single founder among Genoese pieces from the 16th century; besides the CNN 5 tentatively attributed to him, his work is represented by 13 pieces (*tab*. 1), the most part of which were recovered from the wreck of *La Juliana*.

Gregorio II Gioardi

Gregorio, surely the maker of pieces CNN 1, 2 and 6, was born in around 1520 to Vincenzo I, first cousin of Dorino II, and was named after his grandfather. As Vincenzo moved to Rome into the service of the Papal state, becoming master founder in 1537 (Da Mosto 1904, pp. 107-109), Gregorio, together with his younger brothers Gio. Battista and Stefano, joined him there and worked beside his father, honing his professional skills in

fig. 25 – *Esmeril with Pope Paul III's coat-of-arms now in the Museum of Art in Cleveland (OH – USA). It was cast almost surely by Gregorio II Gioardi and his brother Gio. Battista in 1542-1543 for the fortress of Perugia (from* Ridella *2007).*

the foundry of Castel Sant'Angelo. By the time he was about 22 years old, he could be considered an accomplished founder, as demonstrated by his work in Perugia to equip the new fortress. Indeed, between autumn 1542 and March 1543, while their father dealt with much heavier pieces, he and Gio. Battista produced 5 Demi-Cannon, 7 Quarter-Cannon, 22 Falcons and 4 Esmerils. One of the latter was almost certainly a small piece with a young girl's head on the breech (*fig.* 25), now in the collections of the Museum of Art in Cleveland (OH – USA). Additionally, to prove their cleverness, they cast a large battery Cannon, weighing 11,452 Roman pounds (3,883 kg), decorated on the reinforce with the head of Pope Paul III in bas-relief and with a satyr head in full relief on the breech (Angelucci 1886, pp. 1-4).

After their father's death in 1545, while he was working in Ancona, Gregorio and his brother continued their activity in Rome for the following seven years (Bertolotti 1878, pp. 208-209; id. 1884, pp. 92-93), after which, seeing a decrease in orders for casting, Gregorio came back to Genoa, while Gio. Battista moved to Piedmont.

The first news of Gregorio's presence in the city dates to 1552, when he produced a 37.12 *cantara* Demi-Cannon there for the fort of Bastia in Corsica (ASGe, SG, S. 34, n. 1382, 1.IV.1552). In this period, the Genoese rulers were already beginning to predict the Franco-Turkish attack against their Corsican colony the following year and were preparing to defend against it. However, as we have already seen, the island was invaded, and Gioardi, like his colleagues, had a particularly intense involvement in producing artillery to reconquer it (Ridella 2014, pp. 31-35). Gregorio was the most involved in terms of the number and quality of the pieces produced in the five years of

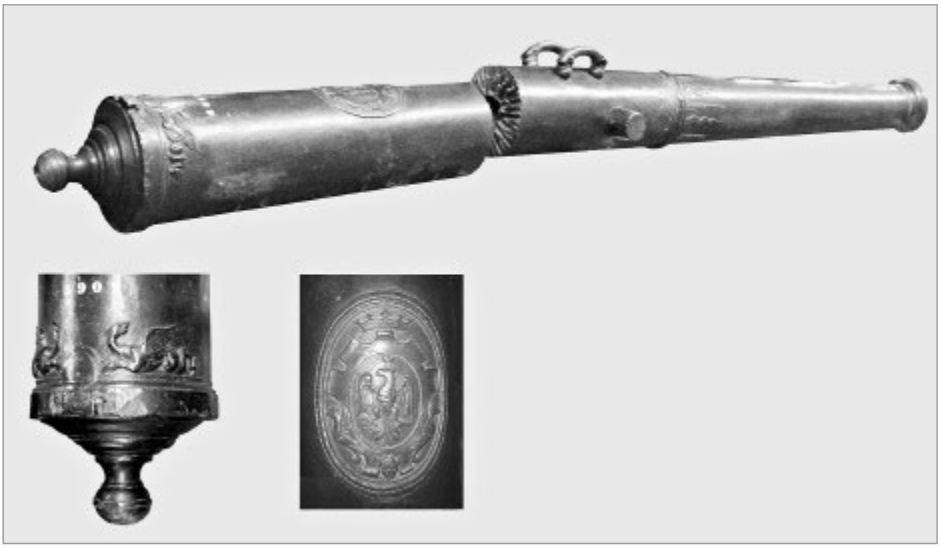

fig. 26 – *Heavy Demi Culverin, dated 1575, now on display in the Museo del Ejercito, Toledo (SP), attributed to Gregorio II Gioardi who should have cast it for the Spanish Sicily (from* Ridella *2011).*

war; a fine battery Cannon (*fig.* 12) dating to this period, or slightly later, is testament to his superior skills. This piece (Ridella 2006) was sent to Corsica in 1563, where it remained for the following two centuries before passing into the collection of the Royal Artillery Museum at Woolwich which has unfortunately been dismantled in recent years. We have already mentioned the supply of 142 cannon to the Spanish Duchy of Milan, cast in the city in 1558-1559 by a company of Genoese founders which also included Gregorio II Gioardi. This is possibly the first example of his collaboration with his cousin Dorino, with whom he would continue to cooperate in the following decades. Another example of shared work and earningsis the previously mentioned production of bronze pieces for the Spanish viceroyalty of Sicily in the years 1575-1576, in which the majority of founders pooled in a company formed three years before are known to have participated. The seven associated founders were: Alessandro Gioardi, Dorino II, Gregorio II and his brother Stefano, Giacomo Merello, Gio. Battista Gandolfo and Bartolomeo Sommariva (ASGe, NA, f. 2897, *not. Gio. Gerolamo Fiesco Paxero*, 20.III.1572). Of the pieces produced for Sicily on that occasion, only two seem to have survived: The quoted Dorino's Saker in San Sebastián and a very long, heavy Demi-Culverin (*fig.* 26) marked 50.65 *cantara* (2,413 kg), now on display in the Museo del Ejército, Toledo (SP), which has been attributed to Gregorio due to its excellent manufacture (Ridella 2011, pp. 49-50). Another of his pieces as part of this supply was a Battery Cannon bearing, among other signs, a G on its touchhole. It was also registered extensively in a1583 inventory of the Spanish fortress in Palermo: *another* (cannon) *of 47 cantara*[28] *(50 libbre shot) with the Spanish coat-of-arms and that of the Duke of Terranova and the inscription GREGORIVS IOARDVS GENVENSIS ME FECIT and a star near the mouth* (ASPa, TRP, n. 762, 1583). Concerning this last symbol, almost certainly the eight-pointed star present in the Gioardi family's coat-of-arms, this appears as a typical feature of Gregorio's work, already introduced by him on guns cast in Perugia in 1542-1543 and also observable in the surviving cannon now at Woolwich, mentioned above.

In the following years, we see Gregorio engaged in smaller productions, such as the two Sakers and two heavy Falcons he cast in collaboration with his cousin Dorino for the city walls of Spezia in the Eastern Riviera of Liguria (ASGe, NA, f. 3153, *not. Domenico Tinello*, 16.VI.1578) or those for the town of Loano, in the Western Riviera of Liguria, ordered by Gio. Andrea Doria, the largest landowner of the region (Merli & Belgrano 1874, p. 74).

With respect to his work in equipping private merchant ships, we have already mentioned archival evidence relating to the sale of some pieces to a Ragusan maritime captain. However, the most important detail about this matter is a supply he made in 1583 to Pietro Paolo Vassallo (*fig.* 27), who could have ordered this new ordnance to

[28] This unit is the Sicilian measure, composed of 250 *libbre* instead of the 150 of the Genoese *cantaro*. The Sicilian *cantaro* was therefore equivalent to 79.432 kg.

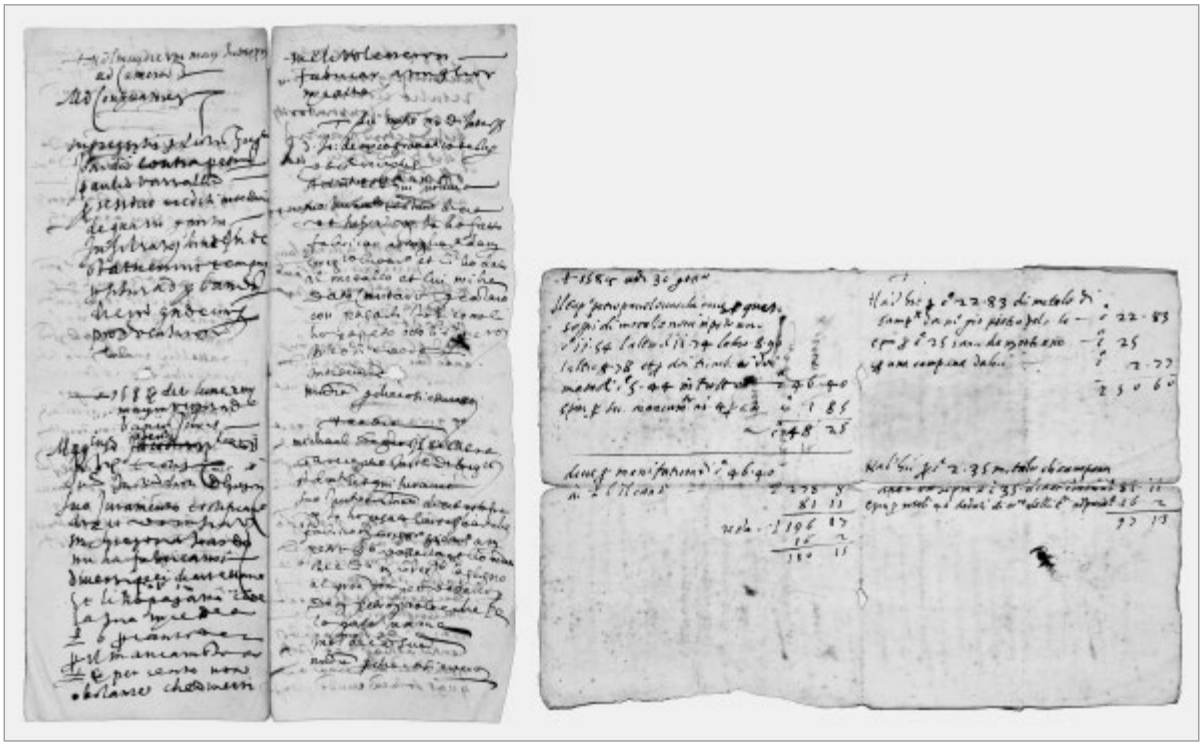

fig. 27 – *Archival records dating to 1584 and dealing with a dispute between Gregorio Gioardi and Pietro Paolo Vassallo on the price of some bronze guns the first one had produced for the latter almost surely to equip his ship San Giorgio (permission from the Archivio di Stato di Genova N. 5/17 – Prot. 1398 cl. 28.28.00/1).*

strengthen the armaments of the *San Giorgio*. On that occasion, Gregorio had cast four pieces, which in the record are improperly labelled as Sakers, but which by looking at their weights we can correctly classify as two heavy Falcons (11.74 and 11.54 *cantara*) and two medium pieces of the same category (8.90 and 8.78 *cantara*). We know this from a writ of the magistracy of the *Conservatori del Mare* ("Curators of the Sea") obliging the founder to practice a lower manufacturing price (ASGe, CM, f. 3, 30.I.1584), evidently in order to encourage owners who wanted to improve their ships' defensive devices. Consequently, Pietro Paolo Vassallo saved 16 Genoese Liras on a total manufacturing cost of 278 (around 6%). It is possible these guns were still aboard the *San Giorgio* when she was sunk and belonged to those recovered from her wreck in the following months, kept by the Spanish authorities and paid to her captain Clemente Vassallo. In addition to this, material evidence of Gregorio's activity has been found in the three pieces of the Delta II wreck, and a fourth, a bastard Demi-Culverin (*fig.* 28), preserved in the Museo San Telmo of San Sebastian/Donostia (Ridella 2014, p. 34, f. 12). It is relatively similar to CNN 6, also a Gregorio's work, save its muzzle mouldings, which are of Type B, denoting it is older than CNN 6.

By the end of his life, Gregorio II Gioardi was a wealthy man, although he had no male offspring who could continue his activity; we can therefore consider his nephew Vincenzo II, son of his step-brother Clemente, a beneficiary of his will, as his professional heir. Gregorio II died in 1591 at his villa in Multedo, a hamlet a few miles west of Genoa, and was buried in the local church of Santa Maria di Monte Oliveto (Remondini 18th c.: n. 4209).

Up to now, there have been five surviving pieces attributable to him, excluding those from the Delta II wreck (*tab.* 2).

Gio. Battista Gandolfo

We can also consider Gio. Battista Gandolfo as belonging to the Gioardi family, as he was born around 1535 to Gregorio Gandolfo, a maritime captain and small ship-owner, and Benedettina Gioardi (ASGe, NA, f. 3147, *not. Domenico Tinello*, 12.IV.1566), sister of Dorino II under whose guidance Gio. Battista carried out his apprenticeship. In 1559, we find him involved in the cannon foundry of the Castello Sforzesco, Milan,

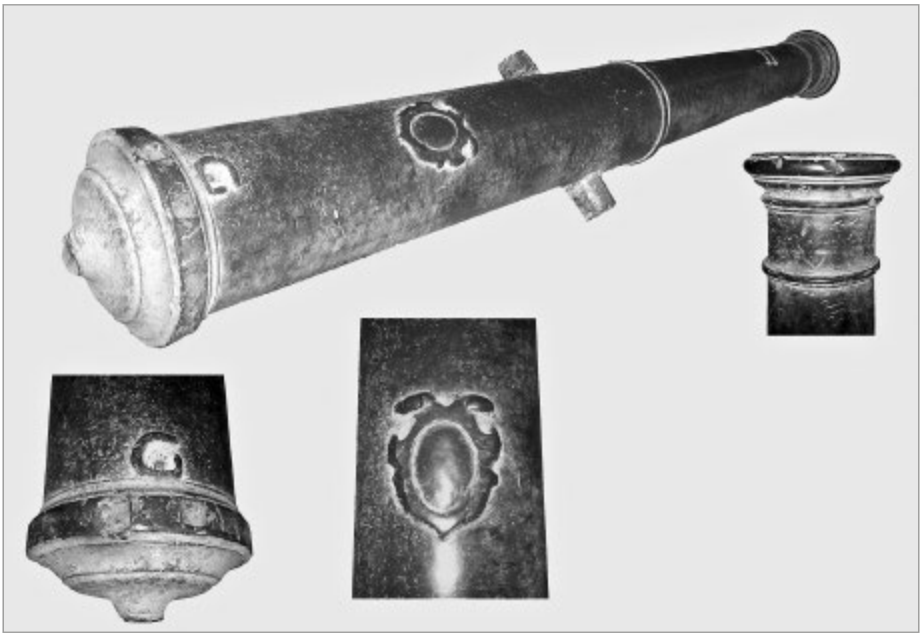

fig. 28 – *Bastard Demi Culverin, with the G of Gregorio II Gioardi, preserved in the Museo San Telmo, San Sebastian/Donostia (SP). It is similar to the CNN 6 save in having the older Type B muzzle mouldings (from* Ridella *2014).*

Category	Cast. year or period	Marked weight	Muzzle mouldings	Particular features	Year, wreck Place of finding	Reference
Battery Cannon	late 1550s	*C.ra* 53.83	Type A	Griffin head on the breech	recovered off Morocco 1885 in the Royal Artillery Museum, Woolwich (GB)	Ridella 2006
Battery Cannon only the breech	1570s?	not detectable	not detectable	Unicorn head on the breech	embedded in the walls of the Arsenale, Venice (I)	Ridella 2011
Heavy Demi Culverin	1575	*C.ra* 50.82	Type C modified	Coat-of-arms of Palermo	ever held on the dry land Museo del Ejercito Toledo (SP)	Ridella 2011
Bastard Demi Culverin	early 1560s	no mark	Type B	Broken button of the breech	ever held on the dry land Museo San Telmo San Sebastian (SP)	Ridella 2011
Muzzle loading Esmeril	1542-1543	no mark	Polygonal	Coat-of-arms of pope Paul III	1916 purchased by The Museum of Art Cleveland (OH - USA)	Ridella 2007

tab. 2 – Survived bronze guns cast by Gregorio II Gioardi (excluded those from the Delta II wreck).

where he worked as a subordinate of the often cited company of which his uncle Dorino and Gregorio II Gioardi were also part.

Some years after he began his activity as an independent cannon founder, we can mention among his early works an 8 *libbre* Saker of 16.67 *cantara* (794 kg) that he cast in 1563 for the anti-Barbary defence of the little town of La Pietra (today Pietra Ligure) in the Western Riviera (ASGe, NA, f. 1795, *not. Giacomo Villamarino*, 12.VIII.1563). The following year, he agreed with the Spanish ambassador in Genoa, Don Gomez Suarez y Figueroa, to cast a Culverin weighing 70-71 *cantara* by 8 January 1565 (ASGe, NA, f. 2550, *not. Agostino Cibo Peirano*, 13.XI.1564).

Four years later, with his father's financial support, he opened his own foundry, where he produced cannon to equip merchant ships and galleys (ASGe, NA, f. 1797, *not. Giacomo Villamarino*, 21.IV.1567).

In the following decade, he continued working in Genoa until 1579, when on 21st August he entered the service of the Republic of Lucca (Tuscany – Italy) as a public master founder, signing a contract renewable from year to year. We also know that those authorities, before appointing him, inquired about his workmanship: *we have ascertained he is sought-after by many states with a higher pay* (Angelucci 1886, pp. 16-17).

His work in the Tuscan town ended in March 1584 and it is possible that he then soon moved from Lucca to Rome, passing to the payroll of the Papal State. Possible evidence of this is a piece of his, inventoried many years later in 1624, in the Pontifical stronghold of Perugia, with this entry: item *a 35 libre reinforced battery cannon with the coat-of arms of Pope Sixtus V between the breech and the trunnions and, between the coat-of-arms and the trunnions, these letters are carved* IHS MARIA *and, behind the coat-of-arms toward the breech, these*

fig. 29 – *Light Petriere with the IB on its touchhole and Gio. Battista Gandolfo's complete authorship inscription on the base-ring. It was found off Sardinia island and dates to 1591 (from* Ridella *2004).*

fig. 30 – *Late 16th-century Saker with the IB of Gio. Battista Gandolfo recovered from a wreck off Brsecine, Croatia (from* Ridella *2011).*

other letters are carved S.V.P.M. (Sixtus V Pontifex Maximus) *and on the touchhole there is a B and there are the following letters running around the base-ring (of the breech)* opvs io. bapta gandvlfvs (Angelucci 1886, pp. 3, 18). As this Pope ruled from April 1585 to August 1590, Gio. Battista's stay in Rome would be included within this period of time. We find, once again, the same inscription of authorship on the base-ring and the IB for *Iohannes Baptista* on the touchhole of a light *Petriere* cast by him in 1591 (*fig.* 29), found in the 1990s off Porto Torres, Sardinia (Ridella 2004, p. 30, f. 4). Another merchant-ship piece like this one, in this case a medium weight Saker, was recovered in 2003 from a wreck-site off Brsecine near Dubrovnik, historically known as Ragusa di Dalmazia, Croatia (Mihajlović *et al.* in press); this piece also seems to belong to this founder's later works (*fig.* 30).

Gio. Battista Gandolfo died at home on 17th July 1601 and was buried in the church of Santa Maria di Castello (APSMG, *Liber Mortuorum*, I, 17.VII.1601), bequeathing his workshop and profession to his stepson Antonio Pensa, who was later appointed master founder to the Republic of Genoa until 1653 (ASGe, CGF, f. 113, *Atti*, 14.V.1612).

To date, seven pieces produced by Gio. Battista are known, not including those from the Delta II wreck (*tab.* 3). One of these, a light *Petriere* marked 4.04 *cantara* (*fig.* 31) is particulary interesting, both for its unusual shape, with the diameter of its chase wider than the reinforce, and for the place

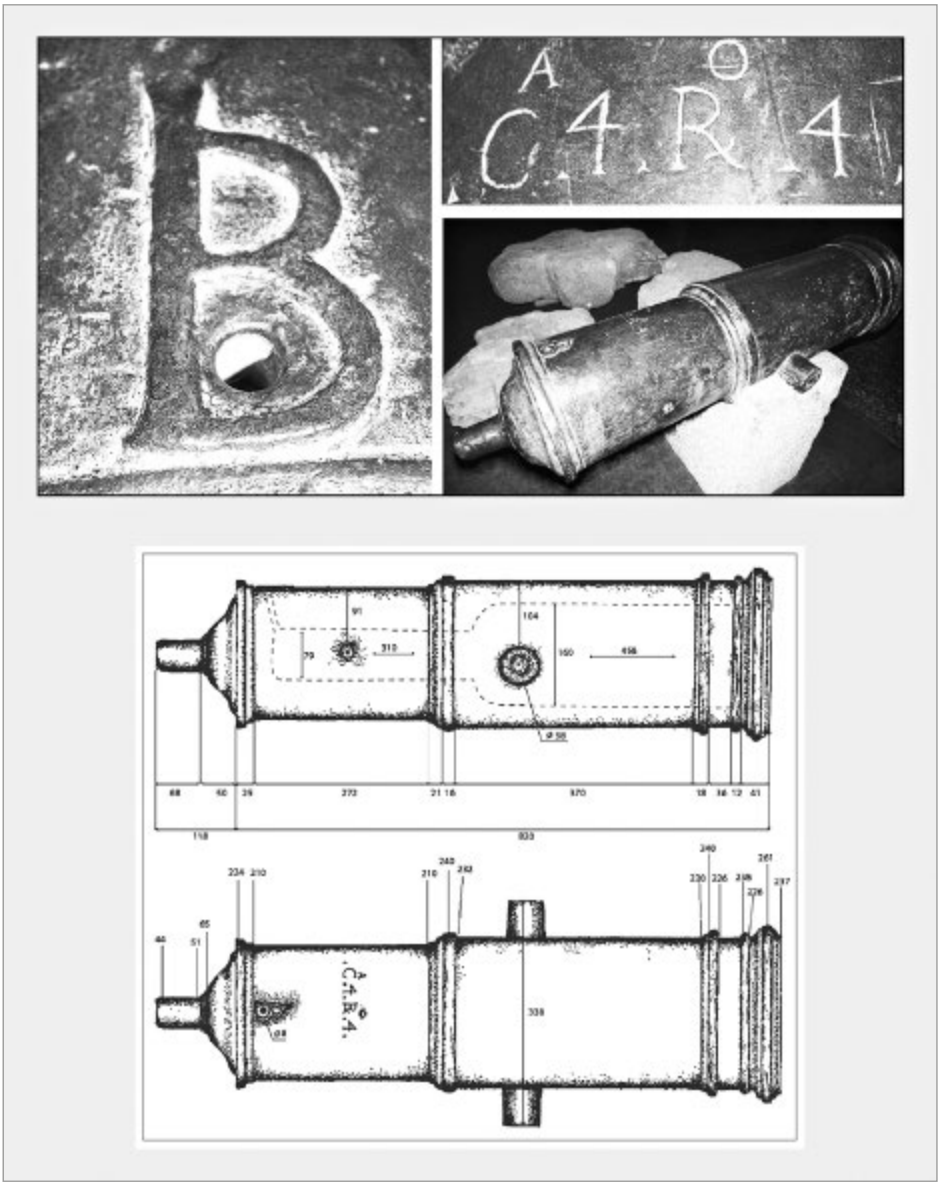

fig. 31 – *Light Petriere with an unusual mortar shape found in the river Dnepr near Nikopol, Ukraina. It shows the IB on its touchole and the Genoese weight mark (fom* Malchenko *2012).*

Category	Cast. year or period	Marked weight	Muzzle mouldings	Particular features	Year, wreck place of finding	Reference
Medium Saker	1590?	no mark	Type C	none	2003 wreck off Brsecine / Dubrovnik (HR)	Ridella 2011
Heavy ***Petriere***		no mark	lost	Broken. Only the breech and reinforce remain	2003 wreck off Brsecine / Dubrovnik (HR)	unpublished
Heavy ***Petriere***		no mark	lost	Broken. Only the breech and reinforce remain	2016 wreck off Brsecine / Dubrovnik (HR)	unpublished
Medium ***Petriere***	post 1570	no mark	Type C	Winding flames at the beginning of the chase	1921 from dredging in the port of Naples	unpublished
Light ***Petriere***	1591	C.ra 4.84	Type C	Coat-of-arms with a cross and four birds around it	off Porto Torres Sardinia (I)	Ridella 2011
Light ***Petriere***	post 1570	C.ra 4.04	Type C	The reinforce has a lesser diameter than the chase	19th century - in the Dnieper river 13 km upstream Nikopol (UA)	Malchenko 2012 in print
Muzzle loading Esmeril	mid 1550s	no mark	Tipe A	Cylindrical button. No coat-of-arms	1992, wreck of the ***San Juan / Parissona grossa*** off Sciacca, Sicily (I)	Ridella 2012

tab. 3 – Survived bronze guns cast by Gio. Battista gandolfo (excluded those from the Delta II wreck).

fig. 32 – The wrought iron bombard recovered from the Delta II wreck composed of the barrel CNN 8 and two removable powder chambers CNN 9-10 (photos: José M. Higueras).

where it was found, an islet in the river Dnepr, 13 km above Nikopol. The reason for its presence so far from the areas in which Genoese cannon were employed at the time could be that it was first seized in the Mediterranean by Turkish or Barbary corsairs from some Christian ship. The following step implies it was later placed aboard an Ottoman galley engaged in attempts at military expansion toward the northern coast of the Black Sea and captured by the Zaporizhian Cossacks while sailing up the Dnepr (Malchenko 2012).

The wrought-iron bombard CNN 8-10 (fig. 32)

To conclude the discussion of the ordnance from the Delta II wreck, we must deal with the iron bombard stowed together with the five bronze pieces and the two anchors. It has been labelled with three different numbers, as it was divided into as many elements.

We can make only general considerations about this weapon owing to the poor legibility caused by the oxidation of its surfaces. First of all, we consider the barrel (CNN 8), which is 173 cm long, has an external diameter of 235 mm on average and a bore diameter of roughly 155 mm. The latter size could mean it fired stone shot weighing about 3.900 kg, equivalent to 12 Genoese *libbre* and with a theoretical diameter of 144 mm[29]; in this case, the barrel length would be almost exactly equivalent to 12 shot diameters. The thickness of the barrel, amounting to approximately 30 mm, demonstrates the intrinsic weakness of these weapons compared to the muzzle-loading bronze guns, due to its structure being composite, formed by a tube of lengthened iron staves strengthened externally by alternating sleeves and hoops, all of these shrunk on[30]. This forging technique had already been used for the production of iron ordnance since the Middle Ages, when the melting of iron was not so developed as to enable the production of reliable cast iron guns. We have seen that the *Vassalla piccola* was also equipped with eight pieces of this latter type, which must have been wholly recovered soon after her sinking, as none of them was found in the wreck. It is very probable they were from England, where the casting of this type of artillery had taken place since the 1540s. As the production of the blast furnaces of the Weald area had become superabundant for domestic demand from the early 1570s, founders began to export them, even to countries potentially hostile to England, such as those in the Spanish sphere of influence. For this reason, these cast iron guns could fall into the hands of Mediterranean ship-owners in small consignments, possibly purchased in the Netherlands in order to bypass English government attempts to prevent the uncontrolled export of cast iron pieces (Brown 2011, pp. 99-100; Barter Bailey 2003, pp. 53-54). However, there were other ways for these guns to reach those markets: captains of English ships are known to have sold

[29] This theoretical calculation was made on a sphere with this diameter as at least a centimetre of tolerance with the bore was indispensable due to the irregular surface of a stone shot. The specific gravity of the stone has been taken equal to that of marble and granite that is 2.5.

[30] This building system is analyzed in detail and described in Smith, Brown 1989.

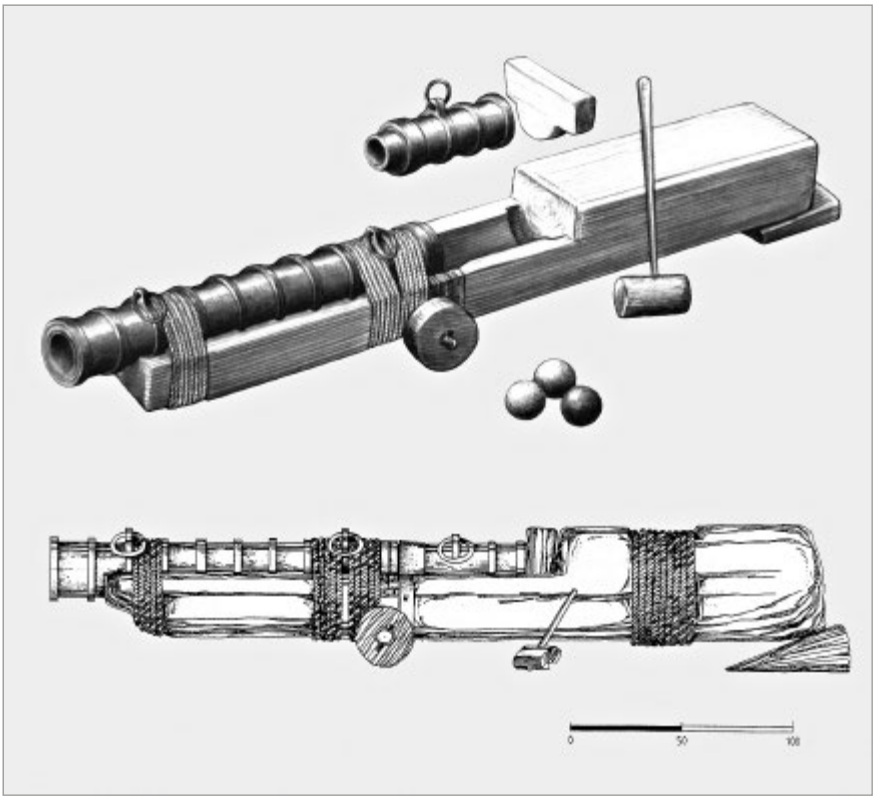

fig. 33 – Drawing showing the setting on its wooden carriage and the system of loading of a bombard found in the wreck of the Genoese merchantman Lomellina sunken in 1516 off Villefranche-sur-Mer (from Guérout et al. 1989).

their ships, including the complete armament, to foreign purchasers. One such example was the case of the merchantman *Il Dono di Dio* ("The Gift from God" – 225 metric tons), bought in Genoa by the Florentine Luigi Gadi from the English captain William Crowe, whose ship's weaponry consisted of ten cast-iron guns, 'two iron bombards of England', twelve harquebuses and three bows (ASGe, CM, f. 3, 3.III.1583).

The other two elements, CNN 9 and CNN 10, show very similar measures, being about 60 cm long and having an average external diameter of 195 mm. At first sight, owing to oxidation, they could appear to be broken parts, but the presence of a handling ring on one of them leads us to think rather that they represent removable chambers for the barrel CNN 8, even though their diameters are slightly smaller than that of the barrel. These chambers, closed at one end, contained the powder charge and were fitted at the breech of the barrel, being held in place by a wedge forced against the wooden carriage (*fig.* 33).

This type of ordnance, of medieval origin, was certainly quite obsolete in the latter decades of the 16th century due to its low power, limited range and the danger of leaks of firing gases from between the barrel and chamber. However, as we have just seen for the English ship of 1583, they remained in service aboard merchantmen as short range weapons; material examples of this also exist from the 1588 Spanish Armada wreck of *El Gran Grifón* (Martin & Parker1988, pp. 273-274).

To conclude, the presence of an old wrought-iron bombard among the ordnance carried by the *Vassalla piccola* is not a wholly unexplainable finding.

5. The Anchors

Before analyzing the Cadiz Delta II wreck anchors, it is important to describe what could have been those of a ship like the *San Giorgio*.

Anchors on board Genoese ships

Unfortunately no 16th century maritime law nor nautical treatise have survived to inform us on the anchors on board Genoese ships of the time, however through other sources it is possible to examine how the fitting changed in the three previous centuries. In a dozen lease or sale contracts of Genoese ships from the mid-13th to the beginning of the 14th century, anchors on board were 15 to

source	anchors on ships of all sizes	anchors on ships over 477 t	maximum ship capacity	weight of the largest anchor (sheet anchor)	ratio: sheet anchor weight to ship capacity
Lease or sale contracts 1246-1301	**6-26** (kedgers not mentioned)	**22-26**[a] (kedgers not mentioned)	**10000** *cantara* **477** t[a]	**10** *cantara* **477** kg	0,10%
Statuto di Gazaria 1403	**6-16** (kedgers not mentioned)	**11-16** (kedgers not mentioned)	**12000** *minae* **989** t (+107% comp. to 13th c.)	**13** *cantara* **619** kg (+30% compared to 13th c.)	**0,06%**
Statuto di Gazaria 1441	**7-14**[b] including one kedger	**9-14**[b] including one kedger	**21000** *cantara*[b] **1001** t (+1% compared to 1403)	**30** *cantara* **1430** kg (+130% compared to 1403)	**0,14%**
Law 1498 for ships over 477 t	-	**9** including one kedger	(not mentioned)	-	-

[a] 477 t is the estimated maximum capacity of the Genoese ships of the time, obtained paralleling ships with same crew in Venetian Statutes of 1255.
[b] The Statute of 1441 makes a distinction between ships for merchant use and ships involved in military operations: the formers had a maximum capacity of 20000 *cantara* (953 t) and 13 anchors, the latters 21000 *cantara* (1001 t) and 14 anchors.

tab. 4 – Anchors on board Genoese ships (13th-15th centuries).

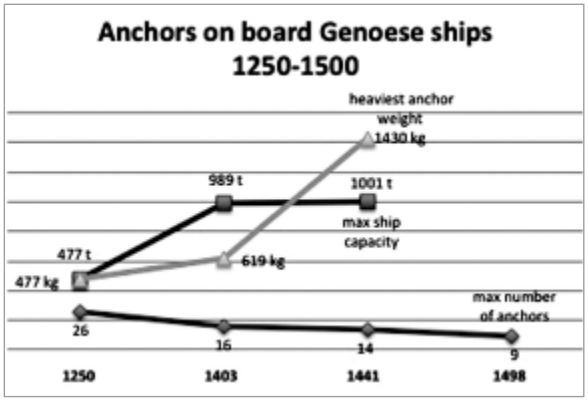

fig. 34 – Graphic showing the evolution, in number and weight, of the anchors on board Genoese ships from 1250 to 1500 (arrangement: Fabrizio Ciacchella).

26; ships capacity was never specified, but their crew ranged from 40 to 100 men[31]. Ships with a mid-size crew (40 to 75 men) had 15 to 20 of them, while those with maximum crew (90 to 100 men) had 22 to 26 (Byrne 1930, pp. 9-11, 78-129; Jacoby 1985, pp. 5-12). Determining capacity can be attempted by finding parallels with ships in the Venetian Statutes of 1255: the largest crew mentioned, like those in the Genoese contracts, consisted of one hundred men, and the maximum tonnage of Venetian ships was 1000 *milliaria*, or 477 t (Predelli, Sacerdoti 1903, p. 176). The largest Genoese ships probably had a similar capacity, equivalent to 10000 Genoese *cantara*.
The Genoese *Statuto di Gazaria* of 1403 imposed the use of six to sixteen anchors, proportional to ship capacity that ranged from circa 290 t to 990 t; in a similar statute of 1441 they were seven to fourteen[32]. Ships over 10,000 *cantara* (over 477 t) had eleven to sixteen of them in the former, and nine to fourteen in the latter, including one kedger[33]. The heaviest anchors mentioned in the 13th contracts weighed 10 cantara / 477kg, in the 1403 statute 13 cantara / 619 kg, in the 1441 statute 30 cantara / 1430 kg (Pardessus 1837, pp. 465-489; Vitale 1951, pp. 173-214; Forcheri 1969, pp. 18-21). In the very last years of the 15th century, the 1498 law for ships over 10,000 *cantara* (over 477 t), reduced their number to nine, including one kedger, plus two iron grapnels for the ship's boats. Ships going west of Cadiz could carry some more spare anchors kept in the hold (ASG, MS, 125, f. 132v-135r).
During the last three centuries of the Middle Ages many changes occurred in the Genoese navy. From the second half of the 13th century to the beginning of 15th century, maximum ships capacity more than doubled (passing from 477 t to 990 t), while the weight of the heaviest anchors increased by only 30% (from 10 cantara to 13), and their maximum number on board progressively decreased by 40% (from twentysix to sixteen). As a result, the heaviest (or sheet) anchor weight to ship capacity ratio decreased from 0.10% to 0.06%, meaning that it was still necessary to use many of them at a time to stop large ships in heavy weather, as was usual in the 13th century (Wailly 1874, p. 283). Less than forty years later, before the mid-15th century, while ships capacity remained almost the same,

[31] Almost all the ships mentioned in the contracts were mid-size or large ships, the only exception were some small tarids for horse transport, leased by Louis IX in 1246, carrying only twenty horses, while the large ones could carry one hundred of them. They had only six anchors on board. It has been chosen not to include them in the list, because the contract does not specify the crew on board, and no comparison is possible with the other ships mentioned.

[32] The 1403 Statutes considered ships from 3000 to 12000 *minae* (287-989 t), the 1441 Statutes from 4000 to 21000 *cantara* (191-1001 t). The slight difference in ship capacity range was due to the different measure units.

[33] The kedger was a small anchor used to move the ship upstream in a river or from one position to another of an anchorage.

there was a dramatic improvement in the manufacture of large anchors: their maximum weight more than doubled, reaching nearly 1.5 metric tons, three times the weight it had in the mid-13th century; consequently the sheet anchor weight to ship capacity ratio increased to 0,14%. Their maximum number on board was twentytwo to twentysix in the mid-13th century, then decreased to sixteen in 1403, to fourteen in 1441, and in 1498 it was reduced to nine; according to this trend, in the late 16th century a Genoese ship over 477 t should have had less than nine of them (*tab.* 4, *fig.* 34). In the early years of the 15th century, the Genoese technology of anchor manufacturing was less advanced than the English one. According to Friel, "English anchorsmithing had reached a high degree of sophistication as early as the first half of the 14th century": in an English document of 1337, the biggest anchor mentioned weighed 1203 kg, while in the 1403 Statute of *Gazaria* the heaviest one was only 619 kg. By the 1440s the Genoese anchorsmiths had filled the technological gap and were among the best of the time, considering that in the 1441 Statute of *Gazaria* the biggest anchors weighed 1430 kg (Friel 1995, p. 124; Friel 2015, p. 79; Vitale 1951, p. 214; Pardessus 1837, p. 489).

Anchors on board early modern Mediterranean ships

Lacking coeval Genoese sources, some nautical treatises of the Mediterranean tradition of the late 16th and the early 17th centuries can be taken as a possible reference. In 1571 Nicolò Sagri, a Dalmatian author writing in Italian, stated that four to eight large anchors plus two or three small kedgers were on board Ragusan ships, according to their capacity; in 1602 the Roman writer Bartolomeo Crescenzio reported the same proportions. A ship of 3300 *salme* (470 *carra*, or 630 metric tons) like the *San Giorgio* should have had six large ones and two small ones for kedging (Dell'Osa 2010, p. 142; Crescenzio 1602, p. 77). From the early 16th to the early 17th century, four Spanish authors of nautical treatises mentioned anchors. In his *Espejo de navegantes* (c. 1537), Chaves stated that a 220 t ship had five of them, but he didn't specify if kedgers were included (Chaves c. 1537: ff. 60v-61r). According to Escalante de Mendoza (1575), on board Spanish ships there were at least four of them, but again he didn't explain if kedgers were in the number (Escalante de Mendoza, 1575, pp. 43-44). Garcia de Palacio in 1587 suggested that Spanish ships had a variable number of anchors: in his example, a *nao* of 400 *toneladas* (nearly 370 metric tons), had six of them (a sheet one, four common ones, and a kedger), plus two grapnels for the ship's boats. The *San Giorgio* was almost the double in capacity, and a Spanish ship like her should have had a slightly greater number of anchors (Garcia de Palacio 1587, p. 306). The anonymous author of the *Dialogo entre un Vizcayno y un Montañes sobre la fabrica de navios* (believed to be Pedro Lopez de Soto, circa 1632) considered for every galleon five large anchors and two kedgers, plus a grapnel for the ship's boat. For ships of different capacity their number didn't change, but their weight did (Vicente Maroto 1998, p. 188).

The weight of the sheet anchor

To determine the weight of the strongest anchor cable, the two forementioned authors writing in Italian used a formula proportional to the sum of ship dimensions: the length of the keel plus twice the beam[34] plus four times the depth in the hold, expressed in Venetian feet, divided by ten. The sheet anchor weighed 2/3 of it (Dell'Osa 2010, p. 142; Crescenzio 1602, p. 77). As the *San Giorgio* measures are not exactly known, it is better not to use this method, because it would result in a major error.

Spanish authors of the late 16th and early 17th century had a completely different method, proportional to the ship capacity, i.e. to the multiplication of the ship dimensions. Half a century earlier, in his manuscript *Espejo de navegantes* (c. 1537) Alonso de Chaves made the example of a ship of 200 *toneles* (240 *toneladas*, or 220 metric tons) with a sheet anchor of 11 *quintales* (506 kg)[35]. He gave no explanation about the formula to determine it, but considering the proportion expressed by later Spanish authors, it corresponded to 0.23% of the ship capacity[36] (Chaves c. 1537, ff. 60v-61r). In 1575 Escalante de Mendoza recommended a sheet anchor of 10 *quintales* (460 kg) for a ship of 100 *toneladas* (92 t), then 3 *quintales* more (138 kg)

[34] The ship beam is the maximum width from side to side; in a similar way the anchor beam is the width from one arm tip to the other.

[35] One *tonel* was made of 24 *quintales*, one *tonelada* of 20 *quintales*, so the equivalence was 1 *tonel* = 1.2 *toneladas*. In metric measurement, one *quintal* was eqivalent to 46.009 kg, one *tonelada* to 920.18 kg, one *tonel* to 1104,22 kg.

[36] Perez-Mallaìna 1998, p. 225 refers the example to a 300 *toneles* ship, but the original by Chaves was for a 200 *toneles* one.

every further 100 *toneladas* of capacity of the ship: this proportion can be expressed by the formula 3 *quintales* every 100 *toneladas,* plus 7 *quintales*, i.e. 0.15% of the ship capacity, plus 322 kg. According to this formula, a 240 *toneladas* ship like the one in Chaves' example, would have had a sheet anchor of 13½ *quintales*, instead of 11. The *San Giorgio* (630 metric tons, equivalent to 685 *toneladas*) would have had one of 28 *quintales*, or 1288 kg (Escalante de Mendoza 1575, pp. 43-44). In 1587 Garcia de Palacio gave a double choice: a ship of 400 *toneladas* (368 t) had a sheet anchor of 18 or 16 *quintales* (828-736 kg), equivalent to 0.23% or 0.20% of the ship capacity (Garcia de Palacio 1587, p. 306). Spanish authors of the early 17th century used the proportion of 0.20%: in 1611 Cano proposed 4 *quintales* (184 kg) for the sheet anchor every 100 *toneladas* (92 t) of capacity of the ship; the anonymous author of the *Dialogos entre un vizcaino y un montagnez* (c. 1632) used the same ratio for a 500 *toneladas* ship (Cano 1611, pp. 30-31; Vicente Maroto 1998, p. 188). According to this proportion, a Spanish ship the size of the *San Giorgio* had a sheet anchor of 27.5 *quintales* or 1260 kg, very near to the weight obtained using Escalante de Mendoza's formula.

The weight of the other anchors

The weight of the other anchors was determined in proportion to the sheet anchor, using ratios that differed according to the different authors. Sagri and Crescenzio[37] proposed the bigger of the common anchors to weigh 7/8 of the sheet anchor, the smaller 3/4, the medium-size 1/2 and the kedgers 3/8 (Dell'Osa 2010, pp. 141-142; Crescenzio 1602, p. 76). In the *Espejo de navegantes* (c. 1537), Chaves stated that the anchors of a 200 toneles (220 t) ship, besides the sheet anchors of 11 quintales, weighed one 10 q, one 9 q and two 7 q, corresponding to 91%, 82% and 65% of the the heaviest anchor on board (Chaves, c. 1537, f.60v). In 1587 Garcia de Palacio specified the weight of all the anchor cables: the heaviest was 18 *q,* the common ones were 16 *q* and 14 *q*, and the one for the kedger was the 6 *q,* corresponding to 89%, 78% and 33% of the strongest cable. Only the sheet anchor weight was expressed, but the others probably followed proportions similar to those of the cables (Garcia de Palacio 1587, p. 306). The *Dialogo entre un Vizcayno y un Montañes* (c. 1632) is the only Spanish naval treatise of the time giving the weight of all the anchors: the common ones were 90% and 80% of the sheet one, and the kedgers were 22,5% and 17,5%. Unfortunately, he doesn't specify the cable weight (Vicente Maroto 1998, p. 188).

Summarizing the different authors, bigger common anchors ranged from 87% to 90% of the weight of the sheet anchor, smaller ones from 75% to 80%, and kedgers from 17.5% to 37.5%. Mid-size anchors of 50-65% of the weight of the sheet anchor could be found on board ships of some central Mediterranean navies (*tab.* 5).

Anchor fitting of a ship like the San Giorgio

A late 16th century Genoese ship of 630 metric tons like the *San Giorgio* probably had five or six large anchors: the largest one – the sheet anchor – weighing around 1260-1418 kg, and four or five common ones of two different sizes, 7/8 or 9/10 of the sheet (1103-1276 kg), and 3/4 or 4/5 (945-1134 kg). If she followed the habits of other Italian and Dalmatian navies, she could also have a medium-size anchor of half the weight of the sheet (630-709 kg). The standard fitting included one or two small kedgers (220-532 kg each), and one or two grapnels for her boats (*tab.* 6).

One or two of the common anchors were hanging at each side of the bow for normal operations, while the remaining ones were kept inside the ship, the sheet anchor ready to be used as the last hope in case of extreme danger. Some spare anchors could be stored in the hold, especially if the ship was going west of Cadiz (*Cadexe*, as the Genoese wrote), that was considered the limit before the more demanding Atlantic navigation.

The Cadiz Delta II wreck anchors

Only two anchors were found during the Cadiz Delta II excavations; they were in the central part of the wreck, lying over five Genoese bronze guns, which were over the ballast stones, sealed inside a block of hardened clay mud which preserved them in an unusual state of conservation, with no concretions, very little corrosion and only a few

[37] These authors writing in the Italian language determined the anchors weight in proportion to the heaviest cable weight: the sheet anchor was 2/3, while the common ones were 7/12 and 1/2. Crescenzio didn't mentioned kedgers, Sagri stated that they were 1/3 or 1/4. Reversing the fraction, the heaviest cable weight was 3/2 of the sheet anchor; it's possible to refer all proportions to the latter, by multipling them for 3/2: the common ones were 7/12*3/2 = 7/8 and 1/2*3/2 = 3/4, kedgers were 1/3*3/2 = 1/2 and 1/4*3/2 = 3/8.

author/year	number of anchors onboard	weight of largest anchor (sheet a.) determination	weight of common anchors compared to the largest anchor	weight of mid-size anchors compared to the largest anchor	weight of kedgers compared to the largest anchor	total weight of anchors compared to the largest a. and to ship capacity
AUTHORS OF ITALIAN LANGUAGE						
Sagri 1571	**4-8 anchors,** **2-3 kedgers,** proportional to ship capacity	proportional to sum of ship dimensions **= 2/3(L+2B+4D)**[a]	1 to 4×**7/8 = 88%** 1 to 4×**3/4 = 75%**	1 or 2×**1/2 = 50%** for *pennello*	2 or 1×**3/8 = 37,5%** for *andrivello*	370 t ships had **426%-439%** of sheet a. weight[b]
Crescenzio 1602	**4-8 anchors, (kedgers?)** proportional to ship capacity	proportional to sum of ship dimensions **= 2/3(L+2B+4D)**[a]	1 to 4×**7/8 = 88%** 1 to 4×**3/4 = 75%**	not mentioned	not mentioned	-
SPANISH AUTHORS						
de Chaves circa 1537	220 t ships had **5 anchors, (kedgers?)**	220 t ships had ×**0,23**%	220 t ships had 1 1×**91%** 1×**82%**	2×**64%**	not mentioned	220 t ships had **401%** of sheet a. (0,92% of ship capacity)
Escalante de Mendoza 1575	ships had **≥ 4 anchors, (kedgers?)**	proportional to ship capacity 1x**(0,15%+322 kg)**	not mentioned	not mentioned	not mentioned	-
Garcia de Palacio 1587	variable number (unspecified); 370 t ships had **5 anchors,** **1 kedger**	370 t ships had 1×**0,20-0,23%**	370 t ships had 2×**89%** 2×**78%**[c]	-	370 t ships had 1×**33,3%**[c]	370 t ships had **467%** of sheet a.[c] (0,93-1,07% of ship capacity)
Cano 1611	not mentioned	1x**0,20%** of ship capacity	not mentioned	not mentioned	not mentioned	-
(Lopez de Soto?) circa 1632	ships of all sizes: **5 anchors,** **2 kedgers**	460 t ships had 1×**0,20%** (valid for ships of other size too?)	460 t ships had 2×**90%** 2×**80%** (valid for ships of other size too?)	-	460 t ships had 1×**17,5%** 1×**22,5%** (valid for ships of other size too?)	460 t ships had **480%** of sheet a. (0,96% of ship capacity)
synopsis Spanish authors	earlier: **≥ 4 a.,** proportional to ship capacity later: **5 anchors,** **2 kedgers** for all ship size	earlier: 1×**0,23%** later: 1×**0,20%** of ship capacity	earlier: 1x**90%** + 1x**80%** later: 2x**90%** + 2x**80%**	earlier: 2x**64%** later: no more in use	earlier: ? later: 1x**33%** or 1x**17%** + 1x**22%**	earlier: **400%** of sheet anchor (kedgers to add?) later: **480%** of sheet anchor, kedgers included

[a] Ships dimensions: L = length of the keel; B = beam; D = depth in the hold. As the *San Giorgio* dimensions are not exactly known, it has been preferred not to use this method, because it would result in a large error.

[b] The amount of anchors onboard varied depending on ship size, so did their total weight. According to Sagri (1570-71), Ragusean ships of 370 t (like the example mentioned by Escalante de Mendoza, 1575) had four anchors, plus one for the *pennello* (?) and one for the *andrivello* (kedging?): the largest (100%), one larger (88%, one smaller (75%), a fourth one like one of the previous two (88% or 75%), plus two even smaller (50% and 38%) = 426 or 439% of the largest anchor weight.

[c] Ratios of the anchor cables weight, which had to be similar to the ratio of the anchors. According to Escalante de Mendoza (1575), anchor cables had the same weight of the anchors.

tab. 5 – Anchors on board Early Modern Mediterranean ships.

author/year	number of anchors on board a 630 t ship	weigth of largest anchor (sheet anchor) on board a 630 t ship	number & weight of common anchors compared to the largest anchor	number & weight of mid-size anchors compared to the largest anchor	number & weight of kedgers compared to the largest anchor
Sagri 1571, Crescenzio 1602	**1 sheet anchor,** **5 common anchors,** **1 small anchor, 1 kedger**	proportional to sum of ship dimensions = 2/3*(L+2B+4D)[a]	2-3x**7/8(87,5%)** + **3-2x3/4**(75%)	1×**1/2** (50%) for *pennello*	**1×3/8** (37,5%) for *andrivello*
Escalante de Mendoza 1575	**> 4 anchors (not including kedgers?)**	proportional to ship capacity (1×0,15%+322 kg) 1×**1267** kg	not mentioned	not mentioned	not mentioned
Garcia de Palacio 1587	**≥ 5 anchors,** **≥ 1 kedgers**	proportional to ship capacity (0,20-0,225%) 1×**1260-1418** kg	2×**1121-1262** *kg (89%)*+2×**983-1106** kg (78%)[b]	-	1×**420-473** kg (33,3%)[b]
(Lopez de Soto?) c. 1632	**5 anchors,** **2 kedgers**	proportional to ship capacity (0,20%) 1×**1260** kg	2×**1134** kg (90%)+2×**1008** *kg* (80%)	-	1×**220** kg (17,5%)+1×**284** kg (22,5%)
synopsis	1 sheet anchor, 4-5 common **a., 0-1 small a., 1-2 kedgers**	1×**1260-1418** kg	2×**1103**[c]**-1276** kg+2×**945**[d]**-1134** kg	0-1×**630-709** kg	1-2×**220-532**[e] kg

[a] Ships dimensions: L = length of the keel; B = beam; D = depth in the hold. As the *San Giorgio* dimensions are not exactly known, it has been preferred not to use this method, because it would result in a larger error.

[b] Ratios of the anchor cables weight, which had to be similar to the ratio of the anchors. According to Escalante de Mendoza (1575), anchor cables had the same weight of the anchors.

[c] Considering the ratio of 7/8 (87,5%) reported by Sagri (1571) and Crescenzio (1602).

[d] Considering the ratio of 3/4 (75%) reported by Sagri (1571) and Crescenzio (1602).

[e] Considering the ratio of 3/8 (37,5%) reported by Sagri (1571). Crescenzio (1602) didn't mention neither small anchors nor kedgers.

tab. 6 – Anchors on board Mediterranean 630 t ships like the San Giorgio *(late 16th-early 17th century).*

fig. 35 – *General view of the two anchors recovered from the Delta II wreck with the Anchor 2 in the foreground (photo:* Tanit *Gestión* Arqueológica).

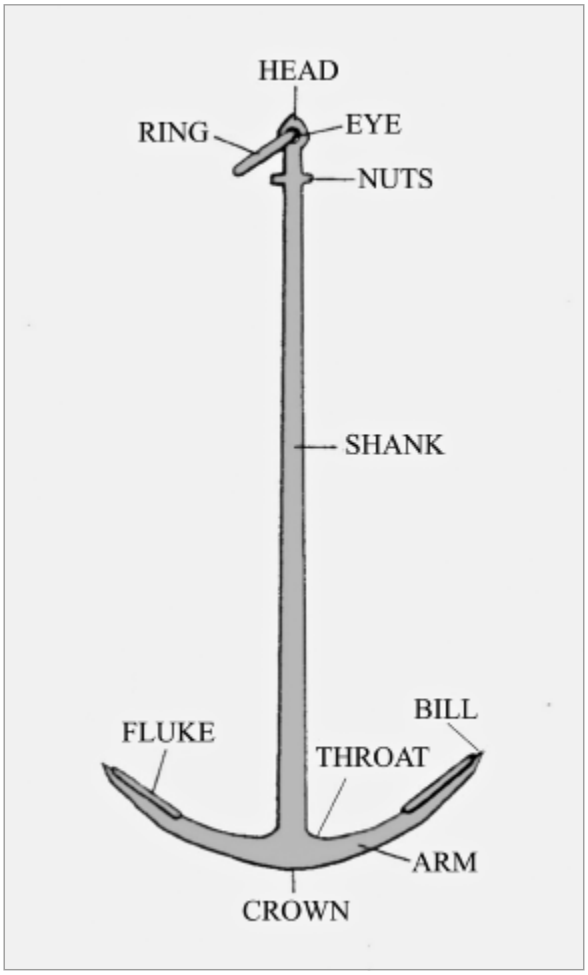

fig. 36 – *Drawing with the terminology used currently to describe early modern anchors (from* Keith *1988a, modified).*

parts broken (*fig.* 35). From the archaeological context (their position relative to the hull) it has been argued that they were stored in the lower part of the hold.

According to archival sources the *San Giorgio* started her last voyage in Genoa, made a stop in Cartagena, was unloaded in Cadiz and loaded again, and at the moment of the sinking she was ready to sail back to Genoa, but no information is known on where the two anchors had been loaded. Even if it were possible to know at which harbour they had been brought on board, we could not be sure of their origin: anchors were imported whenever navy needs couldn't be met by internal production, and Genoa and Spain were often exporters as well (Carrion Arregui 1995, p. 200, 202; Gay 1997, pp. 95-96). They could also be taken as spoils, if a ship had lost some of her own at sea. It is possible to determine the origin through typological comparison; however, this is the case only with Spanish anchors, as the Genoese ones remain almost unknown: the only piece found comes from the *Lomellina* wreck, sunk in Villefranche bay (France) in 1516. Only its upper part, including the head and the ring, survives; the arms and the lower part of the shank are unfortunately missing, so it can be of little help in informing us about shape and proportions (Guérout, unpublished). Both of the Cadiz-Delta II wreck anchors are broken: Anchor 1 (CdzDIIA1) is missing the upper part of the shank and the edges of the flukes, while Anchor 2 (CdzDIIA2) is missing only part of the ring, one arm tip and one fluke; since it is the best preserved, and shows more features for analysis, it will be examined first. Early modern anchor terminology is shown in *fig.* 36.

Anchor 2 (*fig.* 37)

(morphology, dimensions, weight and proportions are synthesized in *tab.* 7).

Morphology

Anchor 2 is a two-armed iron anchor measuring 275 cm long, originally fitted with a wooden stock,

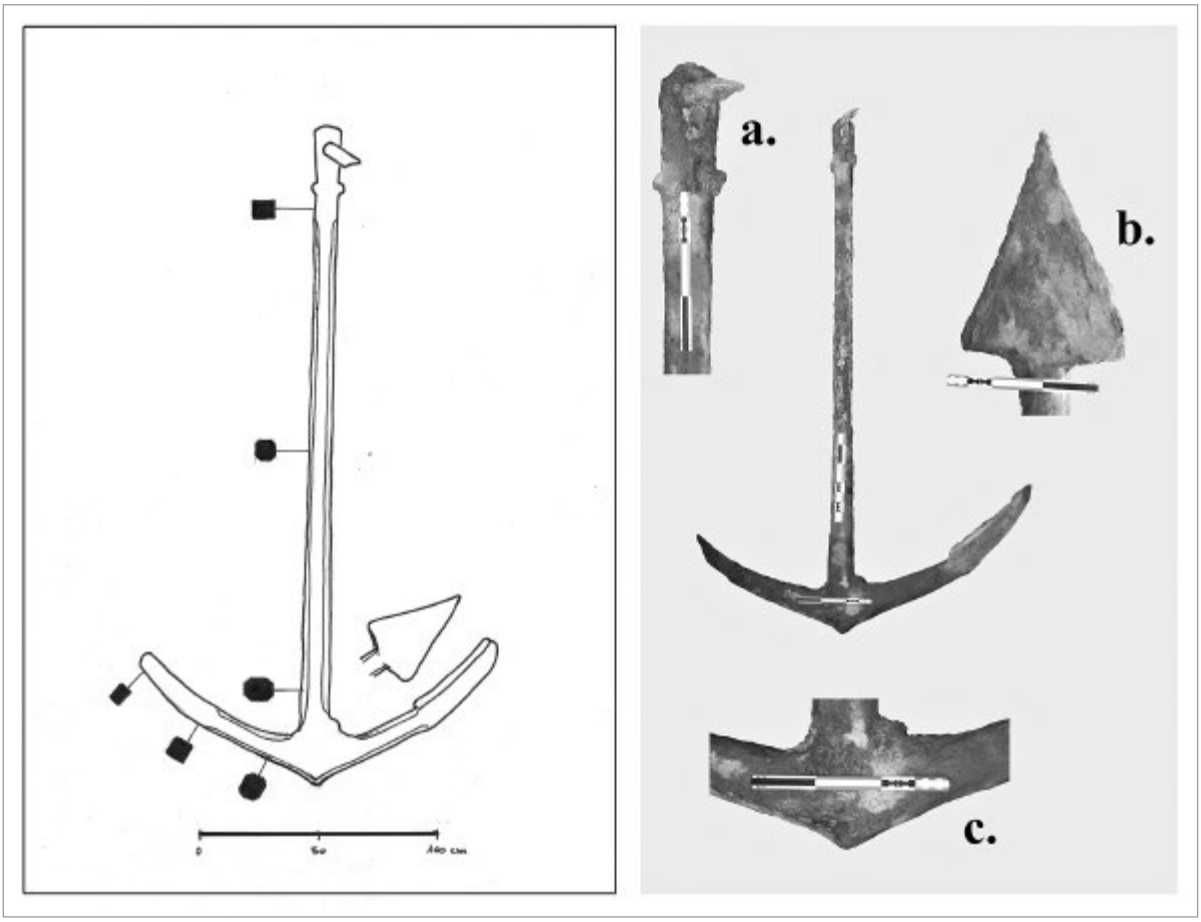

fig. 37 – The Anchor 2 and its details: a. *head,* b. *fluke,* c. *crown (Cdz-DII-A2, drawing and photos: Fabrizio Ciacchella). The photo of the whole anchor shows perspective distorsion.*

which did not survive. The ring is preserved only in a small part; this is enough to estimate its original diameter, however it is possible that the remaining part was deformed when it broke. The shank's cross-section is squared in the upper part (the so-called "square of the shank") and octagonal elsewehere, giving the shank a faceted appearance. Above this, the head is almost straight, slightly broadening from the square of the shank to the rounded top. Mid-way up the square, two nuts (keys to prevent the stock from turning or sliding) protrude laterally on the same plane as the arms, on the opposite sides of the shank; unfortunately, corrosion prevents us from knowing their original form (*fig.* 37.a). At the bottom, the shank meets the arms at an angle of 50° at the crown, and circa 60° at the throats (the two concave sides of the crown), that are reinforced with the welding of some extra iron (*fig.* 37.c). The crown is tipped and the arms have a curved form: near the crown they are faceted like the shank, near the extremity they have a squared cross-section to offer more surface for the welding of the flukes. One arm tip is broken, and the fluke is missing; the surviving one is slightly kite-shaped, welded at the very end of the arm, without leaving any bill (*fig.* 37.b)[38]. The fluke base has been hammered to slope over the upper face of the arm, unlike many other 16th century anchors, in which a step is present between the two (Ciacchella 2015, p. 82). A parallel for many morphological aspects can be found in an anchor from the *N. S. de Atocha* wreck (sunk off Florida in 1622), now exhibited in the *Museo de Anclas* in Salinas, Spain (*fig.* 38). Like the Cadiz Delta II Anchor 2, the nuts are in a lateral position, parallel to the arms, the shank is square in its upper part and faceted below, the crown is tipped, the arms are curved and the flukes are trapezoidal. A few differences exist: in the *Atocha* anchor, the shank is more tapered, the head is expanded, to reinforce

[38] The bill is the arm tip which is uncovered by a fluke welded in a sub-terminal position.

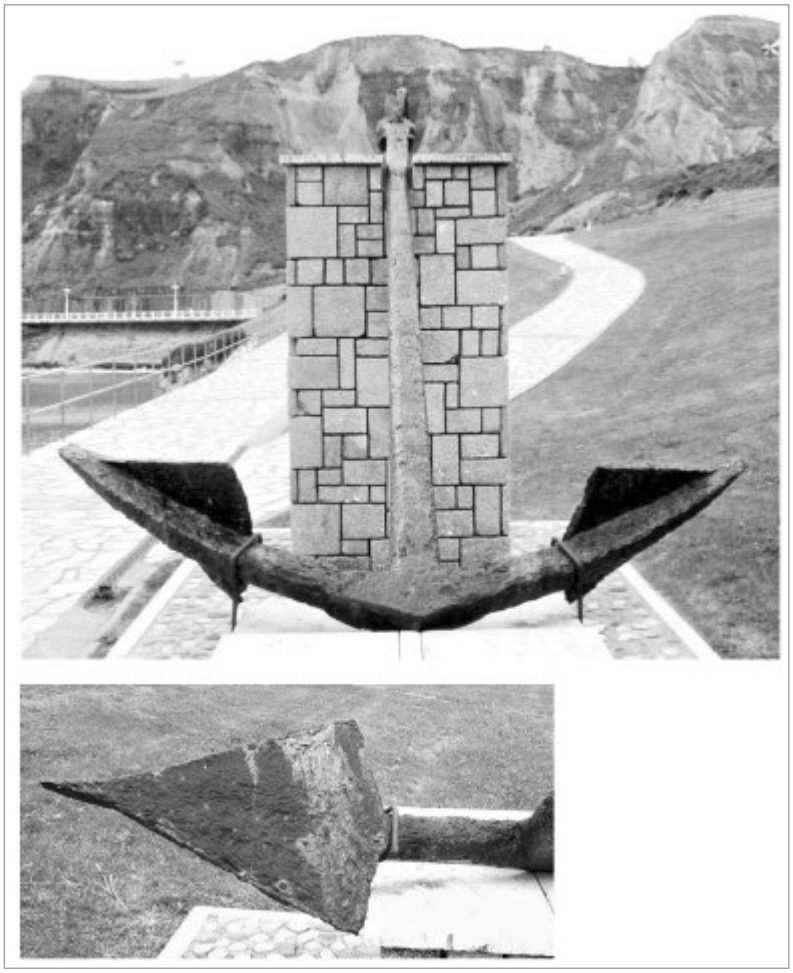

fig. 38 – *An anchor from the wreck of N. S. de Atocha, sunk off Florida in 1622, today on display in the Museo de Anclas in Salinas, Spain (from Hormaechea, Rivera, Derqui 2012).*

the ring hole sides in an upper shank made thinner by the marked tapering, as was common in the 16th century, and the fluke tip, as well as the arm tip, appear to have been sharpened (Hormaechea, Rivera, Derqui 2012, pp. 103-104). A parallel for the fluke base sloping over the upper face of the arm can be found in the Anchor 1 of the *Gagliana grossa* wreck, a Venetian ship sunk off Gnalic (Croatia) in 1583 (Ciacchella 2015, pp. 59, 82).

Weight

The original weight, including the missing parts of the ring and flukes, can be estimated at circa 310 kg[39].

Proportions

The unusually good state of conservation of Anchor 2 allowed measurements to be taken that were very close to the original, which is usually impossible because of concretions or corrosion.

The head is almost straight, slightly broadening from below the ring hole up to the rounded top (top width to under ring hole width ratio is 1.2), and is three times wider than the thickness of the ring, so both sides of the ring hole have the same width of iron as the ring thickness. The shank is almost straight, very slightly tapering from base to top (the width under square to width at the base ratio is 0,91), which is uncommon in the 16th century. Spanish anchors of the time were famous for their 'spindliness', due in particular to a marked tapering (Keith 1988b: 51). Figures of this aspect

[39] Anchor 2 weight has been estimated from its volume, considering the ring diameter to be one sixth of the anchor length, according to the following formula: Anchor volume = shank volume + arms volume + flukes volume + ring volume = (shank length 275×84 cm² mean cross-section) + (arms 2×mean length 81×72 cm² mean cross-section) + (flukes 2×base 36×40 cm height /2×2 cm thickness) + (ring estimated circumference π46×π22 cm² cross-section) = 23,100+11664+2,880+1,814 cm³ = 39,458 cm³ = 39.458 cm³ Anchor 2 weight = Anchor 2 volume×iron density = 39.458 cm³×7.85 kg/dm³ = 309.7 kg.

MORPHOLOGY	ANCHOR Cdz-DII-A1	ANCHOR Cdz-DII-A2
head form	(not preserved)	slightly broadening, rounded top
nuts number, position & form	(not preserved)	2/parallel to arms/(corroded)
shank cross-section (upper/lower)	(not preserved)/octagonal	squared/octagonal
crown form	tipped	tipped
arms form	two different curves	two different curves
arms cross-section (near crown-near tip)	octagonal/squared	octagonal/squared
flukes form	slightly kite-shaped	slightly kite-shaped
bills form	(bills absent)	(bills absent)
MEASUREMENTS (cm)		
total length	preserved **272 estimated [a] ≥ 323**	275
beam	156	(preserved 157) estimated [b] 162
arm length (tip to crown) L/R	109	(broken tip 90) L/**R 98**
arm length (tip to throat) [c] L/R	91 **[c]**	(broken tip 78) L/R 84 **[c]**
ring mean diameter × thickness	(not preserved)	(not preserved)×**4**
head length (over eye + eye) × **width × thickness**	(not preserved)	**(8+4)×12×6** (top) **- 7** (eye)
nuts length × width × thickness	(not preserved)	4×2.5×7
square length (under eye) **× width × thickness**	(not preserved)	28×10×7
shank (under square) **upper width × thickness**	(preserved part) **9×7**	10×7
shank trend [d] width × thickness	11×9	(corroded 8.5)**×8**
shank base width × thickness × perimeter	13×10×46	11×9×40
arm base width × thickness L/R	12×11	11×8.5
arm @ fluke base width × thickness L/R	9.5×9.5	8.5×8.5
fluke length × base × thickness L/R	max preserved **51×≥32×2**	not preserved L/**R 45×30×2**
arm (tip) width × thickness L/R	(corroded)	5×2.5
bill length × base width × base thickness L/R	absent	(not preserved) L/**R absent**
estimated weight	≥ 433 kg	c. 310 kg
ANGLES AND PROPORTIONS		
arm-shank angle @ crown (arm tip-crown-shank axis)	50°	(broken L)/**R 50°**
arm-shank angle @ throat (arm tip-throat-shank side)	60°	(broken L)/**R 60°**
general proportion (anchor beam: length)	< 0.57 **(estimated ≤ 0.48)**	0.59
anchor (shank) length: arm length @ throat [c]	> 3.0 (estimated ≥ 3.55) **[c]**	3.27 **[c]**
anchor (shank) length: arm length @ crown	> 2.5 **(estimated ≥ 3.0)**	2.81
ring 'spindliness' (mean diametre * π: thickness)	not applicable	not applicable
ring mean diameter: shank length	not applicable	not applicable
ring circumference: shank length	not applicable	not applicable
ring thickness: shank length	not applicable	0.015
ring thickness: shank base width	not applicable	0.36
ring cross-section circumference: shank base perimeter	not applicable	0.31
ring cross-section area: shank base cross-section area	not applicable	0.13
head width: ring thickness	not applicable	3.0
head expansion (head max width: head width under eye)	not applicable	1.20
nuts expansion (tip-to-tip nuts width: square width)	not applicable	1.50
nuts relative heigth (eye base to mid-nuts: shank length)	not applicable	0.047
square relative length (eye base to square end: shank length)	not applicable	0.10
shank 'spindliness' (length: base width) (length: base perimeter)	preserved>21 estimated≥24.8 preserved >5.9; estimated ≥7	25 6.88
shank tapering (upper shank width: shank base width)	c. 0.69	0.91
fluke length to arm length ratio (throat; crown)	0.56 **[c] ; 0.47**	0.54 **[c] ; 0.46**
fluke expansion (fluke breadth: arm thickness @ fluke base)	> 3.4	3.53
fluke 'spindliness' (fluke breadth: fluke length)	≥ 0.63	0.67

[a] Anchor minimum length estimated by adding to the preserved length the length of the square of the shank, that was equal to the length of the fluke.
[b] Anchor beam estimated by doubling the perpendicular from the unbroken arm tip to the shank vertical axis.
[c] Length measurements of the upper face of the arm (from tip to throat) are less significative, because they are influenced by huge throat reinforcements.
[d] The trend is the point of the shank as distant from the crown as the arm length.

tab. 7 – Cadiz Delta II Wreck Anchors.

are very rare, because width measurements are not usually taken, however a few exceptions exist. In the anchor of the 16th century, the Bahia Mujeres wreck, shank tapering ratio could be calculated to 0,72 (Keith 1988a: 123). In Adriatic anchors of the 16th century, the shank tapering ratio was in most cases 0.5, and in a few cases raised up to 0.8. Shank length is exactly 25 times shank base width, a ratio very close to the Anchor 1 of the late 16th century Gnalic wreck (24.3) and to the data reported by Witsen in 1671 for Dutch anchors (24.0) (Ciacchella 2015, p. 72; Hoving 2012,

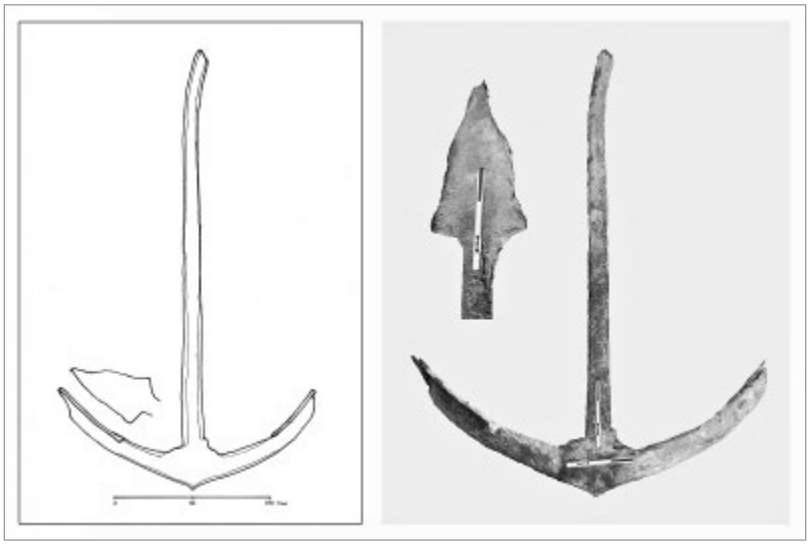

fig. 39 – The Anchor 1 and detail of a fluke (Cdz-DII-A1, drawing and photos: Fabrizio Ciacchella). The photo of the whole anchor shows perspective distorsion.

p. 167). The shank is 2.8 times longer than the arm, measured from tip to crown, and 3.27 times measured from tip to throat, but the latter is less significant, because the arm measurements were taken outside the huge reinforcements. Arms and shank bases, excluding the crown reinforcements, have similar width and thickness. The typical length of 16th century flukes was half the length of the arm, measured on its upper face from tip to throat, but the surviving one of the Cadiz Delta II Anchor 2 seems longer, probably because the arm appears shortened by the iron reinforcement at the throat. Fluke breadth is two thirds of its length, and the ratio is 0.67, very near to the one measurable in the photo of the *Atocha* anchor (0.60).

Anchor 1 (*fig.* 39)

(morphology, dimensions, weight and proportions are synthesized in *tab.* 7).

Morphology

Anchor 1 is a two-armed iron anchor, missing the upper part of the shank and the wooden stock, with a preserved length of 272 cm.
Due to the missing upper part of the shank, the shape of the head and the form and position of the nuts cannot be determined, however because of the strong tapering of the surviving part of the shank, its upper extremity is so narrow that the head would have to expand laterally to strengthen the ring hole. The surviving shank in many points shows traces of the original octagonal cross-section: in anchors with a faceted shank, the upper part of the latter was always squared in cross-section, to help welding the nuts and affixing the wooden stock, and the square of the shank, as it was called, was in general as long as the fluke. As for Anchor 1, considered the length of its fluke, the total length would have been 323 cm or more.
The shank meets the arms at an angle of 50° at the crown, and 60° at the throat. The crown is tipped, and the throats are reinforced with the welding of a large amount of extra iron. The arms are curved, each arm with a different curve: the part near the crown in some spots shows a faceted appearance like the shank, while the part near the extremity has a squared cross-section. The damaged edges of the flukes don't allow us to determine their breadth, but the surviving parts of the base show that they would have been slightly trapezoidal, with the fluke base hammered into a slope over the upper aspect of the arm, like those of Anchor 2. The tip of one of the two flukes survives and demonstrates the absence of bills (see note 39). The morphological parallels are the same as Anchor 2, except for the upper part of the shank, missing in Anchor 1.

Weight

Considering the estimated length of Anchor 1 (≥ 323 cm) and a ring diameter of one sixth of the shank length, a common proportion for the time, the original weight would have been 433 kg or more[40].

[40] Anchor 1 weight has been estimated from its volume, according to the following formula: Anchor volume = shank volume + arms volume + flukes volume + ring volume = (shank estimated length ≥323×94 cm² shank mean cross-section) + (2x arm mean length 101×90 cm² arm mean cross-section) + (flukes 2×32×51 cm/2×2cm) + (ring estimated circumference π323/6×π 2.52 cm²

Proportions

Due to the missing upper part of the shank, most of the proportions cannot be calculated. The only certainty is the fluke length to arm length ratio: 0.47 referred to the arm length from tip to crown, 0.56 considering it from tip to throat, but the latter is less significative, because arm length measurements were influenced by the huge throat reinforcements). The tapering of the surviving shank (upper width to base width ratio) is 0.69, and originally it was probably very near to this figure, possibly two thirds (0.67). The missing part included the square, that was usually straight, without any further taper, and it isn't known if under it there was some more faceted and tapered shank. If this was the case, it wasn't likely to be much more tapered, since the upper extremity of the surviving shank wasvery narrow.
Considering the missing upper part of the anchor, and the estimated total length, the other proportions can only be calculated as being less than a datum, or more of it.
The general proportion (beam to estimated length ratio) would have been ≤ 0.48, while the shank 'spindliness' (estimated length to base width) would have been ≥ 24.8.
The shank would have been three times or more longer than the arm, measured from tip to crown, and three and a half times or more measured from tip to throat, but the latter proportion is less significant, because the measurements on the upper face of the arms were influenced by the huge throat reinforcements. All these figures are commonly found in 16th century anchors (Ciacchella 2015, pp. 82-84).

Considerations on the two Cádiz Delta II wreck anchors

Comparison between the two anchors

Many morphological features are present in both anchors: the faceted shank and arms, the angle between them, the reinforced and tipped crown, the curved arms, the kite-shaped flukes without bills, and the proportion between flukes and arms, yet some differences exist. Considering its missing upper part, Anchor 1 would have been longer and narrower: the general proportions (beam to shank length ratio) would have been ≤ 0.48 in Anchor 1, and was 0.59 in Anchor 2, meaning that the former was more slender than the latter. The shank tapering (upper width to base width ratio) was ≤ 0.69 in Anchor 1 and 0.91 in Anchor 2, reflecting in the former a shank with a slight upward taper, almost parallel, as is commonly found in the 17th century and, in the latter, a shank much narrower in its upper part: such a tapered shank would have needed an expanded head to strengthen the ring hole, typical features of the 16th century (Ciacchella 2015, pp. 73-74, 78-79).

Function of the anchors

As we have seen, the five or six large anchors weighing 1 ton or more, which would have been part of the ship's equipment, have not been found; neither were the one or two small kedgers that would have been on deck, usually near the stern. This is probably because they were salvaged, as is the case with the deck guns: they were very expensive artifacts, large and easy to spot.
Considering their estimated weight, the two Cadiz Delta II anchors could have been two kedgers of the *San Giorgio*, however their archaeological context (the central part of the hull corresponding to the hold, lying on five bronze guns) suggests that they were not part of the ship's standard equipment, instead they were spare anchors or part of her cargo. It is unknown whether they were broken during the bombardment that caused the sinking of the ship or whether they were already broken on loading and were transported for repair or as scrap metal.

Origin

Their origin cannot be identified for certain: a comparison can be made with Spanish anchors of the time, but not with Genoese ones, which remain almost unknown, meaning we lack evidence to check against. Furthermore, they could have been imported from another country: their import-export was common at the time. However, the kite-shaped flukes, the curved arms, the tipped crown and the faceted shank and arms have a strong parallel with an anchor found in the *N. S. de Atocha* wreck, sunk in 1622, and seem to suggest that those of the Cadiz Delta II were probably Spanish in origin.

Tracing the chronology of some morphological aspects

The morphology of typical 16th century anchors includes expanded head, nuts in a lateral position (at either side of the shank, parallel to the arms), shank and arms with squared cross-section (square near the extremities, oblong near the crown) and

estimated cross-section) = ≥ 30,3623+18,180+3,264+3,317 cm^3 ≥ 55,123 cm^3 ≥ 55.123 dm^3 Anchor 1 weight = Anchor 1 volume x iron density≥ 55.123 dm 3×7.85 kg/dm^3 ≥ 432.7 kg.

triangular flukes (equilateral or with the base equalling the height). The head top, crown and arms could come in different forms, probably depending on region (Ciacchella 2015, pp. 71-91). Spanish anchors, especially in the first part of the century, were very narrow and tapered, and this thinness was the origin of an old Dutch saying: «as meagre as a Spanish anchor» (Curryer 1999, p. 44).
Afterwards, anchors underwent many changes: shank and arms were forged with octagonal cross-sections, giving them a faceted appearance, but at their extremities, where flukes and nuts had to be welded and the wooden stock affixed, a square cross-section persisted. Forging faceted bars, as opposed to squared ones, meant hammering from eight different directions (instead of four) on smaller surfaces with higher pressure and allowing heat to penetrate deeper inside the metal to expel air bubbles; in other words, it allowed for better forging. The shank became less tapered, and there was no more need for the head to expand laterally to reinforce the ring hole, so the head became straighter. Before the Cadiz Delta II excavations, the earliest examples of straight head were the anchors from the *Vasa* wreck, sunk in 1628 (Hocker in press). Later, nuts moved to a front/rear position, perpendicular to the arms, and consequently the mortise on the inner part of the two halves of the wooden stock changed form. Of course, these changes didn't happen all at once, neither suddenly, nor everywhere at the same time. Until the Cadiz Delta II wreck excavations, it was believed that all these changes had occurred during the 17th century: the earliest examples of faceted shank and arms comes from the anchors found in the *N. S. de Atocha* wreck, sunk in 1622. In the manuscript *Fragments of Ancient English Shipwrightry*, attributed to Matthew Baker and to his followers, there is a drawing with some notes entitled *The proportiones of ye best sort of Anckers by L. T.,* believed to be Lewis Tate, an anchorsmith known to have worked at the time. Being in a part of the document written by other hands than that of Baker's, it can be dated to after his death in 1613 (Barker, personal communication; Barker 1985, pp. 161-178). A note referred to the upper part of the shank reads "*square*", suggesting that the lower part had a different cross-section: if the whole shank was squared, such a note would have had no meaning.
The Cadiz Delta II wreck anchors show that many morphological aspects documented by archaeological evidence to as early as the 1620s (the straight head, the square, the faceted and slightly tapered shank and arms) were already present at the time of the sinking of the *San Giorgio*. Anchor 1 can be considered a transitional form, combining a characteristic of the early 16th century, the strongly tapered shank with the expanded head, with a more recent one, the faceted shank and arms. Anchor 2 is a forerunner to the late modern forms, not only for the faceted shank and arms, but also for the almost straight shank and head.

6. Conclusions

Taking into account everything described here, the archaeological remains located during the construction of the new container terminal in the city of Cadiz, known to date as Delta II, are part of the Genoese ship named *San Giorgio e Sant'Elmo*, also known as *Vassalla piccola*. She was built in 1573 in Portofino and owned by Pietro Paolo Vassallo (son of Cristoforo) and captained by Clemente Vassallo (son of Delfino) and was sunk on 29th April 1587 after suffering an attack by Francis Drake.
She was not the only ship of Pietro Paolo Vasallo that sailed between Genoa and Spain. The *Vassalla piccola* or *San Giorgio e Sant'Elmo* was complemented at least by the large ship *Vassalla grossa* or *Santa Maria de la Serra*. In 1591, the 4,000 *salme* (760metric tons) ship transported the Florentine Francesco Carletti from Livorno to Alicante, the first leg of a voyage that took him around the world (Carlieri 1701, p. 2).
The ships owned by Pietro Paolo Vassallo represent typical examples of the merchantmen that travelled along the western Mediterranean in the second half of the 16th century, following what we could call the "wheat and wool" routes, after the main goods shipped along them. These routes connected the grain ports of Sicily to those of Mediterranean and Atlantic Spain, with an important intermediate step in Genoa, whose merchants controlled a large part of this trade. As complementary merchandise, they also loaded other products, such as those we have seen recorded and which we have uncovered in the wreck of the Delta II – *San Giorgio.*
Another example of these ships is represented by the *San Juan / Parissona grossa*, built in San Sebastián and later transferred to Genoese owners, which was wrecked off Sciacca in January 1581 while loading wheat at this Sicilian loading point (Ridella 2012)[41].

[41] In addition to her history, this article also describes and outlines the trade routes she followed.

We also know that the ten merchantmen embargoed by the Spanish crown to form the Levanter squadron of the 1588 Armada belonged to the same category of ship we are dealing with here. These comprised four ships from Ragusa di Dalmazia (today Dubrovnik), three from Venice, two from Genoa and one from Mataró, Catalonia, and almost all sunk off the Irish and Scottish coasts during their return to Spain after the failed attempt to invade England. Only the Genoese *Santissima Trinità*, owned by Nicolò Lomellini, escaped this fate, arriving heavily damaged at the port of Santander (Ridella 2011, p. 50), while the Venetian *Regazzona* sank as soon as she entered the Ria de Ferrol (González-Aller 2013, pp. 14, 18). Some wrecks of the Levanter ships have been found and partially excavated, for example that of the Catalan ship *La Juliana* from whose site in Sligo Bay (Birch, McElvogue 1999, pp. 271-272), northwestern Ireland, 12 bronze cannons were recovered in 1986 and 2015. Most of these, similarly to those from the Delta II wreck, were cast by the Genoese founder Dorino II Gioardi in 1570 (Ridella 2004; Moore, Brady, Kelleher 2015).

MEASURES OF THE BRONZE CANNONS RECOVERED FROM THE DELTA II WRECK (mm)	**CNN 1** Perrier **G**	**CNN 2** Perrier **G**	**CNN 3** Saker **V**	**CNN 4** Falcon **IB**	**CNN 5** Saker **D** *C.ra 14.04*	**CNN 6** Bast. Demi Culverin **G** *C.ra 19.30*	**CNN 7** Saker **IB** *C.ra 16.15*
1 OVERALL LENGTH	1.950	1.950	2.650	2.338	2.640	2.666	2.610
2 CONVENTIONAL LENGTH	1.777	1.772	2.452	2.201	2.472	2.482	2.446
3 BASERING/TRUNNION DISTANCE	750	745	1.050	941	1.062	1.052	1.048
4 TRUNNION/MUZZLE DISTANCE	1.025	1.025	1.402	1.260	1.410	1.430	1.398
5 CHAMBER LENGTH	435-437	300	----------	----------	----------	----------	----------
6 DIAMETER OF THE CHAMBER	126	129	----------	----------	----------	----------	----------
7 DIAMETER OF THE TRUNNION (MIN-MAX)	80-89	80-86	86	68-75	72	78	78
8 LENGTH OF THE TRUNNION (MAX)	76	73	78	64	70	70	78
9 DIAMETER AT THE TOUCHHOLE	285	286	252	216	258	299	278
10 DIAMETER AT THE TRUNNIONS	290	282	231	192	225	259	241
11 DIAMETER AT THE MUZZLE MOULDINGS	213	218	155	136	150	172	156
12 MAXIMUM DIAMETER OF THE MUZZLE MOULDINGS	240	258	228	198	207	234	227
13 BORE DIAMETER	162	164	concr. ~ 90	74	closed 90	closed 90	90
WEIGHT (kg)	taken 562	taken 575	calcul.672	calcul. 417	mark. 670	mark. 920	mark. 770

tab. 8

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AGS, MPD (Archivo General de Simancas, *Mapas, Planos y Dibujos*).

ASCGe, PC (Archivio Storico del Comune di Genova, *Padri del Comune*).

ASGe, CGF (Archivio di Stato di Genova, *Camera di Governo e Finanza*).

ASGe, CM (Archivio di Stato di Genova, *Conservatori del Mare*).

ASGe, MS (Archivio di Stato di Genova, *Manoscritti*).

ASGe, NA (Archivio di Stato di Genova, *Notai Antichi*).

ASGe, NC (Archivio di Stato di Genova, *Notai di Chiavari*).

ASGe, SG (Archivio di Stato di Genova, *Ufficio di San Giorgio*).

APSCDG (Archivio della Parrocchia dei Santi Cosma e Damiano a Genova).

APSMG (Archivio della Parrocchia di San Marco a Genova).

APSMP (Archivio della Parrocchia di San Martino a Portofino).

ASPa, MP (Archivio di Stato di Palermo, *Maestro Portulano*).

ASPa, TRP (Archivio di Stato di Palermo, *Tribunale del Real Patrimonio*).

DADU (Državni arhiv u Dubrovniku. Dubrovnik State Archive).

MN, Col. FN (Biblioteca y Archivo del Museo Naval de Madrid. Colección Fernando Navarrete).

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Summary

Construction work on the new container terminal at the Port of Cadiz has uncovered three shipwrecks. The documentary investigation carried out on the wreck known as Delta II, together with information derived from the artillery it was carrying and the various cargo that has survived, have made it possible to identify the remains as belonging to the Genoese merchant vessel *San Giorgio e Sant'Elmo*, sunk by Francis Drake during his attack on the Bay of Cadiz in the Spring of 1587. The ship has also been identified as one of those used to transport artillery for the Spanish Armada, which was then being formed by Philip II in Lisbon to attack England.

Keywords: anchors, Cadiz Delta II, cochineal, Genoese Reinassance shipwreck, merchantman, guns, gunfounders, underwater archaeology, 16th century.

Riassunto

Il relitto Cadice-Delta II: la "San Giorgio", veliero mercantile genovese affondato da Francis Drake nel 1587. I lavori per la costruzione del nuovo terminal container nel Porto di Cadice hanno portato alla scoperta di tre relitti. La ricerca documentale condotta su quello di essi denominato Delta II, congiuntamente alle informazioni tratte dai pezzi d'artiglieria rinvenuti e alle diverse merci del carico conservate, hanno permesso l'identificazione dei resti come quelli del veliero mercantile genovese *San Giorgio e Sant'Elmo*, affondato da Francis Drake durante la sua incursione contro il porto di Cadice nella primavera del 1587. Si è anche capito che la nave stava allora trasportando armamenti per la flotta spagnola che, su ordine di Filippo II, si stava allora allestendo a Lisbona per attaccare l'Inghilterra.

Parole chiave: ancore, archeologia subacquea, cannoni, cocciniglia, nave mercantile, Cadice Delta II, relitto rinascimentale genovese, XVI secolo.

Resumen

El pecio Cádiz-Delta II: la "San Giorgio", nave mercante genovésa hundida par Francis Drake en 1587. La construcción de la nueva terminal de contenedores del Puerto de Cádiz ha deparado el hallazgo de tres pecios. Los estudios de las fuentes documentales llevados a cabo sobre el naufragio conocido como Delta II, junto con la información aportada por la artillería que transportaba y el variado cargamento conservado, ha posibilitado tanto la identificación de los restos – como pertenecientes a la nave mercante genovesa *San Giorgio y San Telmo*, hundida por Francis Drake durante el ataque que llevó a cabo en la Bahía de Cádiz en el año 1587 –, como su contribución en la formación de la Gran Armada que estaba organizando Felipe II en la ciudad de Lisboa.

Palabras clave: anclas, arqueología subacuática, cañones, cochinilla, nave mercante, pecio renacentista genovés, Cádiz Delta II, siglo XVI.

20
2016

Dopo una serie di volumi tematici, che hanno caratterizzato negli ultimi anni le politiche della Rivista, Archeologia Postmedievale si apre nuovamente, con il suo numero 20, a una polifonia di contributi che ci portano dalla *Conflict Archaeology* alla storia biologica della popolazione, all'archeologia del commercio e a quella dell'alimentazione. Con un ventaglio di casi ben distribuiti nel territorio europeo, essi rappresentano al meglio la vivacità dell'archeologia postmedievale e l'ampia visione metodologica che la contraddistingue. Il saggio di apertura ci porta a Cadice e al recente rinvenimento di un relitto cinquecentesco, affondato nel porto di questa città andalusa, di una nave mercantile genovese, varata nel 1573 e attiva nel commercio del grano dai porti della Sicilia verso Genova e la Spagna, dove caricava lana e beni alimentari. Sul tema delle fortificazioni alpine, segue un solido contributo su un sito di frontiera del Ducato di Savoia, nei pressi del valico del Piccolo San Bernardo, nel sito di Orgères (La Thuile, Aosta), che fu interessato da articolate opere di fortificazione a partire dal 1691, sul confine franco-sabaudo. Al tema della storia biologica e sanitaria della popolazione si riferisce il saggio che approfondisce il ruolo della micropaleobiologia e il caso di studio della peste, come approccio integrato tra metagenomica, ricerca storica e archeologica. Lo studio segna un passo in avanti veramente significativo nello strutturare in modo più solido obiettivi della ricerca biologica applicata alle aree cimiteriali in generale, ma in particolare a quelle di catastrofi sanitarie. La sezione "Archeologia Postmedievale in Italia" si presenta da questo numero in una rinnovata veste editoriale, con le schede arricchite da illustrazioni a colori delle indagini sul terreno, di elaborazioni 3D, di restituzioni grafiche, di reperti e documenti d'archivio. La crescita della consapevolezza di una vivace comunità scientifica attorno a questa parte del patrimonio archeologico e culturale, continua a rappresentare ancor'oggi, al passaggio del ventesimo numero, un cardine imprescindibile della mission della politica culturale della Rivista.

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