Archaeology of a shipwreck

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Any investigation into sunken ships, especially beginning in the post-Medieval era, makes reference to the correspondence between the physical and archive data. If the first has an incomparable advantage of referring to the area of artefacts, the living proof, the second have the exclusive right of providing to a greater or lesser degree and depth, clarification of the historical facts, both generally and specifically. Midway between them is located the geomorphologic setting of the circumstances of any shipwreck.

The sandbar of the Tagus river, for a variety of reasons, among which stands out its specific geomorphology, comprises one of the largest cemeteries for shipwrecks in the world. This despite the excellence of its great size that had already been recognised from Antiquity (Strabo, Geografia, III, 3, 1).

A recent estimate of shipwrecks in this large area of the estuary of the Tagus river and its immediate surroundings permitted an inventory of around five hundred of these vestiges (Alves, 1994), although this number is obviously much lower in reality. It must be pointed out that this estimate considered subaquatic findings, as well as the reports of shipwrecks taken from written sources. The oldest of the latter referring to the area near the zone under consideration, is contemporary with the capture of Lisbon in 1147 and related to the assistance provided by the Crusaders to Dom Afonso Henriques, 1st King of Portugal. In fact, numerous sources document the wrecks of Portuguese ships, particularly beginning in the 16th century with there being many works that assisted with this inventory or specifically give this type of information.

It is, of course, not surprising that the shipwrecks on the sandbar of the Tagus only between the 16th and 18th centuries, counting ships both entering and leaving, increased by several dozen. In addition, around twenty of these instances, distributed in approximately equal percentages, belonged to the India and Brazil Routes. It is worth mentioning that the former were recorded between the first quarter of the 16th century and the first third of the 17th century, and the latter between the first quarter of the 17th century and the first third of the 18th century. Also pointing out that the period between the end of the 16th century and the beginning of the 17th century was especially fatal, as the loss of thirty-eight naus of the Indias in twenty years (1582-1602) confirms. Melchior Estácio do Amaral mentions this in 1604, less than two years before the loss of the Nossa Senhora da Salvação and Nossa Senhora dos Mártires on Lisbon's doorstep.

It is emphasised that relative to the shipwrecks previously pointed out, and substantiated from several basic sources that have apparently exhausted the theme, that only one ship is expressly stated as being

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1 Data collected within the scope of the Inventory - Carta Arqueológica do Património Subaquático, promoted since the 1960's by the Museu Nacional de Arqueologia in Lisbon (Ble 1997a and b).

2 Refers to the shipwreck of a small bank from the Crusaders somewhere between Cape of Roca (Sinta) and Lisbon (Osborn, p. 31).

3 Among the many are mentioned the reference works of Commandant António Marques Esparteiro, in 32 volumes (1974-87), of Vice-Admiral Ignácio da Costa Quintella (1975), of Commandant Henrique Quintino da Fonseca (1986), as well as specific works related overall with the route from the Cape, among which are highlighted those of Simão Ferreira Paez (1937), of Alfredo Batelho de Sousa (1950, 1958, 1975), of Manuel de Faria e Sousa (1947) and of João Vidago (1969).

4 See the Documentary Appendix of the present book.

5 Tratado das batalhas e sucesso do galeão Santiago com os holandeses na ilha de Santa Helena, e da nau Chagas com os ingleses entre as ilhas dos Açores, ambas capitâncias da Carreira da Índia. É da causa e desastres porque em vinte anos se perderam trinta e oito naus delas, com outras causas curiosas, Lisbon, 1604 (Chapter twelve - On the cause and disasters for which thirty-eight naus of India were lost).

Almost all of these sources agree about the date of the shipwreck of the Nossa Senhora dos Mártires, the day of September 15, 1606, two days after the Nossa Senhora da Salvação struck the coast at Cascais. An exception is the Memorial by Pero Rolz Soares (Almeida, 1953), that gives, on ch. CXII, the 14th as the date of the shipwreck: “In this same year was lost the nau Mártires and the nau Salvação from Cascais to here being one of the worst losses that has ever been seen, the beach being strewn with dead and Riches, not escaping any Living Thing and was on 14 – of September day of praise of the true cross of [1606] at that tower of sào gião everything breaking apart on those large rocks [...].” (Ibid., p. 402).

However, this question would be irrelevant if it were not for the fact that the 15th, on which all of the remaining sources agree in indicating as the date of the accident, was precisely the date of the first letter from Dom Luís Bravo de Acuña.\footnote{Archivo General de Simancas, Estado 203 and 205; Guerra y Marina 668. Letters of 15 and 19 September 1606. See Appendix I.} Add to this the fact that through this it is known that the Nossa Senhora dos Mártires arrived and anchored in Cascais on September 13, the day following that of the arrival there of the Nossa Senhora da Salvação, this also being the day on which this nau struck the coast due to its moorings having broken because of the storm from the south-west (“el viento sur”) already in evidence at least on the eve, the date of its arrival at Cascais.

“La otra nave forzada del temporal como la primera, faltándole las amarras en tiempo de baxa mar y no teniendo otro remedio por el tiempo sur ser forano en esta playa, determinó pasar la barra y caminando con el tiempo dicho junto al castillo de Sant Gin por el recodo que el dicho castillo hace le faltó el viento y perdiendo el timón como la passada dio sobre unas penas a la punto de un cavalier del castillo San. Lastimosamente que no ha aparecido della pedaço de mediana grandeza sino tan destro-

dado y menudo todo como si hubiera muchos años que hubiera sucedido [...].” (Ibid.)

Despite not being able to make a definite conclusion, it seems doubtful that the Nossa Senhora dos Mártires had waited almost two days in Cascais before weighing anchor, given that only a few hours separated this location from São Julião da Barra. Therefore, it is conceivable that the disaster had, in fact, occurred on the 14th.

In addition, another source states that “[...] the nau Mártires after leaving the Viceroy buried in the islands, went to Cascais a day after the other loss [Nossa Senhora da Salvação] occurred and the other permitting much water to enter made sail before the time and going then close to the fortress of S. Gião there was a rain from the South with much wind that made it run aground next to the same tower where it was broken into pieces and almost everyone died and lost its structure within an hour. [...]” (Gomes, 1990, p. 120). In fact, for “loss”, you can read already been lost, or that had come to be lost.

The short period of time during which the tragedy took place should be observed in passing: one hour – compared to the four hours mentioned by Luís Bravo de Acuña.

Through the contents of this last report, it can also be concluded that the Nossa Senhora dos Mártires had tried to go around São Julião da Barra through the northern channel, that is between Cachopo North and the north shore. Except in a desperate situation, this would have been a suicidal thought, to be at first excluded because it was not viable. In fact, no large ship would have dared to do it with a storm from the south (south-west) and, additionally, at ebb tide. Navigation in this channel is justifiably only recommended with favourable winds, that is from the north quarter.

It remains to be seen if the Nossa Senhora dos Mártires would in fact have had this alternative. It would have depended primarily on the exact quadrant.
of the south wind that was blowing at the time. If it were possible, the deliverance of the nau would have been to try to enter the sandbar by the south channel between the two Cachopos, going around Cachopo North by the west. This in fact may not have been viable due to the direction of the wind. In addition, those conditions, in themselves already very difficult due to the two cumulative, unfavourable components, the flow of the tide and the storm from the south, continued to become worse due to the heightening effect of the interaction of the two events. This was translated into a strengthening of the waves and in the increase in their irregularity. An ebb flow of the tide with a storm from the south-west is, in fact, the worst that could happen on the sandbar of the Tagus. It is of course difficult to assume what choice would have been made between that which would have been very risky on the one hand and a suicidal attempt on the other.

Even with the necessary reservations, but by substantiating the assumption that the Nossa Senhora dos Mártires would have tried to enter through the south channel of the sandbar, we are permitted to underline the reference that "[...] the nau Mártires was lost entering in the Cachopos".

In any event, evidence emerged that the nau, with its hold full of water, battered by the rain and wind, and already out of control in a stormy sea, would not have been downriver of São Julião da Barra. This is because of the simple fact that the very strong ebb current would have pushed it to the south of the fortress. That is if it had come through the north channel.

As a matter of fact, the Nossa Senhora dos Mártires had entered by the south channel, and should have passed wide of the mid-point of the fortress. It was then and there that it had lost control because of the violent cumulative effect of the ebb flow and of the sea from the south (in addition, anyone who knows the characteristics of the sea right next to São Julião da Barra knows very well that the area of greatest turbulence is located precisely to the south-east of the fortress).

Despite these reports warranting the aforementioned reservations, they must be interpreted as somewhat likely to the degree in which they also confirm the assumption that the ship had gone out of control after entering the south channel. In fact, only in this way would there have been a likelihood, given the circumstances, the weather and the space available, to suggest the possibility of the Nossa Senhora dos Mártires preparing a boat. If it had come through the north channel, safer than preparing a boat would have been to try to land in Caravelos in a catastrophe, dropping the anchors to turn the prow into the wind and the waves.

No, everything indicates in reality that the fatal final course was in the SE-NW direction. Thereby resulting in the Nossa Senhora dos Mártires breaking up on the extreme east of the large rocks of São Julião da Barra, on the prominent point known by the name Ponta da Laje. The tide, the sea and the wind would have quickly continued to push it against the fortress. However, before going to pieces against the rocks, the keel of the nau struck the rocky bottom a little more than a hundred meters from them, probably in the low point of the surf typical in areas close to this type of coast.

It instantly lost a major part of the bottom of the hull below the waterline, shattering the keel in several places, a large part of its cargo and its equipment, specifically several pieces of artillery, falling into the sea at this specific location. Upon settling and becoming fixed on the bottom, this fragment of the hull became embedded and remained protected on a platform of flagstone that, step by step, rose in the direction of the fortress.

Around about it, everything that equipped, furnished, defended and transported an India nau was scattered, settling or moving at the whim of the bad
HYDROGRAPHIC chart of the Tagus sandbar, Lisbon, Instituto Hidrográfico.

No archival records have yet been found relative to possible rescue activities for submerged goods as would be probable. Despite the letter of Dom Luis Bravos de Alcântara expressly mentioning the idea of recovering the ship's artillery, what took place occurred certainly over the area adjoining the rocks where the ship was broken up. What is a fact is that in the area of the hill, farther offshore, a magnificent culverin (a type of long cannon) remained until 1995 – conclusive proof that this area had not been the object of underwater recovery activities.

The significance of the archaeological potential of São Julião da Barra was very clear on the event of the Exhibition "Lisbon Subterrâneas", organised in 1994 in the Museu Nacional de Arqueologia in Lisbon within the framework of "Lisboa. Capital Europeia da Cultura", where, in a specific theme area ("Lisboa Submersa") the highlight was a large collection of pieces coming from this site that was brought together and made public. See Alves, 1994a.

weather, being broken into fragments or being protected within the sand, pebbles and boulders that the constant force of the sea carried from one side to the other. There could be no better example of this than the reports that provide evidence of the tremendous scattering of the wreckage of the ship and the cargo along the beaches in the immediate area of São Julião da Barra. As a matter of fact, due to the cumulative effect of the wind, the sea from the southwest and the ebb tide prevailing at the time of the shipwreck, the greatest part of the wreckage had been spread along the beach of Carcavelos, just to the west. Later, with the turning of the tide, the wreckage still afloat, specifically the pepper, was also spread upriver.

We can imagine the Tagus full of pepper that, like a gigantic black mantle, ascended and descended at the whim of the tides, blackening the beaches upriver and downriver. As a result, from everywhere, from land and in boats, the riverside inhabitants and the officials of the King, immediately came to assist in devoting themselves to the task of collecting the spice. On a stretch of several kilometres around São Julião da Barra, presumably generally to the west of it, the beaches were literally strewn with wreckage from the Nossa Senhora dos Mártires: bales, packing boxes and casks, all mostly broken open – and bodies of the more than two hundred persons that had lost their lives in this fateful shipwreck.

The rocky point on which the fortress of São Julião da Barra was built, located between the beaches of Torre on the east and of Carcavelos on the west, represents the northern border of the sandbar of the Tagus River from a geo-morphological point of view. It is natural, therefore, that its immediate vicinity comprises a true subaquatic archaeology field.

In fact, there is a long oral tradition of finding gold and silver coins on these beaches – obvious evidence of the well-known phenomenon of objects lost in the sea washing on to the beach. Added to
this, with the development of amateur diving in recent decades, the discovery and recovery of numerous aggregates of archaeological evidence that without any doubt have come from sunken ships must be recorded.14 This is evidence that is, additionally, fully confirmed by the written sources. The immediate area of São Julião da Barra, because of its geographic position, is, in fact, a true cemetery of ships, a fateful location consecrated by tradition and history.

In 1993 a project was announced that was taken up initially with a natural priority within the context of subaquatic archaeology in Portugal and that, officially approved, was developed in the following year.15 October 5, 1994. The last day of the first campaign of underwater archaeology at São Julião da Barra. During one of the dives for a final exploration in a larger zone that came to be known by the designation SJB215, an interesting discovery was made.

This was a collection of very deteriorated wood remains of a ship's hull emerging from the sand, apparently embedded on a rocky platform on the bottom. Almost at the end of their air supply, the main divers collected several fragments of different types of ceramics from the area for recognition. All of these were clearly of Oriental origin. Notable among them were the blue and white porcelain, the glazed brown sandstone “martaban” and the green and yellow faience with a “barbotina” decoration (Alves, 1995).

Unexpectedly, the association of these two complementary types of archaeological documents could be postulated for the first time in the location:16 the remains of a ship and its cargo – the container and its contents. Although such a fact would recall the celebrated designation of a sunken ship as a time capsule, from the beginning the impossibility of such a characterisation was recognised in the specific case of São Julião da Barra. This was due to the mixture of pieces clearly originating from different shipwrecks from several periods as a result of the extreme agitation of the seabed.

From the beginning, the strategy for the archaeological intervention at São Julião da Barra was based on the development of work in the most important zone, previously identified, and that had been given the code name SJB2, without harming the exploration of other surrounding areas whose interest would have to be confirmed.17 As a matter of fact, the information available pointed to the presence of findings in the entire surrounding area of the fortress, with a particular concentration on the small and well-protected bay to the south, corresponding to zone SJB1, the object of archaeological studies in 1994.

The finding of the first astrolabe in June 1996, in a reconnaissance dive made precisely between zones SJB1 and SJB2, suggested that the work be started here and expanded in the direction of the fortress. However, after the work had begun, it was noted that the surrounding zone, east of the hull and corresponding to the rocky table that enclosed it to the north and west, was criss-crossed with holes and cracks, some deep, but completely covered with mud. Their methodical excavation down to the geological substrate immediately produced archaeological results of great interest.

The activity begun in October 1996 in zone SJB2 was therefore developed on two priority and contiguous fronts: one centred over the remains of the hull already previously identified, the other above the immediately surrounding area. The characteristics of
General plan of the remnants discovered in zone 58Bz.
each of these contexts demanded, therefore, a technical-instrumental and suitable methodological approach to beginning with the appropriate reference systems to use.

The determination of the "zero point" of the site was undisputed. It was marked by a mountain climbing stake fixed to the rocky slab, exactly in the vertical of the diamond of the large iron anchor that was in the area. This anchor, that was recovered at the end of the campaign, was lying on the rocky slab that bordered the hull on the north and west on a higher level, and always served as an anchorage point for the support vessels for the work.

The archaeological potential of the zone of this rocky table that "boxes in" and protects the hull to the north and east, was in turn underlined by the finding of a small bronze cannon in the immediate vicinity of the aforementioned anchor resting there. This cannon was classified as a small culverin, a piece characteristic of the period from 1580-1640 when

Recovery of the anchor located at the epicentre in the archaeological excavation zone for 1996-97.
Photo: Francisco Alves

Support craft: a) in the central work area; b) on the dock at Paço d'Arcos (Lighthouse Administration), logistical base for the support "fleet" for the underwater archaeological work.
Photos: Francisco Alves
Portugal was under the domination of the Spanish (Alves, 1997), although it could have covered a longer period. Next to this firearm, and almost covered by its breech, the mouth of an apparently whole pitcher emerged from the sediment of a hole in the filled slab. The excavation of this immediately in the first days of the campaign proved that this pitcher was whole, without even a scratch. As with almost all the ceramics found in the vicinity, it was a characteristic product from the south of China from the Wan-Li period. However, the excavation in the immediate area of the aforementioned hole held another surprise. A little more than a metre farther on, another similar pitcher was found. Despite being totally shattered, it has been completely reconstructed.

In the meantime, mountain-climbing stakes were placed randomly at several points in the area and connected by lines ("threads of Ariane") during this first phase. These assisted in the positioning of the findings and underwater orientation. This system also allowed any finding to be “caught” in the polygonal net defined by the points.

The micro-bathymetric measurement of the site was carried out through a geophysical investigation, utilising lateral-sweep sonar and included the entire surrounding area of the Fortress of São Julião da Barra between the beaches of Torre and Carcavelos.

In spite of the frequent interruptions due to the bad state of the sea or to the need to redo the network of reference and orientation lines that had been damaged by the sea or poorly informed fishermen, the excavation of the fissures in the rocky table produced excellent results. Along the trail of the anchor, culverin and the pitchers mentioned above, pieces of great interest were gradually discovered that established this being at the epicentre of the scattering of the goods characteristic of an India nau. A highlight among the most significant archaeological evidence of this zone was the systematic finding of pepper at certain well-determined stratigraphic levels – sometimes with whole or fragmented coconuts embedded in the surrounding mire; a bronze mortar – that was next to numerous pestles collected earlier at the site; a tsuba, a sword basket-hilt characteristic of a Japanese wakisachi; fragments of blue and white Wan-Li porcelain, green and yellow faience also typical of the south of China from the transition period of the 16th-17th centuries, and glazed grès that today we know belongs to the same period and originates from Japan, Burma and Thailand.

The analysis of the stratigraphy of the SJBz zone resulted in the excavation of the zone of the rocky table that protected the hull to the east and north, and of the surrounding zone, to the north of this, a location where metallic squares for archaeological reference were placed. As a complement, the sounding survey carried out to the south and west of the hull also resulted from the analysis.

In a general way, it can be confirmed that the stratigraphy found at all points follows a consistent pattern. As can be noted, there are always two basic layers present (layers I and III) positioned above a rocky substrate sometimes covered by very fine, compact sand, jointly with which is noted the occurrence of two other layers, alternately or jointly (layers II and IV).
Archaeological vestiges were found in all four of the layers mentioned above. In the first, made up of sand and small-diameter, quite mobile gravel, an important aggregation of ceramic fragments was found mixed with rubbish from several centuries, that did or did not come from other shipwrecks. It is worth mentioning the fact that fragments of ceramics from the same piece were found several dozen meters from each other, thereby demonstrating the mobility of this layer. The third level of larger gravel was practically sterile.

Layers II and IV were less contaminated and most of the spoils in them were highlighted by organic material such as pepper, leather and textiles, as well as by numerous artefacts, among which were two nautical map compasses, lead sounds, pewter plates, stone cannon balls and the greater part of the blue and white porcelain. This is the layer that is assumed to be contemporary with the shipwreck of the Nossa Senhora dos Mártrires.

At the beginning of February 1997, on the first calm day since the end of the Autumn of the previous year, during a dive for evaluating the damage that the sea had made in the implanted reference network, a second astrolabe was found. As with the first, it was in the zone located to the north of the hull, but only about a dozen metres from it, in a depression that was on the northern limit of the rocky zone that extended in the SE-NW direction.

In this zone two large pieces also were sighted: an iron firearm, subsequently recovered, and a piece of prepared wood apparently related to the hull located immediately to the south. In a small sounding carried out there, the stratigraphy was found to be identical to that of the periphery of the large rocky table.

Therefore, considering the natural difficulties of the position, both in the zones excavated daily, as well as in the vestiges themselves, it was decided to visualise the excavation zones through the use of 4 x 4 m squares made of easily moveable, metal tube.

Pieces of leather (a and b) and textiles (c) found in the same stratus in which pepper is plentiful.
Photos: Pedro Gonçalves
This system was found to be extremely practical for the documentary management of the excavation, and ideal, given the frequent alteration of the state of the sea. As a matter of fact, under these specific conditions, made worse by the shallowness of the location, no other more complex or permanent installation would be viable.

The area excavated corresponded to seven squares aligned along the north border of the rocky table and included around a hundred square metres. In this area some of the most interesting findings of the campaign took place specifically in a pocket of sediment with pepper, which was apparently stable (although not free of contamination, as usual), from which was recovered an important aggregate of organic material and a stack of seven porcelain plates, that were resting on organic material with the appearance of straw. This stack of plates had remained protected between two large rocks — both weighing between 1 and 1.5 tons — and sat on a fine layer of compact pepper that, in turn, contained various other fragments of porcelain that provided the complete restoration of two other plates.

The most important finding in the excavation of this zone took place in square N. 2 in July 1997. Just 50 cm from the aforementioned iron cannon, a third astrolabe was found after turning over a large slab that was blocking the excavation. It was located in the aforementioned layer II and was simultaneously protected from mechanical action and electro-chemical corrosion. It was in an exceptional state of preservation and had two engraved inscriptions. One was the stamp of the foundry, the letter G; the other was the date 1605, the year of departure of the Nossa Senhora dos Mártires to India.

On the other hand, from the archaeological point of view, the finding of three astrolabes at São Julião da Barra within an area of less than 600 m² in the scope of a project programmed completely is in itself a noteworthy occurrence, although nothing guarantees that all of them belonged to that nau.¹⁶
In fact, it must be underlined that until the triple finding of São Julião da Barra, only in two other places in the world had a greater number of these prototypical nautical instruments been discovered. One was in the wreckage of the Nuestra Señora de Atocha, which sank in 1622, it being fitting to point out that four of the five specimens from this ship are of Portuguese manufacture, two of which make up part of the collection of the Museu de Marinha in Lisbon today. The other was during the excavation of the remains of the V.O.C. Batávia, shipwrecked on the western coast of Australia in 1629, in which four specimens were recovered.

Of the remainder, only in two other cases has the discovery of an equal number to São Julião da Barra been confirmed. One is in the wreckage of the Nuestra Señora de la Concepción, shipwrecked in 1641 in the Bancos da Prata in the Dominican Republic, and the other in one of the ships of the fleet that was lost on Padre Island off the coast of Texas, in 1554, probably the Santa María de Yciar (Stimson, 1988).

Other areas around the fortress were also the object of attention as a function of the planning of the work and the state of the sea. Therefore, three more zones of interest were identified. These were designated SJB3 – in front of the existing spur on the west of the promontory, SJB4 – to the west, visible from the beach of Moinho at the extreme east of the beach of Caravelos, and SJB5 – to the west in the vicinity of SJB4.

In the SJB3 zone a small group of iron firearms was found and photographed, next to which were collected square and round copper nails, plates of lead and what may be a bronze piston of a hold pump. In zone SJB4, a group of three anchors were located, very solidified to the bottom, and a group of four lead ingots and a pewter plate. In zone SJB5 an aggregate of concretions trapped on the rocky bottom were located, partially covered by sand, being identified and recovered two musket stocks appearing on a preliminary analysis to date from the 18th century, several lead projectiles of small calibre and escomilha. In SJB1, where almost two dozen iron cannons had already been located and drawn in 1994, dozens of silver coins, almost all from a period later than the 17th century, lead seals, around a dozen pewter plates, and fragments of porcelain, almost all very difficult to correlate with the ship.
wreck of the *Nossa Senhora dos Mártires*, were in turn collected. As far as zones SJB3 and SJB4, only the further advancement of the investigations will permit documentation of their potential, it being assumed that SJB3 corresponds to the location of the first impact of the ship on the rocks of São Julião da Barra.

The fact is generally apparent that in zone SJB2 the majority of the vestiges clearly correlated with the wreckage of the hull are still concentrated around it.

The wreckage of the hull of the *Nossa Senhora dos Mártires*

The first apparent vestiges of the fragment of the hull in question were the thick planking that emerged north of the structure, and a large quantity of fragments of strips and plaques of lead that were spread over the bottom of the vicinity. Little by little, to the degree that the contact with the remains became regular, and that the frequent variation in the cycle of silting up/clearing off permitted, the points of a very strong framework began to emerge from the sand. Shortly it was possible to begin to keep areas clear and to lower the level of the sand, although the silting up/clearing off cycle continued.

The position of the base was determined through triangulation among conspicuous points and reference stakes on the periphery. Next, measurements were taken for the entire area of the structure, all the reference points classified and the most significant profiles of the planking between the floor timbers and of the lower and upper outlines of the floor timbers drawn. Several plane surfaces of the structure – planking, top of the keel, etc., were measured by a digital inclinometer. Finally the entire structure of the hull on the vertical was photographed in "mosaic".

In March of 1997, around three useful months having passed since the beginning of the work, the limits and the physical structure of the structure of the existing hull were defined in a gross manner and the excavation had permitted clarifying the stratigraphy of the location. In the first place there was sand that was greatly mobile, but only rarely leaving the most distinct parts of the remains visible. Beneath the sand there was a fine gravel with many rocks from 10-15 cm. This stratum, disperse and encrusted, covered the entire structure, specifically in the spaces between the floor timbers and interestingly also served as the bed for the structure. Apparently, this had settled initially on the most prominent points of the rocky substrate, time and the favourable action of the depths resulted in this gravel filling in the interstitial spaces that were between the base rock and the lining of the hull. On the south-west extremity of the structure, an enormous boulder was positioned on top of a long board of the planking, showing unmistakably the extent to which the strength of the sea could mould the bottom. Finally, in the central part of the structure, especially between the floor timbers and over the planking (sometimes under it) there was a sediment made up of a black mire, very compact and plastic, indicating an elevated incorporation of decomposed organic material. This mire was found literally impregnated with pepper, which was immediately noticeable to the touch.
PLAN of the structure of the hull fragment discovered in the central zone S1B2.
Drawing of the profiles and cross sections of the structure of the hull.
Photos: Augusto Salgado
Spread across the entire site and present in all the holes excavated, the pepper was the most articulate evidence par excellence of a maritime tragedy that happened with a carrier of this spice. In spite of not knowing the exact amount of pepper transported, through extrapolation of the numbers known relative to identical cargoes that arrived in Lisbon between 1587 and 1592 (Kellenbenz, 1956) that additionally continued to be approximately identical a few decades later (Disney, 1981, pp. 200-01), an average cargo per ship was obtained of around 5,000 quintais of pepper,\textsuperscript{7} corresponding to 293,760 kg (1 quintal from then equals 58,752 kg today) – one of the largest cargoes being that of 7,101 quintais transported by the Madre de Deus, captured in 1592 and taken to Plymouth where it astonished all of Europe.

In summary, it can be assumed that the Nossa Senhora dos Mártires brought around three hundred tones of pepper in its hold. An assumption that is surely justified when it is considered that, in accordance with Lavanha and Fernandes (Barata, 1989, 1, p. 174), the normal tonnage of an India ship from this period (end of the 16th century, beginning of the 17th) varied around 600-700 tons. This translates as ships with around 18 or more rumos of keel, equal to 27.72 m or more (1 rumo corresponding to 1.54 m), having in turn a deck length of over 40 m – a little more than a hundred and fifty palmos de goa (1 rumo contains 6 palmos de goa, equal therefore to 0.256667 m), and a beam greater than 13 m (more than 50 palmos de goa).\textsuperscript{8}

The excavation of the entire surface of the hull has not shown any artefacts, with the exception of a very small gold bead and of two small wicker baskets, one partially preserved and another practically destroyed, that emerged from the black mire. Dislodged with the utmost care through an ingenious improvised system made up of a collapsible metal box, the two fragments were brought to the surface protected by the sediment itself, later being treated in the laboratory by permeation with polyethylene glycol 400, which only was effective in the better preserved.

The Nossa Senhora dos Mártires was found oriented approximately in the north-south direction along its longer axis. This corresponds to the position of the keel and of the exterior planking, which was the surface that settled on the bottom. It was positioned perpendicular to the coast, that is, toward the fortress of São Julião da Barra, literally appearing to be “in a box” and protected on a platform of rocky flagging that rises in steps in the direction of the large rocks on which the fortress was erected.
The remnants occupy an area corresponding to a rectangle of about 12 m in length and 7 m in width, corresponding to an effective area of 50 m². Although representing an apparently featureless part of the ship's structure, it is, nevertheless, a document of exceptional importance. This is not only because of its rarity—it is the only evidence of a Portuguese ship of this type and this era known throughout the world, and one of the rare examples of the Iberian-Atlantic ship construction tradition—but also because it is by comparison not one of the least significant quantitatively. Evidence for the latter is in the several equally important specimens, although still of much smaller size. (Corpo Santo, Seychelles, Molasses Reef, San Esteban, etc.). This, without considering the qualitative importance and the richness of the details of the findings under consideration.

The structure corresponds to a fragment of the carena [the bottom part of the hull], asymmetric and quite off centre relative to the axis of the keel, given that its eastern part is much larger than that of the western. As a matter of fact, this side is much less preserved than the eastern, both because the structure is tilted precisely toward this side, as well as because, particularly on this side, it is protected along its entire length by a projection of the long rocky layer that stepwise goes up more than 1.5 m in height.

The bottom of the hull is made up of a fragment of keel flanked by 11 continuous rows of planks on the west side and 19 on the east side. Setting on this structure are noted the lower parts of 11 strong frame ribs next to each other. Nine of these are preserved almost their entire length—except on the west, on the ends and on the upper surfaces. In fact, two of them, specifically on the SW (C1) and NE (C3) ends, are only partially preserved.

All of the floor timbers are protracted on their two extremities—although much more significantly on the east side—through the respective first futtocks (curved sections on the lower part of the compound
rib) that “look” toward the south. This means that the first futtocks are connected with the respective floor-timber on its south side. In these side areas of the floor-timber/first futtuck connection, each pair leans on its neighbouring pair, forming a continuous “floor” that completely covers the exterior planking. In a single case, in the extension to the east of the floor-timber C4, the second futtuck (A4E), extends and is flanked by the first futtucks of the floor-timbers C4 and C5 (B4E and B5E).

Both the floor-timbers and the first futtucks are broken at several points, according to regular alignments that correspond to the longitudinal axes of fracture. For this reason, the structure is “ruptured” on the east side, the curvatures of origin having been covered with sand – which additionally also contributed to the preservation of this side.

It is more or less homogeneous on the north face of the structure at the rupture end, not having perceptible variations in the extension of its terminal components. On the other hand, the rupture end on the south side of the structure is very conspicuously irregular, with the planking extending toward the south of the two sides, much more than the keel, that is seen to be literally shattered here. A plank on the east (T19E) is unusually extended toward the south – with its end beneath a spherical rock that weighs more than a ton.

The preliminary commentary that gives rise to the observation of this important structure, most especially because of the characteristics of its north end, clearly corresponding to the central part of the ship, is that it presents a certain “family air”, in this case Iberian, due to the great opening and its bottom being almost horizontal. This fact, especially apparent in the axial area, can be seen in the graphical representation made from the measurements taken in this area with a digital inclinometer of the transverse inclination of the keel and of the covering planks of the side. This representation corresponds perfectly to the respective transverse profile, made by vertical measurement “em pente”, through the use of a removable horizontal bar placed transversally.

The keel appears to be preserved along around 7 m of its length. Considering the previously established assumption of belonging to a ship with at least 18 ramos of keel, equivalent to 27.72 m (1 rumo = 1.54 m), it is seen that the fragment in question represents slightly more than 1/4 of the total length was preserved (between 25% and 28%).

Thus, it is seen that this value is much more significant than in the case of the wreckidual of the *Corpo Santo*, in which the preserved part of the keel measures about 1.4 m, which corresponds to around 10%, being clearly less than that of the *Ria de Aveiro A* in which, with a preserved length of 9.4 m, in a total estimated length of around 13-14 m, equivalent to around 70%, and even more relative to the *Cais do Sodré* (that, with its 24 m of preserved keel, reveals more than 85% of its total length).

Relative to the remaining cases known internationally, in the *San Diego* and in the *San Juan* this part is completely preserved, 23.73 m and 14.75 m respectively, while, on the other hand, in the *Seychelles* and *Molasses Reef* it is non-existent.

The width of the upper surface of the keel of the *Nossa Senhora dos Mártires* is 24 cm, possibly being slightly thicker on the part that is not visible. If we
consider only the comparable specimens, it is noted that this value is equal to that of the ship of Cais do Sodré, and is exceeded only in the cases of the Cattewater, San Esteban and San Diego (30, 31 and 30 cm, respectively). On the other hand, the keel has a curious characteristic, visible on both its north and south ends, of having an unusually small thickness/height relationship relative to everything that is similarly known. In fact, it is only about 12 cm, which is practically equal to the thickness of the planking (11 cm). The surveys carried out on the two ends have additionally confirmed this insubstantial thickness, leaving any conclusion in suspense, because in this phase of the work it was not possible to see the lower surface of the keel along any significant length. As a matter of fact, it seems probable that the keel would have been completed by a false keel compensating for the lesser thickness, through analogy with that of the San Diego where this has a height of 15 cm, but is completed by a false keel with a square section of 21 cm on a side.

The keel also shows the peculiarity of having several vertical scarfs (chamfered joints), called “smooth” or “washed”, that confirm that this is a composite piece, which was usual. These vertical scarfs, through which two pieces are “grasped” completely in the extension of one to the other, have an 8 cm transverse surface on both sides and another longitudinal and oblique 72 cm in the centre, the three scarfs observed, thus, form four fragments of the keel. The first (from north to south) has a length of around 34 cm and is functionally made up of what is appropriately called the scarfed part, since it is located precisely at the boundary of the rupture in the hull. This fragment of keel has of course as its north top the extremity of the rupture of the keel itself, because of which its original section does not exist there. The south top section of this scarf is located under floor timber C14, non-existent, but marked by the respective nailing on the planking. The second fragment is 2.48 m long and shows the scarfs on the ends, with the characteristic of being on the same side. The north top section of this second scarf is located between floor timbers C8 and C9, being closer to the south face of the latter. The south top section of this scarf is located underneath floor timber C8.

The third fragment of the keel, which is the largest, is 2.62 m long and, unlike the previous, that is in a T shape, has an asymmetric form in a Z shape. The remaining southern part of the keel is 2.2 m long. A fourth scarf could still exist on the southern part of the keel, there being in this event four and not three fragments of it. As a matter of fact, between floor timbers C3 and C4, almost leaning on the north face of the first, the keel, that in this area is very decom-
in the work of Lavanha. As a matter of fact, in addition to being graphically represented in folio 62 v (Lavanha, 1996, p. 44, ill. 9), the author refers to this arrangement "[... when a Piece of wood with all the characteristics that could make the entire Keel and curves is found, it may not be fitting [to do so] other than from pieces because, like the timbers they might cut from it, it would crack if it were whole [...] of greater size than the Pieces of wood extend to; sound and without defect, and they may be worked very well for a palmo in breadth, and everything more than a palmo in height that they will be able to get, because the rest of the palmo serves for a housing [encaxo] that is carved in said Keel, called the rabbet [alifriz] [...]." And farther on about this same subject, Lavanha also states that "And since the Keel cannot be whole and has to be in pieces, these are adjusted one with another with scarfs [as shown in the following figure] and are fastened with bolts [pregos] that go through the whole breadth of the timber and rivet [rivetão] the other part, on some iron washers, which method of fastening is called anielados, and in this way the entire Keel will be made and will be joined with the said scarfs".

There are 11 floor-timbers, although only 9 are seen to be almost whole. A small, isolated fragment of floor-timber, of which there still exists only its part most closely attached to the planking, is still visible on the north end of the structure, right next to the keel on the east. It corresponds to floor-timber C 14.

The first point to mention concerning this floor-timbers of the fragment of the hull is their great size. The second is the fact that they show a gradual roughening in the southern direction, with a simultaneous slanting in a V shape of the respective planking. In fact, while on the north end the slanting of the planking in the central area is imperceptible, on the south end it is quite accentuated. In their central part, the floor-timbers, thus, have a height apparently...
related to the respective roughening, of 40 cm in height on the axis at C2 and of 31 cm at C10.

The structure identified, therefore, seemed to correspond to the centre part of an area of the ship located in the delineation of the main floor. It is apparent that the frame extends toward the south in the direction of one end of the ship.

At the same time, all the floor-timber/first futtock pairs have their components in the same relative position. Thus, the floor-timbers are located on the north side, conforming to the central part of the ship, the first futtocks of each side are joined to them on the south side, which correspond to one of the ends. This constitutes a characteristic of an Iberian-Atlantic construction that is present, without exception, in all the examples of ships known world-wide.

In general, the floor-timbers have a thickness of 24-25 cm, that is, the width of its transverse cross section (perpendicular to its major axis, that extends in an east-west direction). The respective height at its two ends and in the identical cross section is around 15 cm. They have an average length of 4.70 m, with a maximum of 5.08 m (C7) and a minimum of 4.24 m (C2). In this convincing manner, it is concluded that this is the strongest transverse structure known internationally of an Iberian-Atlantic construction tradition, along with that of Cais do Sodré, that has comparable proportions. The remainder of all those known were smaller in size, the San Juan (22 cm), Cattewater (20 cm), San Diego (19 cm), and Western Ledge (18 cm).

The floor-timbers (face to face/interval) are approximately 23 cm apart on the average, varying between 18 cm (C2-C3) and 24 cm (C9-C10). The distance between the axes is around 46 cm, varying between 42 cm (C2-C3) and 48 cm (C7-C8). They have a combined (floor-timber and respective first futtock) transversal width of around 46 cm on the average, with a maximum of 50 cm (C6) and a minimum of 42 cm (C3). Taking these last values as a reference point, the evidence of this structural importance is reinforced. Making a comparative observation, the Cais do Sodré is the only case where similar values are noted (40 to 50 cm), the Highborn Cay being only 40 cm and that of Cattewater only 37 cm.

The first floor timber exposed (C1) showed a semi-elliptical scupper hole on its south face, at the base where it seated in the keel. It was clearly off centre toward the west side being 5.5 cm from the edge of the keel on that side. It was 7.5 cm wide and 4.5 cm high and was intended, as usual, for the lengthways flow of water accumulated in the interior of the hull below the floor timbers, because of which all of them show this same device, more or less in the same position.
On the posterior (south) surface in the area of connection with the respective first futtocks, the side-by-side female ends of the floor-timbers show two characteristic mortises. Although these are customarily (in the Iberian-Atlantic tradition) of the “dovetail” type. However, here they take on a clearly rectangular shape and not trapezoidal, as is usual in this construction tradition. They are around 4 cm deep and have an average length of around 30 cm. The vertical axes of these joints are about 60 cm apart, with a maximum value of 65 cm (C3/B3E) and a minimum of 40 cm (C3/B3W). The observation of R. Steffy concerning this deserves mention, according to which “The dovetail joints on the standing frames are curious and bear some consideration. They recreate a lot of extra work and timber and, in light of the other fastenings, do not at first appear to have been necessary. But they did add some security to the joint and must have made frame assembly easier and more accurate. Their appearance and all of the above wrecks found outside of the Mediterranean indicates that, at least in the minds of their builders, their functional importance must have outweighed the additional labour and timber costs [...]” (Steffy, 1994, p. 139).

In turn, on each side, the floor-timber/first futtock connection is reinforced by three iron spikes with a square cross-section of 2.2 cm on a side and round heads in accordance with the deep, wide, entrance holes left on the surfaces of the floor timbers turned toward the central part of the ship. They were moreover placed transversely and horizontally from the central area of the ship to the ends. These three spikes were placed one in each mortise and tenon and, therefore, in the parts corresponding to the two females and to the central male.

This system of reinforcement is not original from the structural point of view, however, relative to the material used it is placed in the same group of ships as the Cais do Sodré. As a matter of fact, in the remaining known examples, the function of these iron spikes for transverse connection is performed by wooden pins of an identical cross-section (in actuality faceted).

The dismantling and restoration of the floor-timbers and first futtocks corresponding to the second and third frame ribs allows observing some curious details, such as:

a) The existence of a filling patch, made of a plank, across the entire width of the futtock for a length of 90 cm on the lower surface of futtock B3 in the area of the floor-timber/first futtock joint. This confirms the need to adjust the external surface to that of the corresponding floor timber, apparently with a view toward a perfect seating of the planking. It also shows a significant characteristic of not having a uniform thickness that, in addition, is almost eliminated in its NE corner;

b) The existence, also on the lower surface of this futtock, of square holes, apparently corresponding to an earlier use of the usual iron nails for the attachment of the planking. These holes were also filled with square, wooden plugs.

Although in some cases the floor timbers seem to be attached to the keel by a strong iron spike that crosses them up to the keelson, which represents an essential guarantee for axial and longitudinal attachment of the skeleton of the ship, it is still premature in the present phase of research to move forward globally whatever about this question, basically considering the status of the superficial concretions of this evidence and the fact that some floor timbers have already lost part of their surface. The future dismantling of the rest of the frame will be able to clarify this question.
Nevertheless, it should be stated that the two floor timbers that were dismantled and recovered in 1997, C2 and C3, display, in addition to the wide orifice corresponding to the aforementioned circular peg with a large diameter (around 3 cm), a contiguous square hole corresponding to an iron spike that crossed them from side to side and that also penetrated into the keel, thereby providing evidence of a double system of axial fastening.

Finally, standing out as an aspect of great relevance is that some floor timbers show two types of incised lines, always on the north surface:

a) Vertical lines incised in the central and lower part (ending at the lower edge), solely visible on floor timbers C10 and C9. In the first instance there are two, with that on the west aligned on the west edge of the keel; in the second case there are three, with the east line coinciding with the east edge of the keel. These lines appear to correspond to the use of the marking gauge that Lavanha expressly mentions: "Then the straight line MS, in the centre of the floor, may be marked with an escopro, and two others that terminate the astilha, set off from this MS, half a palmo from each side, which make the breadth of the keel, and thus with the same escopro the straight line OP of the wronghead may be marked too, so that the floor worked by these outlines which will be laid down in this way, and these lines marked, may be perfect." (Lavanha, 1996, p. 52). Similar marks were seen on the wreck of the Culip VI on the Catalonian coast (Nieto et al., 1989), a topic recently reconsidered by E. Rieth (1996, p. 155):

b) Lines defining Roman numerals, always located on the west side of the central axis and very close to or even touching the edge that separates this surface from the top of the floor-timber. From the position of the numeral V, it is assumed that all of them are inverted. The III on C9, the IIII on C8, the V on C7, and the X on C2 are visible.

This discovery takes on exceptional importance in immediately identifying the part of the ship to which the remnant corresponds. As a matter of fact, in the only two cases known world-wide in which an analogous numbering is seen – the wreckage of the aforementioned ship Culip VI (Nieto and Rieth, ibid.) and of the Cais do Sodré – these marks are always on the surfaces of the floor timbers facing the bow. It is, of course, justified to conclude the same in the case of the fragment of the hull of São Julião da Barra. Therefore, this part of the hull belongs to the stern part of the ship, that extends toward the south, starting from the missing floor of the master section. Because of which, it would continue to the north with floor-timber l, corresponding to C11, also missing.

Both the lines and the numerals mentioned are evidence of a practice that is directly correlated with the specific method for the system of design of the carena configuration, well known through the classical sources of Portuguese naval architecture.

Thus, the use of marking gauges for the progressive development of the configuration of the floor timbers, between the main floor and the last frame ribs, makes this numeration of the floor timbers understandable, as well as the size expression of the values inscribed through the use of the marking gauge expressed in the alignment lines of the keel.

This important discovery was completed by another, thanks to the holes of the nails that attached the currently missing floor timbers north of C10.21 Through the square nail holes, characteristically and usually placed at the rate of one pair for each floor-timber, it has been observed that another would have existed (C11) to the north of floor-timber C10, corresponding to floor timber l (missing) in accordance with the aforementioned marks of the incised numerals.

This numeration, corresponding to the order the marking gauge was used, was made starting from the floor of the master section. Therefore, the following row of continuous nail holes, north of C11/l,
would necessarily have to correspond to the floor of the master section.

However, in this area, there is not one but three uninterrupted rows of nails, apparently corresponding to three contiguous floor-timbers. This evidence allows presuming that this nau would have had three main floors — those on the outside having the respective first futtocks on the sides.

Relative to the ship's frame, Fernando Oliveira stated that: "Those that are on the "píão" [part of the bottom] before the scivings begin to rise are called main floors. In small ships of less than 11 rumos there should not be more than a single main floor: and two in ships of fifteen to eighteen rumos: and three above that, but not more, no matter what the size of the ship is [...]" (Oliveira, 1991, p. 94).

Thus, this basic observation thus seems to certify the fact that the hull in question belongs to a ship with at least 18 rumos of keel, equivalent to 27.72 m (1 rumo = 1.54 m).

On the other hand, in accordance with the classical proportional equivalencies, a keel length of 18 rumos, as was assumed above, corresponds to a ship weighing 600 tons or more. As a matter of fact, Fernando Oliveira also stated that "Therefore, when they ask or order that a ship of 600 tons be built, the carpenters know that a keel of 18 rumos is required to reach that capacity, by calculations which we shall make farther on [...]" (ibid., p. 86).

For the first time an element arose permitting an assumption of the minimum dimensions of the Nossa Senhora dos Mártires. It, thus, would have had at least 18 rumos of keel. Nothing more can be said for the moment, given the phase the investigations are in and the limits themselves of the exploration and management of the on-site information collected.

Relative to the first futtocks still visible on the west side, are in summary very small fragments, the majority of them eaten away by the wood-burrowing mollusc Taredo navalis to the point that many times the original surface has been lost. The same also happened to the end planking on this side. They displayed an average length of 1.34 cm, with a maximum of 1.55 cm (B7W) and a minimum of 1.10 cm (B5W).

On the east side, the first futtocks, although invariably broken, extended for an average length of 2.57 m, with a maximum of 3.35 (B4E) and a minimum of 1.4 m (B11E), and had an average thickness/width of 21 cm, with a maximum of 27 cm (B8E) and a minimum of 10 (B4E).

On the front face of the first futtocks in the area of connection with the respective floor-timber, the male ends show two characteristic tenons whose shape and size correspond to the aforementioned female ends of the floor-timbers.

Only one second futtock (A2E) was found preserved. It has a length of 1.7 m and a cross section 22 cm wide and 25 cm high.
The planks for lining the hull have a thickness of 11 cm and an average width of 22 cm, with a minimum of 12 cm (T9NW, north of C10) and a maximum of 35 cm (T14SE, south of C2). They normally have a cross section that is rectangular, or slightly trapezoidal in some instances, as can be seen in plank T11, corresponding to the demands of the curving of the hull. Plank T6NE that, besides unusually enlarging in the area that corresponds to the floor-timbers C12, C13 and C14 (missing, but defined by the nailwork), is inserted with a narrow supplementary plank because of this. A fact that apparently corresponds to the enlargement of the bottom in this amidships area.

In the present phase of investigation, it is not considered significant to determine the average, maximum and minimum lengths of the lining planks of the hull, their tops being, or having been, hidden in the majority of instances. It is noted that the plank on the west side (T1W) that inserts into a notch on the keel extends toward the south several dozen centimetres beyond the keel, allowing a characteristic internal, oblique surface intended to fit perfectly in the rabbet to be seen.

The first comment to make relative to the planking is that it has the greatest thickness ever recorded in ships of the Iberian-Atlantic construction tradition. In fact, this thickness is 10 cm in the San Esteban, 8 cm in the Cais do Sodré, 7 in the San Diego, and 6.7 in the Cattewater, and continues to decrease in the remaining instances to the barely 3.5 cm evident in the Western Ledge.

A few meters west of the structure under consideration is another much smaller fragment of the structure made up only of several rows of planking, also arranged in a north-south direction, and two small pieces of floor-timbers, all in an advanced state of deterioration. Already only the lower parts of the pieces are visible, literally being eaten away by Taredo navalis because they were more frequently exposed. Because of questions of priority, the study of this nucleus of the hull was relegated to a future campaign.

South of the structure, less than 0.5 m east of the keel, is an enormous piece of wood out of context, apparently set down on its side. It is 1.82 m long, 24 cm high and 40 cm wide (in situ), and is atypically jagged on its surface turned to the east. It has not been identified and, for convenience, was called "pseudo-keelson". It has a detail of two iron spikes in a plane approximately parallel to the plane of the jagged surface.

An unusual aspect, and still not well documented in the wreckage of ships of the Iberian-Atlantic construction tradition – excepting the case of the Seychelles that shows somewhat different characteristics in this aspect of detail – is that of the use of fine caulking made of thin sheets of rolled up lead, that always appears longitudinally between the planks of the hull at the half thickness point. This type of separation appears to have been placed during the assembly of the hull planking in the placement of the planks. As a matter of fact, these fine strips of lead always appear flattened by smashing, never demonstrating any indication that allows assuming that they had been inserted by force from the outside of the joints of the adjacent planks already in place. In fact, if it had been in this way, and in order to penetrate so deeply on the central axis of the depth of the plank (5-6 cm from the exterior surface), this lead caulk-
ing, which is a malleable material, should show signs of the percussion caused by the tool on one of the edges. Since these are missing, it can only be concluded that the lead caulking was put into place before the boards were definitively put into position.

Despite perceptible differences, this type of separation recalls the system observed in the wreckage of Portuguese ship from the middle of the 16th century found in the Seychelles. Here, in fact, the strips of lead appear not to have been placed so deeply, thereby documenting a technical detail structurally different from that demonstrated at São Julião da Barra.

Besides that mentioned, it is necessary to record the very frequent presence in the immediate vicinity of the hull of plates of lead that constitute, undoubtedly, the most significant and abundant evidence in the entire area surrounding the resting place, and that are divided into two shapes:

a) In a quadrangular shape, but rarely represented (a square of 20 cm on a side, and several rectangles, the largest being 40.5 x 23 cm and the smallest 12 x 13.5 cm);

b) In strips that vary between 2 and 8 cm, but normally greater than 3.5-4 cm, with very different lengths that can reach 0.9 m.

All of these plates are between 1 and 2 mm thick and are systematically perforated, either along the edges or, in many strips, approximately along the central axis. These square holes correspond to the small nails used in attaching the plates to the planking and are seen at irregular intervals of 4 to 8 cm.

In the part of the hull discovered, through the "negative" or mineralised remains discovered at the front of the hull, it was confirmed that there are only two types of nailwork:

a) Square iron nails: with about 1 cm on a side used only for fastening the planking to the frame without going through it; with about 1.6 cm on a side used for attaching the planking of the hull to the ship's frame and that go through it, having to have a larger size close to the head; and, with about 2.2 cm on a side near the head, specifically used in the system of reinforcing the floor timber/first futtock connections;

b) Iron spikes with a circular cross section approximately 3 cm in diameter, characteristic of some of the vertical axial attachments that sometimes, as shown by floor timber C3, are reinforced by an extra vertical spike.
As mentioned above, there is a total absence of a wooden pegging in the hull of São Julião da Barra, similar to the ship from Cais do Sodré, but precisely contrary to what is observed in the Corpo Santo and in the Ria de Aveiro A. Thus, it is worth underlining that, in Portugal, the use of wooden pins has been demonstrated only in these two ships that, through physical evidence, are both the smallest and the oldest. Would these facts, and that which underlies them, be able, in themselves, to explain this difference? There are questions that in the present state of investigation and discoveries are not able to be answered. It should also be mentioned that this same system of fastening using wood is found in the Molasses Reef, Highborn Cay, Cattewater, Western Ledge, San Juan and San Esteban.

It must be mentioned, however, that there are references to this question in the classical sources. As a matter of fact, Lavana points out about this subject that "The customary fastening among us is iron [...] and rust caused by the dampness of the sea quickly consumes those of iron. These are made use of now and come from Biscay, because of the good tempering that is given to the iron in the province, not breaking in the driving, and in the riveting when it is necessary, as for the perfection with which it is worked, and the acceptable price for which it is bought [...] The author states, on the other hand, that "In France, Zeeland Holland, England and in all other parts of the North, trenails are customary, which are wooden dowels which may cost little, do not pull out because all are wedged, are light, do not cause rust and last equally as well as other wood [...]" (Lavana, 1996, p. 33).

Farther on, Lavana also states that "In order to counteract the damage that this animal causes, it is desirable that the nailwork is not of wood, rather of iron, and well tempered, strong and well made, because the Busano [wood worm] having entered through the planking of the ship and burrowing into it along the grain would not find wooden pins through which it may pass, but hard iron, which its teeth may not gnaw. When this Worm ceases to be a reason, for another reason also wooden pegs cannot serve us in our naus in which we sail to India, arising from their size and the thickness of the wood. Because, as the thickness may be great and the length of the nails would have to be in conformance with it, being of wood and having to have a thickness proportional to the length to be strong, they will be so thick that their holes cut through all the wood, or when care is taken in that they will be disproportionate and so slender that they will break with any movement. Because of both the aforementioned reasons, iron fastenings are used, the Architect in our parts rendering prevention." (ibid., p. 34)

Of the ten samples that were identified in a laboratory\(^{23}\) it has been shown that eight (from the keel, the south and the north, from floor-timbers C2E and C3E, from the first futtocks B4E and B5E, from the only existing second futtock A4E, and from the "pseudo-keelson") correspond to the same type of wood used - the wood of the Cork Oak (Quercus suber).

The two other samples identified, coming from two hull planks (from T1SE, from the port side, and from T11NW), correspond to another type of wood used - the Umbrella Pine (Pinus pinea). Therefore, oak wood is used in all the pieces of the frame and the pine is used on the external covering of the hull.

\(^{23}\) The samples of wood were identified by Dr. Paula Quirino of the Museu-Laboratório Jardim Botânico, of the Science Faculty of the Universidade de Lisboa.
On the one hand, these data completely confirm the native origin of the ship since the species identified are typically Portuguese, and on the other hand, the classical sources of Portuguese naval architecture.

Fernando Oliveira states that "In this land we have two types of wood very appropriate for these two parts of the ships, each one for its own: these are the oak and the pine. The oak for the framing and the pine for the planking [...] because the oak is very hard and does not rot in the water, but rather freshens and is reinvigorated: because it is by nature dry and is preserved in humidity. And in addition to this, it has twisted branches and crooks shaped for bow and stern timbers and ribs and other pieces of this construction, of such a shape, that it seems, that without more alteration it has been born for this. And as this wood is so appropriate for this construction and is necessary in this land and we have no other equal to it for this use, it should be saved and the cork oaks not allowed to be used up [...]. For the planking we use pine because it is flexible and close-grained, free from cracks and does not split: and additionally its sap is resinous and resists the moisture of the water that does not penetrate it. And it also is contrary to the shipworm: that neither breeds in it, nor maintains breeding outside [...]" (Oliveira, 1991, pp. 63-4).

Lavanha, in his turn, reiterates these recommendations: "[...] The Cork Oak is very hard and dry, exterior moisture does not enter it because of its density and the woodworm does not breed, nor does it rot in the Water, rather with the moisture it is preserved and rejuvenates. And besides all these qualities so harmonious to what is necessary, it has another no less important, which is the turning of its Branches curved in such a way, that it appears that they were created only for this Craft. And because from this tree planking cannot be made, the umbrella Pine serves for this, whose wood is pliable, and as such can be bent and accommodate all the turns of the Sides of the Nau that the frame makes [...]" (Lavanha, 1996, pp. 26-7).

No indication of the ballast, usually made up of rocks of similar size and characteristics, was found in the immediate area or on top of the hull of the Nossa Senhora dos Mártires. This certainly must have to do with the strong underwater activity in the area of São Julião da Barra. In the San Diego, the existence of 150 to 180 tons of ballast stones was noted. Only the San Diego is in 50 m of water.

By analogy, with a large quantity of artefacts discovered in the greater area of the periphery at the Fortress of São Julião da Barra, it is extremely difficult from the archaeological point of view, even using the comparative-typology method, to identify, from among the dozens of firearms submerged and spread around the fortress, those that could have belonged to the Nossa Senhora dos Mártires. Even more, those that are exclusively pieces of iron. As a matter of fact, with the exception of a single specimen recovered in the immediate vicinity of the hull under consideration, the pieces of bronze would have been recovered, as the letter of Dom Luis Bravo de Acuña on September 19, 1606, suggested or at any moment in the last four centuries. And some certainly would have been in the last four decades, during which the area became a location frequently visited by divers.

This consideration, however, refers to the peripheral strip of the fortress. In fact, farther offshore, in the immediate vicinity of the hull under study, everything suggests that the location was undefiled by intrusions, whether after the shipwreck or contemporary to it. Only in this way is the preservation of the aforementioned small bronze culverin that remained four centuries on the bottom of the sea explained. This, and the iron cannon in the area where the third astrolabe was found, are of course the only presumable evidence of the artillery of the Nossa Senhora dos Mártires, that would have been lost at the same moment in which its bottom was torn open.
Conclusions
The first results of the archaeological excavations carried out in 1996-97 in the immediate vicinity of the Fortress of São Julião da Barra, in the zone of the wreckage of a sunken ship, quickly led to the confirmation that these were the remains of an India nau lost at the very end of its return voyage. This was documented by the quantity of pepper still present among the wreckage.

Right after the beginning of the excavation of the site, there was a gradual confirmation of a complete agreement between the data from the site resulting from the direct observation of the wreckage in situ and from the goods recovered and the very diverse and complete historical and archival information existing about shipwrecks from the Portuguese India Route between the 16th and 17th centuries.

Therefore, the archival data permitted excluding those wrecks of ships leaving Lisbon — that, of course, did not carry pepper or far-eastern ceramics —, as well as those that took place on arrival, but at Cabeça Seca (Bugio). This left as choices the incidents with the naus Santa Maria do Paraíso, shipwrecked in 1525, Nossa Senhora dos Mártires, lost in 1606, and São Francisco Xavier, which sank in 1626.

In turn, the first and last of these ships were immediately excluded by the fact of having shipwrecked “on the Cachopos”, therefore somewhere farther out, in an area that could not possibly correspond to the location of the hull discovered right next to São Julião da Barra. In addition, pertinent to this, a shipwreck here must be referred to relative to São Julião da Barra, and not to North Cachopo or, much less specifically, to the Cachopos.

The large amount of far-eastern ceramics, typical of the Wan-Li Kingdom in China at the turn of the 16th-17th centuries (1573-1620), in the immediate periphery of the wreckage of the structure of the shipwrecked ship, also permitted reinforcing the mandatory exclusion of the first of these incidents. This was because it was earlier, by about a half century, to the floriá of the ceramics more precisely datable from that aggregation.

The designation of the loss of the Nossa Senhora dos Mártires, mentioned without exception in all the sources, remained with all the force of proof, as having taken place against the boulders of São Julião da Barra. Sources that also allowed the interpretation and understanding, with the assistance of the on-site data, they models for the forming of the resting place, as well as the scattering of the evidence of the catastrophe.

Gradually, in a very well delimited and defined resting place to the west by the wreckage of the hull, much archaeological evidence emerged to strengthen the assumption that this was really the vestiges of the Nossa Senhora dos Mártires, tragically shipwrecked on September 14 or 15, 1606 on its return from Cochin. This despite the confirmation that no area had escaped contamination by artefacts from other periods coming from other shipwrecks.

Therefore, we were confronted with a great variety of artefacts from generally later periods, and from others less well datable, but apparently contemporary with the shipwreck and/or supposedly associated with it. Among these are highlighted, because of their functional and topical unity, a group represented by an iron anchor, located in the immediate vicinity of the hull, that was found practically leaning on a small bronze culverin typical of the period of Portugal during the Spanish domination (1580-1640) and that itself was practically sealed up in a hole in the rock from which an intact pitcher of characteristic Oriental production was excavated. Similarly, little more than ten metres to the north of this group, a small iron cannon marked off a zone where numerous contemporary vestiges were discovered, specifically stacked porcelain plates, several nautical instruments, etc.

In accordance with the study of Nuno Valdez dos Santos included in the present book, it is
pointed out that the two cannons will be dated to the last quarter of the 16th century. That of iron presents, in addition, typological characteristics completely identical with those of example N. 07 from the wreckage of the Ponta do Altar B, dated to the beginning of the 17th century, considered one of the oldest of the group recovered (Alves, 1997, p. 413).²⁶

However, of all these presumptive indicators, undoubtedly the highlight is the last of the three astrolabes discovered – whose engraved date of 1605, constituted the decisive contribution for the acceptance of the identification of the ship – it becoming legitimate to assume that it had been produced in the period immediately prior to the departure of the Nossa Senhora dos Mártires to India at the end of March 1605.

Finally, the discovery in the excavation of a tsuba of a Japanese secti Wakisachi, was hypothetically but curiously correlated with the fact that among the passengers were Father Francisco Rodrigues coming from Japan and a young native of that country.

At the same time, the archaeological and architectural study of the remains of the hull, has been interpreted in an unexpected number of detailed discoveries of great importance that represent an important contribution to the knowledge of the ship under consideration and for nautical archaeology in general. These discoveries also point toward the assumption of the identification being considered, all of its details indicating a ship characteristic of the end of the 16th century/beginning of the 17th, fully in accordance with the patterns recorded in the classical reference works of Portuguese naval architecture of the period, beginning with the woods themselves used: the cork oak for the pieces of the frame (keel, floor timbers, first futtocks, etc.) and umbrella pine for the planking of the hull covering.

In the same way, along with the observation of the shipyard numbers still engraved on the existing floor timbers, of which rare similar examples exist throughout the world, in the end a sequential group of three main floors have been discovered. This discovery, confronted with the architectural patterns of the period, proved that this was a ship with 18 rumos or more of keel, equal to at least 27.72 m – which exactly corresponds to the standard measure of an India ship from this period. This fact confirms the great size and the great tonnage that the ship would have, at least 40 m of deck and 13 m of beam, and a cubic content of 600 tons. This evidence is also expressed in the large sizes of some of its architectural details, such as the thickness of the frame and of the planking of the hull.

Despite the small size and apparently unimportant wreckage of the Nossa Senhora dos Mártires at the moment in which this evaluation is made, they comprise a notable discovery by any measure, representing the evidence of the largest ship of the Iberian-Atlantic construction tradition ever known and archaeologically documented on an international level.

²⁶ The two examples (that from the São Julião da Barra and that from the Ponta do Altar B), besides being typologically very similar and showing a notable "family air" (that even points to the possibility of having been the work of the same cast), independently of the first being of iron and the second of bronze, are different only as far as two details. All the rest are completely identical or very similar. Thus, in addition to both not having handles, they had the muzzle and the style of mouldings and faces completely identical, and the style of the breech mouldings very similar. On the other hand, the São Julião da Barra had one more reinforcement than that of the Ponta do Altar B, and did not have the characteristic escutcheon of the other, present in several cannons specifically found in contexts of Portuguese ships wrecked between the Atlantic and Indian Oceans, the latest of which being that which came from the wreckage of the Santiago, shipwrecked in the Bocas of India in 1560. Finally, the two examples vary only very few centimetres in their length and 1 cm in calibre.
Almeida, M. Lopes, reading and revision, Memorial by Pero Roiz Soares, Coimbra, 1953

Alves, Francisco, "Lisboa submersa", in Lisboa Subterrânea, Lisbon, 1994a, pp. 261-395

Alves, Francisco, "Ria de Aveiro A e B: Dois casos recentes de arqueologia marítima em Portugal", in Actas do II Simpósio de História Marítima, Lisbon, 1994b (in press)


Alves, Francisco, "Os desloços do navio do século XV Ria de Aveiro A - Campanha de 1996", in project Estudo Interdisciplinar e Comparativo de Duas Jazidas Arqueológicas Subaquáticas, project report for INICT, Lisbon, 1997a


Amorim, Melchior Estácio de, Tratado das batalhas e sucessos da galeeira Santiago com os holandeses na ilha de Santa Helena, e da Nau Chagas com os Ingleses entre as ilhas dos Açores, ambas Capitâncias da Carreira da Índia. E da Causa e Desastres porque em Vinte Anos se Perderam Trinta e Oito Naos Délia, com Outras Coisas Curiosas, Lisbon, 1604


Blake, Warren, and Green, Jeremy, "A mid 16th century Portuguese wreck found in the Seychelles", in The International Journal of Nautical Archaeology, 15/1, 1986, pp. 1-23

Blot, J. Yves, and Blot, M. Luís P., "De la glaciation de Warm aux derniers temps de la marine à voile: Élément pour une carte archéologique du patrimoines immergée au Portugal", in O Arqueólogo Português, IV, 8-10, Lisbon, 1990-92, pp. 425-54 [1997a]

Blot, J. Yves, and Blot, M. Luisa P., "Problématique d'une recherche entreprise pour le compte du Musée National de Arqueologia (MNA) de Lisbonne dans le cadre du Programme de Recensement du Patrimoine Culturel Immégrè", in O Arqueólogo Português, IV, 8-10, Lisbon, 1990-92, pp. 469-85 [1997b]

Bonino, Marco, "Lateen-rigged medieval ships. New evidence from wrecks in the Po Delta (Ily) and notes on pictorial and other documents", in The International Journal of Nautical Archaeology, 7/1, 1978, pp. 9-28


Disney, A.R., A Decadência do Império da Pimenta, Lisbon, 1981

Esparteiro, Marques, Três Séculos no Mar, 32 vols., Lisbon, 1974-1987

Fernandez, Manoel, Livro de Traças de Carapinaria (1651), facsimile edition of the manuscript in the Bibliotheca de Ajuda, ms. N. 52-XVI-21, Lisbon, 1989

Fernandez, Manoel (1651), Livro de Traças de Carapinaria, transcription and translation into English of the manuscript in the Bibliotheca de Ajuda, ms. N. 52-XVI-21, Lisbon, 1995

Fonseca, Henrique Quirino da, Os Portugueses no Mar, 2nd ed., facsimile of the 1st ed. (1926), Lisbon, 1989

Franco, P. António, Anno Santo da Companhia de Jesus em Portugal, Lisbon, 1720


Guillemey, P. Elesban de, Menologe de la Compagnie de Jesus. Assistance de Portugal, I, Poitiers, 1867
Specific Bibliography

Cais do Sooré (Lisboa, Portugal). Rodrigues, 1995; Rodrigues et al., 1998a; Rodrigues et al., 1998b


Corpo Santo (Lisboa, Portugal). Alves et al., 1998a; Alves et al., 1998b

Highborn Cay (Bahamas). Smith et al., 1985; Oertling, 1989; Steffy, 1994. pp. 131 e 133

Molasses Reef (Bahamas). Keith et al., 1984; Oertling, 1990a; Steffy, 1994. p. 129

Ria de Aveiro A (Érvo, Portugal). Alves, 1994b; Alves, 1997a; Alves and Rodrigues, 1997; Alves et al., 1998c; Alves et al., 1998d

San Diego (Filipinas). L’Hour, 1994


San Juan (Labrador, Canadá). Tuck e Grenier, 1985; Waddell, 1986; Grenier, 1988; Steffy, 1994. pp. 134-139; Rieth, 1993

Western Ledge Reef (Bahamas). Watts Jr. e Gordon, 1993
Nossa Senhora dos Mártires The last Voyage