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The 16th century Portuguese shipwreck of Oranjemund, Namibia

Report on the missions carried out by the Portuguese team in 2008 and 2009

Francisco J. S. Alves

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INSTITUTO DE GESTÃO DO PATRIMÓNIO ARQUITECTÓNICO E ARQUEOLÓGICO

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Preface

To speak about the 16th century Portuguese shipwreck of Oranjemund
is to evoke an extraordinary professional and personal experience,
due to both the nature of the challenges it presented
and the relationships between all the parties involved in the project
– countries, teams and individuals –
particularly those who participated in the 2008 and 2009 missions.
But it is also, and above all, to evoke a model of exemplary international cooperation
between a "costal state" and a "flag state"
around what both recognized early on to be a case of common heritage.
For this achievement it was instrumental the early recognition by the Portuguese government
that protecting this heritage through cooperation between States
was more important than the question of its possession
– an option that emphasizing scientific and technical cooperation
enables a better preservation of the heritage with such origin,
lost for centuries in worldwide waters.
This case thus became an international paradigm of application of the principles set forth
in the UNESCO Convention on the Protection of Underwater Cultural Heritage
ratified by Portugal in 2006.

Acknowledgements

In addition to acknowledging the role the Portuguese and Namibian authorities played in making the Portuguese's team's missions in Oranjemund possible, the author would like to express his heartfelt gratitude to all those who helped make this an unforgettable scientific and personal experience. Among them are Abisai Heita, Alina Shikongo, Anthony Goosen, Anzel Veldman, Ashton Sinamai, Dieter Noli, Dirk Hoebel, Domingos Alvim, Esther Amweelo, Esther Moombolah-Goagoses, Filomena da Veiga, Fouzy Kambombo, João Pedro Cunha Ribeiro, Joaquim Marinheiro and family, Johan Weber, John Breytenbach, John Mall, Joram Shiinda, Lazarus Shiimi, Marina Mubuzizi, Mike Alexander, Onesmus Shigwedha, Paul Brandt, Peingeondjabi Shipoh, Petrus Kaafita, Tangeni Mulunga, Theodore Feris, Thomas Parkhill, Webber Ndoro and Wilherm Amuteny.

Lastly, the author would like to thank Paulo Monteiro and Pedro Oliveira for their invaluable assistance in drawing up this report, the substance of which greatly benefited from the technical assistance provided by Miguel Aleluia both in the field and in the office and in terms of both the archaeographic work and helpful criticism.

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Leading up to the discovery

In recent years, artifacts have periodically been discovered at different spots along the Namibian coast within a few dozen kilometers of the estuary of the Orange River, which forms the country's southern boundary with South Africa and empties into the Atlantic. The artifacts discovered had clearly come from one or more of the many centuries-old ships that foundered along this vast stretch of the southwest African coast.

Among these artifacts were elephant tusks and pieces of timber. More recently, in October 2007[1], an important piece was found - a parallelepiped-shaped end piece with two parallel openings for operating a block and tackle. This piece – a mast head block, a lifting device at the top of the mast for maneuvering the yards – which is a very rare find in archaeology and which has only rarely been represented in nautical iconography, is illustrated on page 81 of Manuel Fernandes[2], de 1616, *O Livro de Traças de Carpintaria*.

[1] Discovered by Andrew Darné, a Namdeb employee (Werz, 2008: 8).

[2] Along with Fernando de Oliveira and João Baptista Lavanha, one of the three most important authors in the field of Portuguese naval architecture (See Bibliography).

The discovery

On 1 April 2008, open-air mining for diamonds was underway in Mining Area 1 (MA1) in dry marine basin known as "U-60", which lies approximately twenty kilometers north of Oranjemund, a peaceful mining town about 12 miles north of the Orange River estuary in the extreme southwest corner of Namibia and is part of the *Sperrgebiet* ("forbidden zone")[3]. On that day, two much damaged bronze tubes were found[4] which were later identified as breech-loading cannons. These were followed in short order by other artifacts, including copper ingots in the form of half-spheres, elephant tusks, chunks of timber and gold coins, which suggested they were from an old shipwreck.

[3] Maximum security diamond mining zone, a concession owned by Namdeb, an equal share, joint-venture of the Namibian government and De Beers, where Draconian rules govern access and circulation within the perimeter. The city of Oranjemund and its airport lie inside this zone and enjoy a more flexible, special vestibule status. Access to the mining zone itself is completely restricted, with a single road leading from the urban area to the mining zone entrance approximately 4 km north of the city, The road leads to a building that acts like a high security border crossing (a *Scannex* system) employing a number of ultra-sophisticated surveillance devices, including video monitors and x-ray body scanners, as well as systematic individual inspection upon entering and, more importantly, upon exiting the zone. In the high-security area, no contact with the outside is allowed, including by mobile phone; the historical objective being to prevent trafficking in diamonds, particularly in raw diamonds.

[4] Discovered by Tate Kapaandu Shitaka, a Namdeb excavator operator, who immediately informed Bob Burrell, NAMDEB'S chief geologist, who in turn made the preliminary identification (Noli & Werz, 2008: 1).

In the absence of any identifying material, the ship the artifacts came from was initially christened with the name of the mining area (U-60) where they were found; the name was later changed to that of the town on the coast off which the ship sank. To understand the natural setting where the shipwreck was found, it should be explained that these basins are opened along a strip of coastline artificially reclaimed from the sea by building walls of sand dunes over 20 meters high. These walls extend out into the sea and curve parallel to the coast, shutting out the sea in successive areas various kilometers long. These dry pockets are then excavated in contiguous mining basins.

The sea walls are continually fed by sand trucks circulating on their dune-like crests, followed by bulldozers that push the sediment over the ocean side of the wall reinforcing it and stabilizing the crest-top road inside the mining basins, seawater is pumped out of the basins 24 hours a day to lower the water level and artificially maintain it. In 2008, the site where the debris was found lay approximately 7 meters below sea level. The mining is done by sucking The sea walls are continually fed by sand trucks circulating on their dune-like crests, followed by bulldozers that push the sediment over the ocean side of the wall reinforcing it and stabilizing the crest-top road inside the mining basins, seawater is pumped out of the basins 24 hours a day to lower the water level and artificially maintain it. In 2008, the site where the debris was found lay approximately 7 meters below sea level. The mining is done by sucking the sediment until all the anfractuosities of the parent rock have been cleaned away using powerful towable vacuum pumps connected to large diameter tubing. The sediment is aspirated through these tubes directly into trailers equipped with hermetically sealed boxes which are only opened in the industrial treatment zones. The sediment is then sifted, crushed and processed industrially[5], leaving the areas

[5] Each one of these loads contains an average of 4 carats of diamonds. Namdeb expected total production in 2009 to be around 10 million carats (the figure mentioned in a PowerPoint presentation given to guests at a dinner reception for Harry Oppenheimer, chairman of De Beers, which took place in Oranjemund on 29 September 2008, on the occasion of his visit to the minefield and to the shipwreck site).

where the material is deposited to form the strange cone-shaped mountains along the coast that characterize the breathtaking desert-like landscape of this Namibian coastal area, just as the sea walls protecting the mining basins are rapidly swallowed up by the sea once they have been abandoned.

The discovery of the Oranjemund shipwreck quickly led Namdeb to request the full-time assistance of archaeologist Dieter Noli, a specialist in Prehistory and frequent collaborator, who soon recognized the nature and importance of the find, as well as its specificity, whereupon he called on a colleague, maritime archaeologist Bruno Werz, for help.

Meanwhile, the gold coins, which were discovered in great numbers, contributed decisively to the case's notoriety, but also to its being misidentified at first. The fact that the breech-loading cannonry may have been Spanish in origin and that the great majority of the coins were also Spanish led to the initial belief that the ship too was Spanish. However, this assumption was quickly abandoned for plausible historical and archaeological reasons[6]. Then, the hypothesis put forward was that the Oranjemund shipwreck might be Bartolomeu Dias' caravel, one of the ships in Pedro Álvares Cabral's fleet that was lost in 1500 while on its way from Brazil to India and never found. However, this hypothesis also proved to be false when a Portuguese coin known to have been minted during the reign of King João III was found among the artifacts (a picture of this coin was circulated on the Internet in early May). This established the first unassailable *post quem* dating of the Oranjemund shipwreck.

17 April 2008 SPERRGEBIET GAZETTE Page 11

SHIPWRECK DISCOVERED IN MA1

Dr Dieter Noli and Gully Mutera.

On 1 April 2008, Bob Burrell, Namdeb's Mineral Resources Manager, during a routine mining site inspection, discovered a shipwreck on a mining site (U60) which is about 6 m below sea level and was protected by a sea-wall. The site is about 12 km north of the Orange River mouth, and located between 3 Plant and MDTP. Artifacts inadvertently exposed by bona fide mining operations include three bronze cannons, five anchors, 32 elephant tusks, 28 ingots of African copper, some tin ingots, a substantial amount of lead sheeting and a brass mortar and pestle. While it is far too early to come to any definite conclusions, the possibility of the vessel concerned being a 16th century Portuguese sailing ship laden with a cargo of copper and ivory cannot be excluded.

In the meantime a permit (No10. of 2008) has been issued by the National Heritage Council of Namibia to excavate the wreck site concerned with immediate effect on behalf of the Environmental Section of Namdeb. The permit is a temporary one which is valid for one month. Namdeb have sought the assistance of Dr Dieter Noli, one of Namibia's top archaeologists, and an expert of the Sperrgebiet, to coordinate the excavating efforts.

The first phase, being the initial investigation of the site, has been completed, and the second phase is underway, which involves the excavation of the material putting it into storage in a safe place, and due to the nature of the site location, this phase needs to be completed as quickly as possible, as the site will be flooded.

The third phase would be the stabilization of the archeological artifacts to prevent further corrosion/damage.

Dr Noli has expressed his appreciation to the Bedrock team in the area, as they are assisting greatly.

All recovered shipwreck artifacts are being taken to a safer place in MA1 for storage.

During the month of April, the public notoriety of the case spread in the Namibian and South African media. Recognizing the importance of the discovery, later in the month the Namibian government decided to classify the shipwreck as national heritage and suspended the salvage work that had already begun, as they came to realize the to assume responsibility for ensuring the scientific management and protection of such an important piece of national heritage, African and international find. The government recognized that in order for the archaeological rescue to proceed it would need to be founded on a scientific and technical plan with broad national

[6] From an archaeological standpoint, the artifacts discovered could generally be of either Portuguese or Spanish origin. The fact that the majority of the coins discovered were Spanish was not a sure-fire indicator, as the archival documentation found by P. Monteiro subsequently confirmed. From a historical standpoint, the assumption that the shipwreck was Spanish was not well supported since the southwest African coast is situated near the Cape Route was typical Portuguese rather than Spanish route after the Treaty of Tordesilhas.

and international consensus. Up until then, the archaeological rescue operation had been improvised and lacked a scientific and technical foundation commensurate with the importance of the discovery and the responsibility to protect it. This suspension, which was understandable in terms of public management of a case tantamount to the discovery of a national treasure, would end up being a very positive step in that it made it possible to organize a response equal to the challenge that the case presented, even though it inevitably delayed the process and limited the duration of the second phase of the archaeological rescue that would take place[7].

Results of the first phase of the archaeological rescue in numbers: "*5438 artifacts of immense cultural, scientific and intrinsic value were discovered, recovered and subjected to preliminary conservation procedures. These included 2,159 gold coins*[8]*, 1845 copper ingots, 109 silver coins, 67 elephant tusks, 14 cannon balls, 8 bronze cannons, 5 anchors, 3 astrolabes, 3 navigation compasses and part of a compass, as well as tin tableware, copper cooking utensils, swords and chains. The copper alone weighed about 20 tons, and there were also 3.5 tons [of tin ingots]. Among other items, several wrought iron cannons, swords, muskets and a box of sword blades – all encased in concretion – were left in situ (as is), as were the structural remains of the ship timber that were exposed*"[9].

International repercussions of the discovery of the Oranjemund shipwreck

Towards the end of April 2008, but primarily early in May, news of the discovery of the Oranjemund shipwreck and its treasure was spread round the world by the media. On 1 May, Bloomberg announced the discovery on the Internet, illustrating the story with two spectacular photos: One of a nautical compass and a gold coin and several silver coins in the palm of a hand; and another close-up shot of a gold coin emblazoned with the cross of the Order of Christ surrounded by a circle of pearls.

Paulo Monteiro is credited with the first discovery that would be fundamental in establishing an approximate date and identity of the Oranjemund ship, which resulted from the research he did immediately on this particular coin – the "Portuguese", a 10-*cruzado* gold coin of extreme purity, prestige and rarity.

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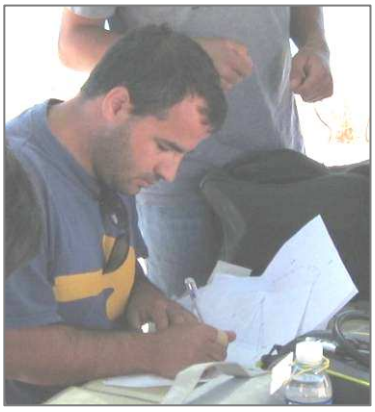
[7] This fact was aggravated by the inadequate archaeological care taken in the field at the end of the first phase of the rescue operation, which consisted of depositing two layers of sand and tumbled stone, one on top of the other, more than 1m thick, with no protective canvas, plastic or geotextile lining. This resulted in the unnecessary loss of a week's worth of archaeological work in the 2nd rescue phase at the site that was spent in the inglorious task of mechanical and manual removal of the debris. This resulted in a great deal of tribulation for the technical and archaeological coordinators.

[8] Exceptionally rare – "*Portugueses*", coins minted between the reigns of King Manuel I and King João III, and Spanish "*Excellentes*", also called "Fernando and Isabels", which were minted over a longer period of time.

[9] Noli, D., 2008b: 1.

In essence, it was based on the presence of an inner circle of pearls around the Cross of Christ on the coin face, a minting detail that is only found documented beginning in October 1525 in the bibliography of the specialty[10]. Thus, the first *post quem* date for the Oranjemund shipwreck was established, although from the standpoint of archaeological research methods this date can only be firmly established after all the coins recovered have been studied.



The international repercussions of the case put immediate pressure on the government of Namibia, which ended up asking the international community for help dealing with the case. In particular, when informed of the discovery, the likely countries of origin of the shipwreck, Spain and Portugal, announced their unconditional willingness to collaborate in the rescue and study of a heritage they believed that historically was also theirs. Likewise, the government of Namibia was contacted by the Texas A&M University (TAMU), one of the most highly respected institutions in the world in the area of nautical archaeology, which collaborates closely with the Institute of Nautical Archaeology, which also is internationally well-known in this area of research.

[10] Gomes, A., 2001: 205

This was not surprising, given that Filipe Castro, who had been a member of the original Centro Nacional de Arqueologia Náutica e Subaquática [Center of Underwater and Nautical Archaeology] (CNANS) team, was invited to join the teaching staff at TAMU after completing his doctoral degree at that university (with his dissertation on the presumed Portuguese Indiaman *Nossa Senhora dos Mártires*[11]). As a Portuguese and a specialist in this subject, he naturally had a first-hand interest in the Oranjemund shipwreck, which was encouraged by the entities he was affiliated with. *National Geographic* also showed an interest in the case and later published an article on the find[12].

The period from May to July of 1998 was marked by a hiatus and reflection on the part of the Namibian government, during which numerous efforts were made, both internally and externally, by entities responsible for Portuguese underwater cultural heritage through diplomatic contacts between the two countries. It was at this time that Portugal clarified its position regarding the remains, which was that of rescuing them rather than possessing them [13]. This appears to be related to the fact that the Namibian authorities explicitly began to consider the remains a heritage shared by the two countries. This period also brought about a result of extreme international importance and significance, which was the Namibian government's decision to organize a major meeting of the stakeholders in the case in August 2008. It is significant that only three entities were invited to participate in this meeting at the international level: the Portuguese government, the Spanish government and the Texas A&M University.

The general meeting of stakeholders (Oranjemund, August 21-22, 2008)

The purpose of this meeting was to encourage broad debate and to advise the Namibian government on the immediate measures to be taken. This was particularly important because Namdeb felt that the work in that mining basin needed to be completed urgently due to the upcoming seasonal weather change which would accelerate erosion of the retaining wall and raise the daily cost of reinforcing the wall dramatically. However, because the archaeological rescue was suspended in April, the consequences of not concluding the work would mean irreversible destruction of the remains that could not be recovered in time, including the surviving structural parts of the ship's hull. The meeting was attended by more than three dozen participants. Among them were representatives of the Namibian ministries most closely involved in the case (Mining and Energy;

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[11] Alves, F., 1998; Alves, *et al*., 1998; Castro, F., 2001; Castro, F., 2005.

[12] Smith, Roff, 2009, Shipwreck in the Forbidden Zone, *National Geographic*, Vol. 216-NO. 4. October 2009:116-127. Smith, Roff, 2009, Naufrágio na Zona Proibida, *National Geographic*-Portugal, Vol. 9-N.º 103. October 2009:56-77 (the original and the Portuguese editions).

[13] For the first time, at least in terms of bilateral diplomacy, as Portugal's position regarding this question had already been expressed by the Portuguese delegation in 2000 during the discussions on the wording of the draft Convention on the Protection of Underwater Cultural Heritage sponsored by UNESCO, following a debate between the Ministries of Culture, Foreign Affairs and National Defense held specifically to address the issue, through the public reading and dissemination of the text agreed on, after revision, in three parts, of the outline drawn up by A. (see Appendix I).

Information, Communications and Technology, Youth, National Service and Sport and Culture). Also in attendance were the National Heritage Council, the Namibia National Commission for UNESCO, the University of Namibia and Namdeb. The Portuguese delegation was composed of Domingos Alvim, the Portuguese Consul in Cape Town (South Africa), by the Ministry of Foreign Affairs and by the author on behalf of the Ministry of Culture. The Spanish delegation was composed of two curators of the *Museo Arqueológico Nacional* of Madrid[14]. The delegation from the Texas A&M University was composed of Donny Hamilton, head of the university's Department of Anthropology and well-known specialist in conservation of nautical and underwater archaeology, and Filipe Castro.

The first day of meetings took place in the morning with the arrival of the Portuguese and Texas University delegations, who by coincidence had taken the same flight between Cape Town and Oranjemund. This circumstance gave them the opportunity to exchange their thoughts about the subject of the reunion. They discovered they were essentially of the same opinion regarding the need for the shipwreck site to be excavated as completely as possible, namely in the part corresponding to the remains of ship's hull that were still structurally connected, an opinion that both delegations reiterated throughout the two days of meetings. At the beginning of the meeting on the first day, the members of the Texas A&M University delegation introduced themselves, followed by the Portuguese delegation, where Domingos Alvim emphasized the Portuguese government's interest in cooperating with the Namibian authorities[15]. Then the author outlined the historical and archaeological importance of the Oranjemund discovery, reiterating in the scientific and operational plans the Portuguese authorities' interest in collaborating on the rescue and on the research of the artifacts, highlighting the experience the CNANS had accumulated in the course of their work on a number of important discoveries made in Portugal since the mid-1990s in the field of nautical archaeology[16].

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[14] Due to an airplane crash that affected air traffic in Spain, the Spanish delegation only arrived midway through the morning session on the second (last) day of the meetings, but the delegation subsequently extended their stay in Oranjemund.

[15] Alvim, D., 2008.

[16] Among these are the 15th century *Ria de Aveiro A* shipwreck (since 1994); the 15th-16th century *Cais do Sodré* shipwreck (1995) and the *Corpo Santo* shipwreck (1996), both discovered on the Lisbon riverfront during the construction work to extend the Metro subway line; the timbers also discovered in Lisbon under the *Praça do Município*, in an area corresponding to the *Ribeira das Naus* naval shipyards which operated from the 11th to the 14th centuries (1997); the Indiaman *Nossa Senhora dos Mártires*, which sank in 1606 on the *barra* at the entrance to the Tagus River on its return to Lisbon from Cochim (1997-1998); and the Angra C and D shipwrecks from the 16th/17th centuries discovered in the bay of Angra do Heroísmo, Terceira Island, Azores (1998), during construction work on the sea wall protecting the marina. These discoveries gained national and international notoriety and the archaeological research on the above-mentioned shipwreck was chosen as a theme of the Portugal Pavilion at the Expo '98 world's fair, as well as for the International Symposium of Medieval and Modern Ships of Iberian-Atlantic Tradition held in September 1998 at the close of the world's fair, which brought together some of the most well-regarded experts in the field from around the world, including George F. Bass, considered the "father" of underwater archaeology. (See the Bibliography for the above-mentioned discoveries and the Proceedings from the International Symposium mentioned above, which were published in 2001).

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Vonkel uit 'klippies'

• Jo-Maré Duddy

'n Moontlike replika van die skatskip wat vroeër vanjaar op Oranjemund ontdek is. Die span argeologie uit Portugal wat deelneem aan die herwinningspoging het geskiedkundige boeke uit die Afrika-ontdekkingsera aan Namibië geskenk. Van links is die direkteur van nasionale museums, me. Esther Moombolag-Gaagoses, dr. Francisco Alves van Portugal, dr. Dieter Noli van Kaapstad, dr. Miguel Aleivia van Portugal, dr. Bruno Wertz, die projekleier en dr. Peingeondjabi Shipoh, permanente sekretaris van Jeug, Nasionale Diens, Sport en Kultuur. Nog foto's deur Christo Retief op bl. 6 en 7.

After the presentation, the Portuguese delegation presented the representatives of the Namibian government with a copy of each of three masterpieces of the history of Portuguese and world naval architecture dating from the end of the 16th century and beginning of the 17th century (written by Fernando Oliveira, João Baptista Lavanha and Manuel Fernandes)[17]. The gift was warmly received by those present. These two presentations made clear not only the reasons for the Portuguese government's interest and willingness to cooperate with the Namibian government but also its legitimate grounds for doing so. That night, at an informal meeting of the delegations from Portugal and Texas A&M University with archaeologists Dieter Noli and Bruno Werz, it was found they were of like mind about how the project should be conducted, with the author expressing his opinion regarding the strategy to adopt for the excavation and removal of the structural remains of the ship hull that still existed.

The second day began with the reading of the *Oranjemund Statement* (*see next page*), which the author had taken the initiative to draw up after the previous night's meeting. After being reviewed by the other members of the Portuguese and Texas A&M University delegations the following morning, it was the option that was ultimately chosen. The representatives of the government of Namibia expressed their willingness to take on the financial burden inherent in prolonging the reinforcement of the retaining wall around the site for one month on the condition that the real work of the archaeological rescue would strictly abide by this deadline.

It was decided that the archaeological work would recommence on 5 September and that it would end, without fail, at the end of that month. The meeting was then closed with the Namibian authorities thanking the invited delegations not only for their attendance, but also for their contributions to the success of the event and the future support that was promised.

Lastly, by unanimous vote of all those present, Bruno Werz, the maritime archaeologist who had advised Dieter Noli during the first phase of the rescue, was invited to direct the second phase of the excavation.

[17] The Naval Academy, the publisher of the work, was kind enough to donate it for this purpose. See Bibliography.

Oranjemund Statement

1. Oranjemund shipwreck, independently of its almost sure Portuguese origin, based on the archaeological and historical evidence, it is one of the most important wrecks of the present times. By being the most important wreck of the rising of the Modern world in African waters, it is a link between countries and continents and is an outstanding part of a heritage belonging to the whole of Humanity.

2. At this crucial point of its archaeological rescue we must stress and salute the decisive role of the Government of Namibia, Namdeb and the archaeological team in safeguarding this heritage.

3. The present situation requires the immediate conclusion of the site excavation. It is important that we save the rest of the site, which includes the threatened wooden hull remains of the ship – independently of their extension or size. This means we have to start Now! ***Time is of essence*** because it is obvious that only a few weeks remain, due to the impending seasonal turning point and the collapse of the sea wall that protects the site (which is 6m below the sea level). If not started now, the remainder of the ship, the artefacts, and the story they can tell will be lost.

4. Therefore we encourage all those Authorities, entities and professionals of and in Namibia to take all necessary measures to accomplish this urgent task. We, along with our organizations are committed to assure all required and possible immediate support in the waterfront, in future lab tasks and in background historical research, to complete this operation as successfully as possible.

We would like this project to be an example and a case study on how underwater cultural heritage management and international cooperation come together to save and present the story of the Oranjemund shipwreck to the world.

Oranjemund, August 22

Sign by

Francisco Alves, Portuguese Ministry of Culture, IGESPAR (Portuguese Heritage).

Domingos Alvim, Portuguese Ministry of Foreign Affairs

Donny Hamilton, Texas A&M University, Department of Anthropology Head

Filipe V. Castro, Texas A&M University, Nautical Archaeology Program Coordinator

Results of the meeting

1. Everyone present agreed that, based on the available historical and archaeological evidence, the Oranjemund shipwreck is Portuguese in origin. The Namibian authorities stated explicitly that the remains constituted a common cultural heritage of Namibia and Portugal.

2. It was clear that the Portuguese government's interest in the case was not to take possession of the remains in its capacity as "flag state", but rather to collaborate with the

“coastal-state" in the interest of helping safeguard this common heritage in order to enhance its scientific and cultural potential for the common good and the good of humanity.

3. Portugal distinguished itself during the course of the meeting and the Portuguese delegation established very cordial relations with all those present. The importance of their partnership in the project was acknowledged, and their participation in future phases of the project was ensured, especially with respect to the final phase of the archaeological rescue work that was scheduled.

The last visit to the site and the warehouse where the artifacts recovered from the first phase of the rescue are stored

On Friday, 22 August, after the last general meeting of the stakeholders, all the attendees were invited to visit the shipwreck site and the facility where the recovered artifacts are stored [18]. As for the site of the shipwreck, which was originally situated about 6-8m below sea-level, all that can be said is that the surrounding landscape was impressive since the entire site had been covered by a layer of sand and tumbled stone more than 1m thick[19]. It was nevertheless obvious, by the nature of the geological substrate, by the original topography of the site and by the photographic documentation of the first phase of the rescue operations, that this was the area of the impact and final destruction of the ship, or rather what was left of that site. Under any circumstances, but particularly when there is a violent storm – which is hypothesized or presumed to have occurred in this case – the first contact of the ship’s hull with the sea floor occurs at a greater or lesser distance from the final sinking or destruction depending on the height of

[18] Except for the most valuable items, such as coins and nautical instruments, which were stored in different locations.

[19] See Note 7.

the wave and the draft of the ship, the latter being a function of the weight of its cargo. The subsequent visit to the site where the artifacts recovered in April were stored was especially important because of the observations it enabled us to make. The first of these had to do primarily with the sheer quantity of items amassed, since the variety of items was already known. The amount was particularly striking in the case of the copper ingots,

which were stored on stacked pallets that occupied approximately 1/3 of the area of the warehouse. The second observation was the precarious state of conservation of most of the material, particularly the metal objects, namely those made of iron (e.g. some small iron

anchors were being stored in water in an iron tank, both of which were undergoing active corrosion). Even more serious was the condition of an enormous, impressive piece of a block, in wood, very important and rare, which was later identified as being a mast head block, which was completely dried out and exposed to the open air[20]. The concern of the Namibian authorities and their awareness of the need to get international help in the area of conservation was therefore perfectly understandable. Faced with this situation, the author recommended that all the pieces be immersed or re-immersed in fresh water in tanks made of a chemically inert material, even plastic-lined wooden tanks would do, which would give them a head start on the essential preliminary process of desalinization. For the iron objects, it was recommended that they be immersed in an aqueous solution of sodium hydroxide or potassium hydroxide at a concentration of 5% – which is the universal recipe for materials of this type coming from a saline environment. Unfortunately, this recommendation was only implemented months later and even then not consistently, during the last true phase of the ship remains recovering.

The second, true rescue of the remains of the Oranjemund shipwreck

After the two reports of the meeting were presented in Portugal to the respective agencies in charge[21] and after some meetings were held between them, the Instituto de Gestão do Património Arquitectónico e Arqueológico [Institute of Architectonic and Archaeological Heritage Management] (IGESPAR), through the Ministry of Culture, and Instituto Português de Apoio ao Desenvolvimento [Portuguese Institute of Aid for Development] (IPAD), through the Ministry of Foreign Affairs, was charged with promoting and providing the means for a Portuguese team to participate in the true archaeological rescue phase of the project. This team was made up of the author and Miguel Aleluia, an archaeology assistant from DANS who has broad experience in archaeology of shipwrecks, having participated in nearly all the excavations of shipwrecks organized by Francisco Alves since 1996, including work on the different phases of dismantling and recovery of structural parts as a member of the permanent team that would in the following year constitute the Portuguese Institute of Archaeology's Center for Underwater and Nautical Archaeology (CNANS). The first priority of the Portuguese team was precisely that of completely excavating and dismantling the parts of the hull of the Oranjemund shipwreck that were still structurally connected. This would be followed by their full recovery – which is the team's specialty[22].

[20] See p. 6 under "Leading up to the discovery", 2º §.

[21] Alves, F., 2008b; Alvim, D., 2008.

[22] Regrettably, Spain and Texas A&M University ended up not participating in this second rescue phase.

Prelude to the actual excavation phase

The Portuguese team arrived in Oranjemund on Wednesday, September 10, 2008, but it was only a week later, precisely on the 17th, that the archaeological remains closest to the surface started to become visible, due to a series of setbacks that were hard to comprehend. The first of these resulted from the method adopted for more than a week of supposed "archaeological training" of the local full-time staff, training that Dieter Noli, who for some unknown reason was systematically relegated to administrative tasks, called "gardening" with a certain bitter irony.

The local excavating team was made up of one archaeologist specially hired for the job (Ashton Sinamai), a curator from the National Museum of Namibia (Fouzy Kambombo), two university students (Anzel Veldman and Onesmus Shigwedha) and several NAMDEB employees, chosen from among those considered their best workers.

The team, photographed by Tony Goosen: From left to right: Back row – Theo Goaseb, driver from the Ministry of Youth, National Service, Sport and Culture; Tony Goosen, Chief Surveyor, responsible for the department of topo-cartography of Namdeb Gebab Barnabus and Wilhem Amuteny, Namdeb employees; Johan Weber, Namdeb foreman; Tangeni Mulunga, video operator from the Ministry of Youth, National Service, Sport and Culture; Middle row – Francisco Alves; Mauno Amakhali, Namdeb employee; Bruno Wertz, head archaeologist; Abisai Heita, Namdeb employee; Onesmus Shigwedha, student; Miguel Aleluia; Alcides Chipeio, Namdeb employee; Front row: Fouzy Kambombo, curator from the National Museum of Namibia; Petrus Kaafita, Oiva Lita and Kashimba Litamaro, Namdeb employees; Dieter Noli, Namdeb archaeologist; Ashton Sinamai, archaeologist hired by the National Museum of Namibia; Not shown: Anzel Veldman, student, participant in the initial phase; and Jonn Mall, Namdeb topographer and dedicated, multi-talented collaborator in the true rescue phase.

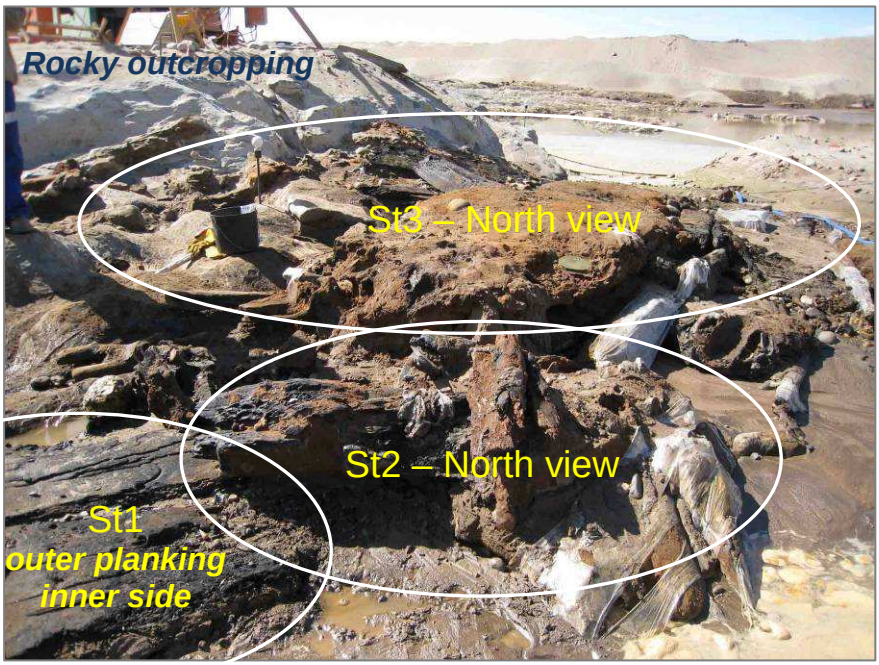
A second setback resulted from the aforementioned method of archaeological protection used at the end of the first rescue phase, where the site was covered with a 1-meter thick layer of sand and tumbled stone without applying a layer of plastic waterproofing, canvas or geotextile between the two levels. A third setback occurred at the beginning of the excavation due to late and limited use of heavy equipment (bulldozers) because of periodic delays and breakdowns. This took up a large portion of the time that was planned for the rescue work. If we take into account that one day was set aside for a press visit, another for a visit by Harry Oppenheimer, chairman of De Beers, and yet another for an interim visit by the governmental coordinators, plus another day for differential GPS measurements, yet another for a public conference with the director of the excavation, and three more for laser scanning of the site, it is not surprising that the actual rescue work had to be extended until Friday, October 10th.

The archaeological site

The location of the Oranjemund shipwreck, which lies on the seafloor at a site artificially maintained open to the air, is a terrain of rocky anfractuosities that rise up gradually from the sea to land (from west to east). The site is perfectly delineated by a rocky outcropping two meters high, the crest of which extends more or less in a north-south direction and served as an impassable barrier for the remains of the shipwreck in the true rescue phase. In essence, what remained of the lower part of the ship hull, which had been travelling along a trajectory from the south or south-southwest when it broke apart on this impassable

rocky barrier, was lying contiguously in two coherent sections of the hull frame, St1 and St2, (St=Structure), and in one other set of pieces of the same type (St3), with the respective peripheral SW to NW area being strewn with non-structural remains.

Thus the total area of dispersion of the exhumed remains had an epicenter characterized by three separate sets of remains lying successively and contiguously from south to north along that rocky outcropping.



All the items were covered by a thick hard layer of orange-cultured concretion built up over the centuries by physical and chemical phenomena, particularly electrolytic phenomena clearly originating from the abundant ferrous archaeological components. The

two sets of remains lying to the north, designated St1 and St2 (St=Structure), were the only pieces in the entire site composed of ship hull timbers that were still structurally connected. The third set, St3, lying south of St2, was much larger than the others. Part of the west side of this set was covered by a much thicker layer of the same orange-cultured concretion. Between this set and the rocky outcropping was a strip of mobile sediment with several large pieces of the ship hull structure protruding from the sediment. These were dismantled pieces with no structural connection. Numerous other items were found in this spot, including dozens of hemispherical copper ingots – like the hundreds that we saw in August in the warehouse where the April finds were stored, which were taken from the area just to the south of St3.

Schematically speaking, we can say that the *epicenter* of the artifact dispersion area comprised three sets of remains spatially arranged in the form of a comet in which the *nucleus* was formed by, the only structurally coherent sets; an intermediate area, St3, formed by the set of ship hull timbers with no structural connection and by the layer of orange concretion, both strewn with copper ingots; and a *tail* zone formed by trail of several hundred copper ingots (recovered in April), weighing over twenty tons in all. This spatial layout was highly significant and indicative of the model of the shipwreck in its final phase, which we will look at shortly. Around and to the west of this *epicenter* comprising St1, St2 and St3, and contiguous with the rocky terrace, the remaining area of dispersion extended from north to south for a few dozen meters. The entire archaeological site attested simultaneously to the violence of the ship's sinking, the storm that led to it, the inclemency of the waves that batter this coast and to the sedimentary, chemical and biological dynamics that left their mark on the remains for five centuries.

The remains of the shipwreck itself, regardless of the mobile sediment in which they were embedded can be divided roughly into three groups: loose artifacts; artifacts encased in

lime concretion, nearly always completely fused to the rocky substrate; and artifacts encased in orange sandy concretion of varying hardness, fused or not fused to the rocky substrate.

The first group – the loose artifacts, completely or partially intact – included, first of all, the coins, copper and tin ingots, mercury, the elephant tusks and nautical instruments as well as numerous metal articles for cooking or serving food, such as plates, tin pots and pitchers, often dented; and secondly, corroded and incomplete artifacts made of metal, ceramics, glass or organic material, which constitute a significant portion of the items found at the site. Among these items were the several cannons recovered in April, portable firearm accessories, gunpowder casks, etc. The organic materials included leathers (soles, shoes, sword sheaths, etc.), textiles (rigging) and even human bone remains, almost always very fragmented (ribs, vertebrae, the bones of a foot still in a shoe and parts of a pelvis). In the area of intervention of the second, true phase of archaeological rescue, these artifacts were much easier to recover[23].

The second group of artifacts consisted of pieces encased in lime concretion fused to the rocky substrate, which were strewn nearly throughout the entire peripheral archaeological area of the three structural nuclei that formed the epicenter of the site.

Among these artifacts were countless pieces of iron of varying sizes. One of the largest of these was the anchor located at the far north end of the site, whose nearly complete ring

[23] It was the author's belief that he should limit this to a brief, though incomplete, list of the various types of artifacts discovered during the true archaeological rescue work at the site, without even illustrating the finds with photographs, as he would be able to do so based on the on-going record he was keeping and on the report written up by Miguel Aleluia, complete copies of which were sent to the Namibian authorities and to the archaeologists who headed up the two phases of the intervention. He also understood that the respective complete reproduction, namely in a condensed format, was fully justified in Appendix B, to be published at a later date, because these records, despite the interrupted sequence, would not only document the Portuguese participation in the various phases of its presence in Oranjemund but also document the overall progress of the work within the framework of the project itself – on which we collaborated as much as possible. This, without prejudice to our having achieved that which was the exclusive responsibility of the Portuguese team: the excavation and dismantling of the two nuclei of ship hull wreckage that were still structurally connected *in situ*.

(although broken and separated from its shaft) was deposited at the exact opposite end, next to the arms, the ends of which (the billhooks) for their part having been propelled several meters away – which well illustrates the violence of the final destruction of what remained of the ship.

In this location, numerous pieces were found that were unidentifiable, in contrast to the swords, daggers and the swivel gun loaders, which were easy to identify. During the second, true phase of the archaeological rescue, this was the set of artifacts whose recovery proved to be next to impossible. Rare were the cases in which recovery was achieved by casting the inside of the concretion, which is obviously designed to conserve them but always at the cost of great persistence and enormous physical effort, either because of the fragility of the surrounding concretion, which would shatter at the least tremble or impact, thereby irreversibly compromising the future recovery of the original piece in the laboratory, or because of the shape of the piece itself.

Among the isolated exceptions were successful attempts at recovering artifacts completely concretioned to the parent rock using a method a devised and executed entirely by Dieter Noli on a dagger covered with concretion, which, after being completely covered with consolidating resin, was laboriously freed from its rocky bed by picking and chiseling the piece free. Likewise, a wooden box filled with completely oxidized sword blades was removed intact from its stony resting place after almost two weeks of arduously and painstakingly chiseling away the rocky substrate to which it was literally fused[24].

[24] This operation was also carried out by Dieter Noli with the help of John Mall.

On the other hand, in final attempt to recover a sword with well-preserved contours in this type of concretion, Bruno Werz almost managed to saw completely around the contour of the sword using a large disc grinder. However, because the discs wore out very quickly and

because of the extreme hardness of the substrate and the difficulty of holding the disc grinder at a convenient angle of attack, the concretion shell began to crack and the piece was recovered in several fragments. This story repeated itself in nearly all similar attempts that were made.

The third group – artifacts encased in orange sandy concretion – included many pieces, nearly always fragmented, including pieces of pipe (chases) from wrought iron cannons (swivel guns), easily recognizable by their regularly spaced reinforcement bands, which were nearly always able to be recovered.

Lastly, the method of recovery used for a large slab of orange sandy concretion from St3, which not only covered a large portion of this area but was also full of loose remains of the ship's hull (large pieces of the frame and the inner and outer planking) and studded with numerous other timber remains and copper ingots. As the excavation of the periphery advanced, the findings bore out what had already been stratigraphically demonstrated in the archaeological site as a whole and something that was very common in situations where there are similar interfaces with archaeological potential: the presence of two basic strata of mobile sediment on top of the superficial geological substrate (bedrock/rocky outcroppings) with different compositions and characteristics, namely with respect to granulometry.

The first is the layer in direct contact with (directly on top of) the rocky outcroppings, which is coetaneous with or was formed and stabilized after the ship sank during a period of time that cannot be precisely determined, but which *a priori*, could be considered to be a

few decades during which the general geo-archaeological components settled and organized according to the underwater dynamics typical of this type of intermittent high energy zone. It is in this stratum that the majority of the archaeological remains are found, particularly those that are denser and heavier. The second stratum is a mobile stratum of finer and more regular particle size, typical of coastal areas all around the world: sand. It was in this stratum, mainly at its base where it is in contact with the stratum below, that most of the coins transported by the Oranjemund ship were found. In most cases, but not always, this is the result of abrasion caused by the periodic cycles of deposit and erosion typical of coastal areas.

Excavation around the extensive slab of orange concretion extending from north to south over the western portion of the St3 zone gradually revealed that, curiously, most of it was

lying on a stratum of mobile sand – the inarguable proof of which was the discovery of a piece of a modern tire found deep inside the face of the wall of sand excavated at the vertical east edge of this slab. Next the area below it was carefully excavated, which created an open tunnel from one side to the other, confirming that a large part of the slab was “floating”, since it was supported by more solid structural remains at only a few points. It was then decided that, once it was securely bound, the slab would be removed in a single block with a crane for later laboratory excavation. This operation was successful.

Finally, without prejudice to the content of the preceding Note 23, a special mention must be made of the copper ingots and the wrought iron and bronze cannons discovered at

the terminal site of the Oranjemund shipwreck – two of the three types of artifacts that can objectively be considered significant archaeological "fossils" of the Oranjemond shipwreck – the third naturally being the set of gold "*Portugueses*" and "*Excelentes*". As for the copper ingots, it should be mentioned that the author saw and photographed the flat side of one of them during his first visit to the warehouse where the recovered artifacts were stored. The ingot was engraved with a trident inside a circular seal, which was later identified by Paulo Monteiro as belonging to the famous Fugger family, whose commercial relations with the Portuguese crown are amply known.

Above: copper ingot with the trident seal. Below: The ingot on the left is one of the few that shows an odd casting drip, those on the right give an idea of the immense amount found.

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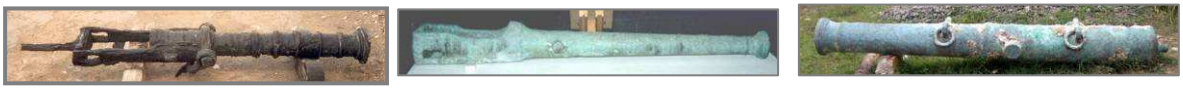
As for the swivel guns discovered, we can only say preliminarily that, except for the one from the eighth section, they belong to the three types of swivel guns found at all sites of Portuguese shipwrecks dating from the 16th century, be they merchant ships or warships or mixed vessels.

Swivel guns found among the wreckage of the Oranjemund ship



From left to right: wrought-iron breech loader ("pedreiro"); long bronze "falcon" swivel gun, known as a "berço" if it is smaller in size and caliber, both breech-loading; and bronze muzzle-loader with suspension rings ("camelete").

The participation of the Portuguese team

Although the Portuguese team was involved in all phases and areas of the intervention and excavation at the site, during the second, true phase of rescuing the wreckage of the Oranjemund ship, the Portuguese team's primary objective was to carry out the excavation, dismantling, recovery and protection of the two sets of the ship's hull that were still structurally connected – using their specific expertise in the field of ship archaeology. Therefore, when it came time to begin the intervention on these structures, the first step taken by the author was to name them "St1" and "St2" (from north to south, "St" representing "structure"); and in keeping with this nomenclature, he went on to designate the area of remains immediately south of St2 "St3". This last area contained numerous imposing dismantled remains of the ship's hull that had no apparent structural connection.

The first precautionary step taken in the field when the various archaeological areas began to be uncovered was to systematically protect the remains made of organic material by wrapping them in plastic cling film, which was procured right away order to in prevent dehydration of the pieces as much as possible.

These remains were immediately wetted down after they were exposed and then periodically, with special attention being given to the three principal nuclei of the timber remains (the *epicenter* of the site): The pieces were covered with black plastic sleeves whenever they were not being worked on and were always covered up at the end of each day. Likewise, right from the start of the work, the author drew the team's attention to the need to immerse the chunks of timber in fresh water once they were recovered[25]. The machine shop at Namdeb was asked to made iron chisels of various sizes and thicknesses – which were the most suitable tools for this type of excavation which implied preliminary removal of the extremely hard layer of sandy concretion covering most of the archaeological structures in question.

[25] Something which only began to be done during the last few days of the intervention

The Portuguese team's excavation of the structural parts of the hull of the Oranjemund ship still structurally connected finally began on September 24 with the St1 structure being the first. This structure was composed of four pieces of the frame of the ship made of a very well preserved hardwood (oak or cork oak?), lying in an east-west orientation tightly fitted and fused to one another by thin layers of petrified concretion. The exposed parts stuck out from the west side under the sandy concretion layer and terminated irregularly in ends that were very corroded by *Teredo navalis*. The hull elements, of the usual rectangular section, had alternating widths measuring between approximately 16 and 23 cm by 18 cm high (thickness) near the extremity of the side initially exposed (W). These elements were sitting atop a wooden plank (the inner or outer planking of the hull), manifestly more fragile (possibly pine?), in very poor condition, nearly falling apart, 9cm thick and irregularly preserved transversally along approximately 1.55m, in five strips with widths ranging between 16.5 and 25.5 cm.

At the extremities between planks and in the surrounding area contiguous to the planking [lead caulking cords (made of rolled strips of lead) were visible, as well as strips of the same metal with small holes along their edges corresponding to the small nails used to mount them, already well known to us[26], which form the respective butt-stop caulking and plug joints between the planks the line the hull, both typical measures used to seal and protect the hulls of Portuguese ships below the waterline against shipworms.

The excavation method used was simple and classic. We began by marking off a 0.5 meter wide strip with two stretched strings running in the same direction of and centered over the four elements of the frame that were protruding from the west side of the structure and then began to chisel down this strip.

[26] Exactly identical to those found in the wreck of the presumed *Nossa Senhora dos Mártires* (Alves *et al.*, 1998: 208-209).

The following day, a thin plank, 1.7cm thick started to become visible, lying at right angles to the framing timbers, firmly in place and clearly standing out due to its much lighter color and its soft touch (could it be the white pine referred to so often in the documentation in Appendix B of the work of Francisco Contente Domingues? [27]).Subsequently several strips of this planking became visible. The planks were asymmetrically toothed for overlay - like the tongue and groove planks still used today in flooring. We were clearly looking at the inner lining of the ship's hull, although we initially thought it too thin to be floor planking. We therefore came to the realization that it was probably from side of the ship – certainly below the waterline (because of the lead caulking cord), but certainly also above the bilge – a height that would not justify the use of thicker planking like that needed for a bilge.

After recording this level in photomosaic, the level was dismantled in order to continue removing the sediment, incrustation and concretions that prevented exposure of the upper surface of this set of framing timbers. After this cleaning, the St1FS1[28] timber was easily freed and it was noted that the second timber (St1FS2) was broken in two. At that point the two pieces to the east were labeled St1FS2.1 and St1FS2.2. The last of these also came free easily. We also noticed that there was a 5th framing timber, much smaller and more retracted, situated at the extreme north end of the set. This timber which was promptly labeled St1FS5, also came free easily.

[27] See Domingues, 2004 (Apêndice B: Orçamentos e Regimentos Especiais de Arquitectura e Construção Naval.

[28] The following nomenclature was used: St1=Structure 1 (the 1st to receive intervention, although it was the furthest to the north); F=frame; S1=South 1 (the 1st counting from south to north).

Dismantling the underlying outer hull planking looked like it was going to be much more problematic, not only due to its poor state of conservation, but also due to the possibility of its being concretioned to the rocky substrate, as the last plank to the east and leaning on it appeared to be. In the meantime, we were able to ascertain that the ship planking was 9cm thick[29], as had already been noted in St3, in the largest of all the planks at the site, unfortunately loose. To clear up any doubt about this last question, the author decided to try to find out what condition the planking of the outer hull was in and what kind of ground it was

lying on with the help of a solid fisherman's knife. It was discovered that the planks were lying on top of a kind of gravel, which led us to believe that they were not concretioned to the rocky outcropping along the rest of their length. Heartened by this possibility, we began the task of dismantling the three last framing timbers (or rather two and a half: St1FS2.1, St1FS3 and St1FS4), which were completely

[29] For comparison's sake, the hull of the presumed *Nossa Senhora dos Mártires*, a ship sunk in 1606 on the bar of the Tagus River at the entrance to Lisbon on its return voyage from India, had hull planking that measured 11cm thick – half of a "*palma craveiro*" of the time (Alves, *et al.*, 1998).

fused together by concretion, using a hammer and one of the larger chisels placed on the vertical, resting on the planking and butting up to the exposed face of St1FS2.1. The entire structure shook with each strike, but the timber did not suffer any pitching, which is what we expected from previous experience. The operation was repeated several times, alternating between the side and top. On third series of chisel strikes, the concretion joint that fused this timber to the next one began to crack, and a short time later the timber was carefully loosened. The same happened with the timbers that followed. It was as simple as that. *Thank you, Peter Waddel!*[30].

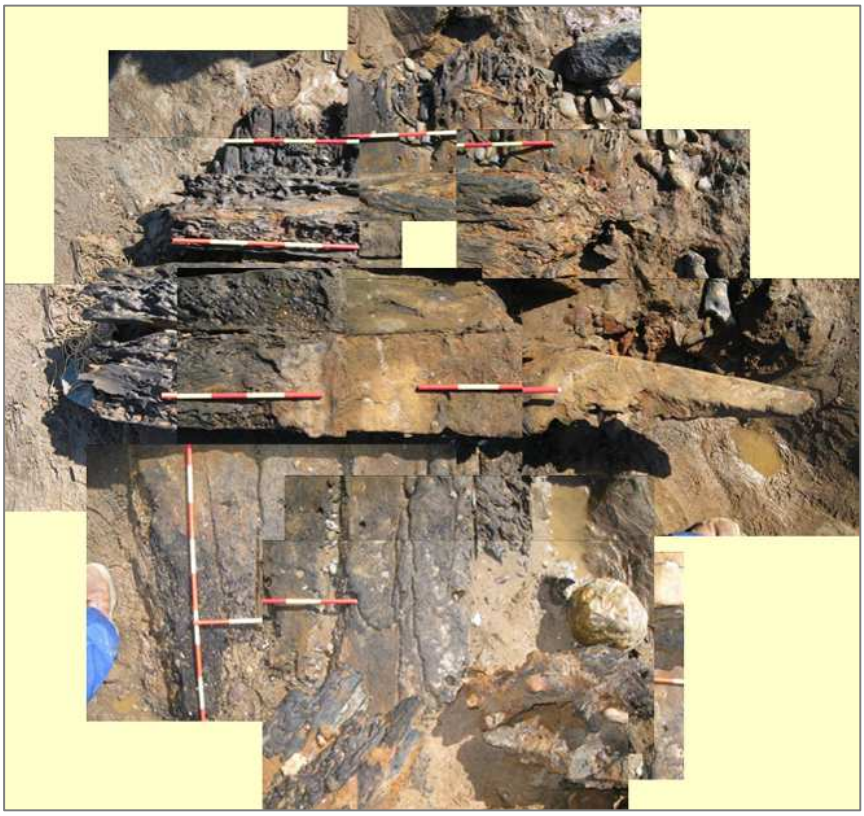


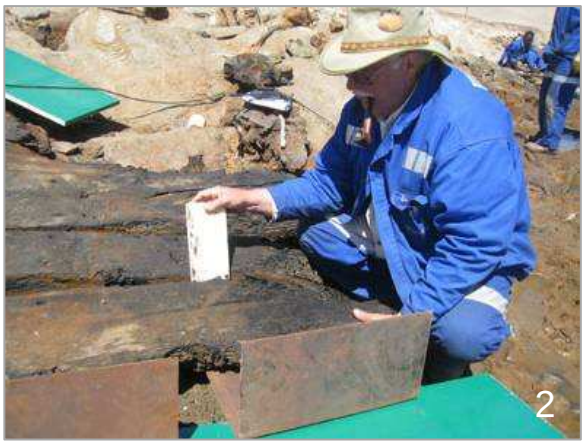
Photo mosaic of St1 after removal of the first framing timbers.
Layout by Miguel Aleluia.

[30] An archaeologist from the Parks Canada Department of Archaeology, one of the best experts in the world at dismantling old wooden ships, who at the invitation of IPA-CNANS flew to Angra do Heroísmo to teach and train us in the techniques of his field of expertise, i.e. the complete dismantling, at our expense and with our assistance, of the ships Angra C and D, dating from the 16th/17th century, the latter having approximately 35m of preserved structures lengthwise and crosswise from the bottom of the hull to the starboard second futtocks (Monteiro, 1999). Later the author would supervise in successive order the dismantling of the *Nossa Senhora dos Mártires* (1998), Ria de Aveiro A (1999), and Arade 1 (2004) shipwrecks. In the last two cases these operations were conducted jointly with and continued, respectively, by Filipe Castro, and by Eric Rieth, Paulo Rodrigues, João Alves and Vanessa Loureiro.

Once all the framing timbers had been removed, the strings of planking that remained were visible, along with their characteristic structural details – including the marks made by the framing timbers and the nail holes used to attach those outer planks to those of the ship frames.

The next phase consisted of carefully cleaning the exposed surface of this planking to prepare for a new series of mosaic photography and for the contact drawing which is drawn on plastic with an indelible ink pen.

Dismantling the outer hull planking was more laborious, because it involved more painstaking work. For this job, was asked Johan Weber, Namdeb foreman and our contact person at the company, to provided us was several 2mm-thick iron plates measuring 0.8 x 0.4 meters bent at right angles in the middle on the longer axis. In the first test run, one side of one of these plates was inserted horizontally in the open crack at the face below the first plank. We were able to fully insert the plate until its vertical side butting up against the edge of the plank.



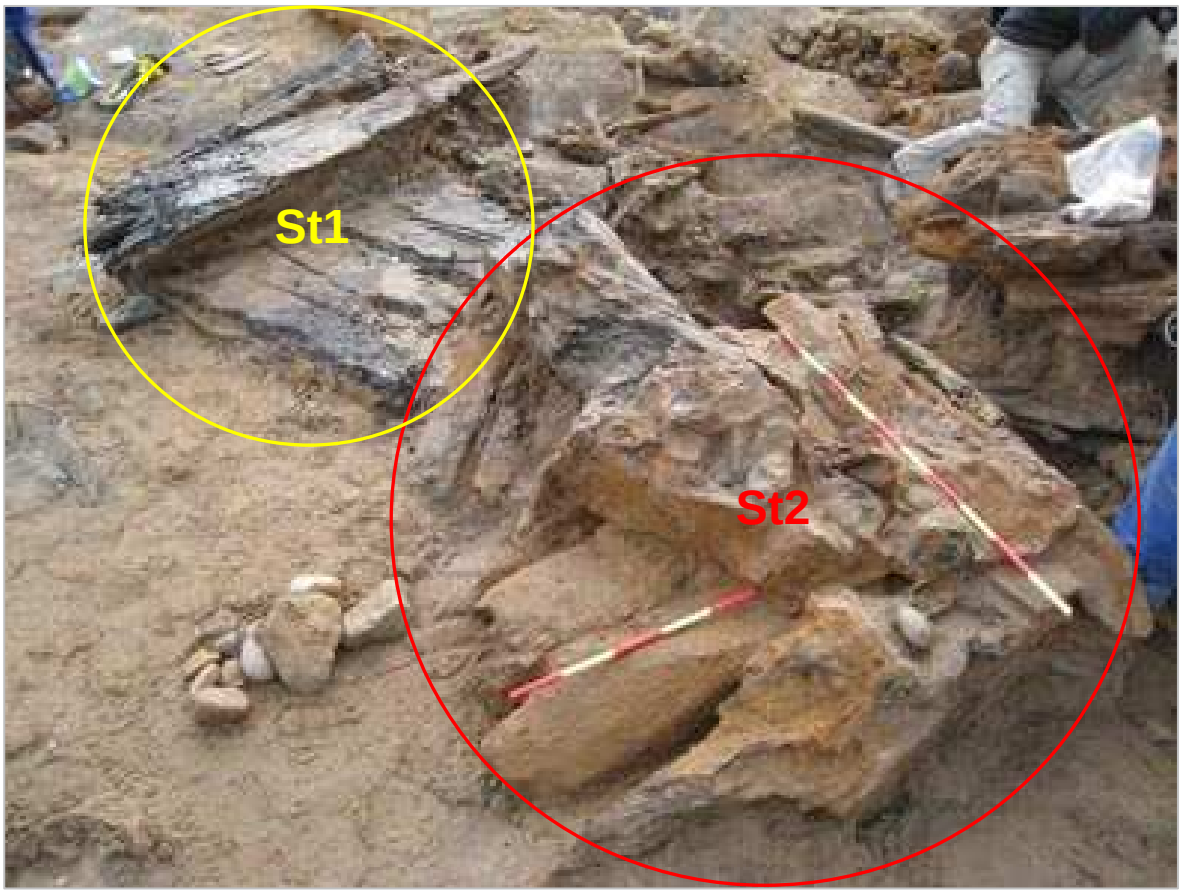
Final sequence of the dismantling of St1

Then, without any difficulty, we inserted other plates along the plank so that it would not fracture when it was moved. The force of this operation was therefore distributed among all the plates, which needed to be lifted simultaneously. One by one, all the hull planks were removed perfectly and immediately placed on wooden trolleys and wrapped in plastic film after labeling.

Finally, as with all the other pieces of timber, they were carried to the preventive conservation pool that had been set up by Namdeb a few kilometers from the site where they were immersed in fresh water, after which the respective distribution map was drawn up.

One would expect that the same *modus operandi* used on structure St1 would be repeated on St2. However, the characteristics of the latter required a different, more complicated initial procedure at the start, but a much easier one at the end. The lower part of the structure was composed of a set of four framing timbers whose structural connections were identical to those of St1, although the visible extremities were pointing northwest (those of St1 were pointing west) and they were not lying on top of hull planking, but on mobile sediment. This made the last part of the removal process easier. However, instead of being covered in sandy concretion like the first, this structure had an oblong and misshapen block of concretion 2 meters long lying on top of it.

The concretion was of a solid stony texture, completely fused to the structure, and appeared to involve the entire enigmatic piece of timber.



Cleaning this block proved to be time-consuming, painstaking work since the size and hardness of the concretion required very intensive, precise work with a hammer and chisel because little by little a piece of timber emerged whose surfaces and carving attested to carpentry work of a very high quality and complexity. Fortunately, the ideal percussion plane for separating the two adjacent faces (between the timber and the concretion) was exactly at the line of contact of their respective planes, and the intermittent vibration caused by the indirect strikes on the perpendicular of these planes helped to gradually loosen the concretions, just like we mentioned above with respect to the dismantling of St1. Therefore, the remainder of the concretion was removed with extreme care and precision, as though carving a sculpture. After removing most of the concretion, the perfect surface of a tooth-ended flat scarf became visible at the west extremity of the structure.

Finally, after removing the timber, its outline was marked in chalk on the upper face of the first frame timber on which it had lain, to the west.

Meanwhile, excavation of the furthermost part (to the south) of the dorsum of St2, revealed the existence of another rather interesting detail, which consisted a succession of several inner hull planks that were lying parallel up against the aforementioned misshapen block of concretion. These were lying at right angles on top of the frame, just as we saw in St1. Curiously, unlike what we saw in St1, the first plank contiguous to this block was leaning against it on the vertical, as though it might have been dragged to that position. The entire set of elements was then recorded in detail by photography and in drawings.

After removing and doing the preliminary cleaning of the large timber that had been lying across the St2 frame, we immediately saw that its cross-section was an irregular quadrilateral shape and that its best preserved side, had a slight convex, longitudinal curve to it, which clearly corresponded to the surface of the outer end that rested on the inner faces of the corresponding frame. This curvature corresponds to the shape of the ship hull itself, clearly indicating that this is a longitudinal piece of its internal structure, and three further reasons corroborate this evidence: the fact that, although it has been dislocated, it

originally rested on the inner face of intentionally tooth-scarved framing timbers; it was juxtaposed with an inner hull plank; and most of all because a series of three female dove-tailed scarfs was found on narrowest of its four sides – the middle of which, the only that is completely preserved, was carved in the form of a dove tail (*queue d'aronde*) – which was a typical process used in naval carpentry of the Iberian-Atlantic tradition (Portuguese and Spanish).

This detail adds further evidence that this is the topside of the original timber, which for its part, provides information regarding the angle of its original position given that the plane of the groove would obviously lie horizontally. The opposite face, lower, flat, wider and having no distinctive signs, was markedly oblique and leaning downward from the inside to the outside of the timber. The face originally turned towards the inside of the ship was the worst preserved of the four as it was very corroded by *Teredo*, precisely because it was resting on top of framing timber and facing upward, which had also encouraged the formation of the enormous amount of concretion covering it. Nevertheless, the west extremity (*in situ*) of the timber was in and excellent state of conservation, and presenting from this side (facing upward *in situ*), was along flat scarf, vertical, that terminated on the inside with an oblique ridged flat tooth. This particular detail corroborated the belief that this was a longitudinal composite /segmented) timber from the ship hull structure, a very important find, especially given the size of its cross-section. This was clearly a segment of an *escoa* (stringer), a timber that,

longitudinally and symmetrically, port side to starboard, internally strengthens the frame. However, the presence of the dove-tails on the upper face, as well as the presence of framing with a "tooth" to support it, suggests that it is not just any old stringer, but rather a deck stringer, a stringer that supports the deck beams – the cross-beams on which the floor planking of a deck is laid[31] - in this case, presumably the 1st deck, the one that covers the bilge, based on the obvious relationship between the structural parts and the abundant remains of the ship's cargo in this terminal area of the shipwreck.

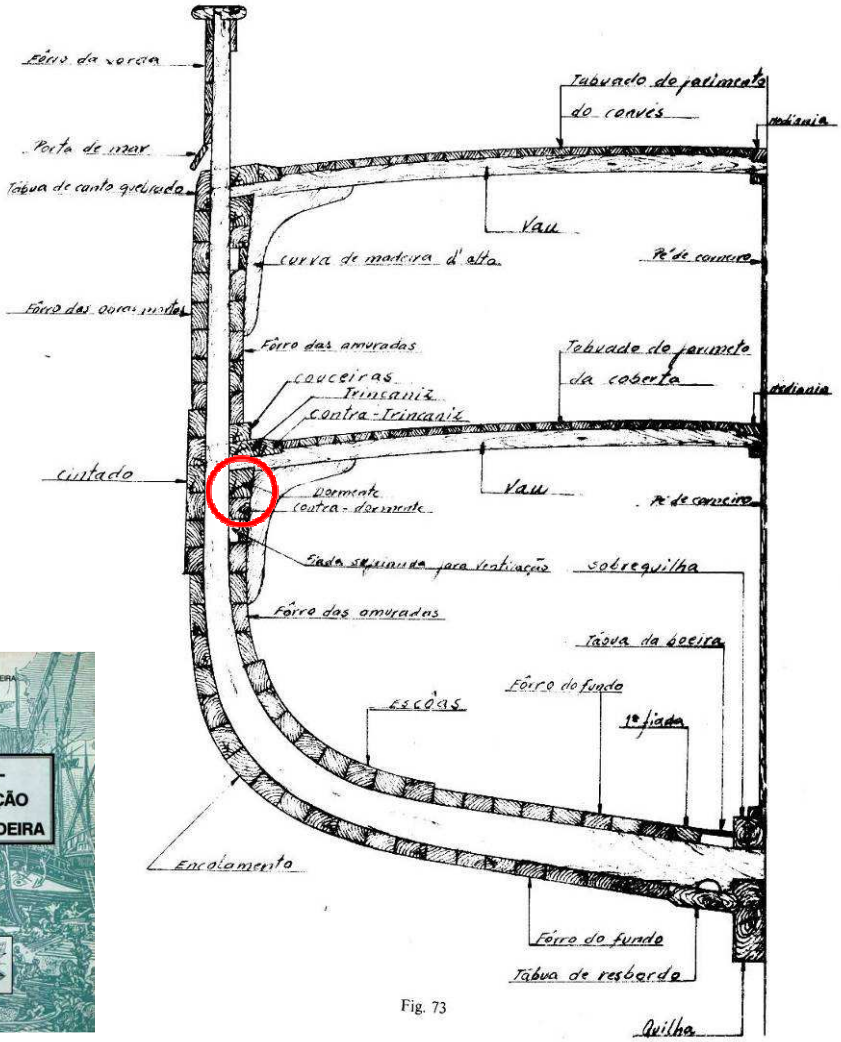
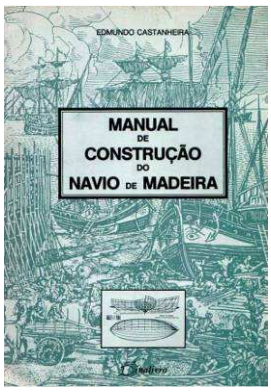


Fig. 73

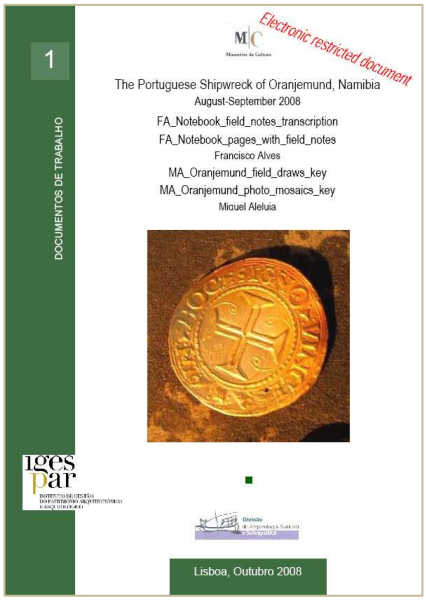


[31] In order to observe the chronological sequence of facts, observations and interpretive itinerary simultaneously, questions raised by these structural details and the conclusions they led to will not be addressed in in detail here; they will be dealt with later on in the section on the archaeographic recording mission carried out by the Portuguese team in 2009 in Oranjemund. They have, however, already been publically presented by the author: at the Library of the *Palácio Nacional da Ajuda* before the Secretaries of State of Culture and Foreign Affairs on October 17, 2008, the week the team returned from Oranjemund, and at the Portuguese Naval Academy on April 7, 2008, two weeks before departing on a new mission to Oranjemund.

Removal of the four framing timbers of structure St2 was even more difficult than in St1, since they were lying directly on top of mobile sediment and the outer planking had already disappeared. Finally, the St2 timbers, just like the St1 timbers and the other timbers recovered, were labeled and wrapped in plastic film, transported to the freshwater tank mentioned above, where they remained for preliminary conservation.

The objective of the Portuguese mission was thus achieved in its entirety, with the help of the extension of the archaeological rescue work until October 10th and to willingness on the part of the Portuguese authorities to grant the Namibian authorities' request to extend our stay until that date.

After the rescue of the Oranjemund shipwreck



After returning from Namibia, one of the most important priorities of the Portuguese team was to write up a report of the mission[32], which included all the field note data and expressed the opinion that there was an urgent need to move on to the next step of making an archaeographic record of all the timbers in mosaic photography and detailed full-scale (1:1) drawings, with the St1 and St2 structures being given top priority since they were the only elements that were still structurally connected. Thus, aware of the scientific importance, but also of the fragility of these fragments of timber and the lack of specialized human material resources in Namibia, both in the field of conservation and in archaeography of this specific type of archaeological remains, the author realized the need to conduct a new mission in Oranjemund, with the priority task and, if necessary, exclusive of executing a complete archaeography of the timbers of the St1 and St2 structures, sue to their exceptional rarity, which would make it possible to initiate and train local personnel in the corresponding recording techniques.

Three circumstances would emerge in favor of this proposition. The first resulted from a second meeting of the stakeholders organized by the Namibian government and held on February 10, 2009. Portugal was represented at the diplomatic level by Domingos Alvim since, according to the author's information, MC-IGESPAR felt their presence was unnecessary since communication of its position would be amply ensured by Mr. Alvim. The position consisted of acknowledgement of the need to urgently undertake the archaeographic recording of the ship hull remains that had been excavated, dismantled and stored immersed for preliminary preservation. It was therefore proposed to once again offer the services of the same mission team as before, a proposal that was heartily

[32] Alves, F.& Aleluia, M., 2008.

welcomed by the Namibian authorities[33]. The second resulted from the participation of an IGESPAR delegation that included João Pedro Cunha Ribeiro, sub-director for the area of archaeology, and of the author, who was a member of the Portuguese delegation, in the 1st Conference of the States Parties to the UNESCO Convention on the Protection of Underwater Cultural Heritage, which was held in Paris on March 26-27, 2009. The third came out of an invitation the author received to participate in a conference on the UNESCO Convention, which was scheduled to take place in in Cape Town on 20-21 April of that year.

While the author was afforded a glimpse of what could ideally be done on a new mission to Namibia as a logical corollary to the Cape Town event, the Paris Conference made this mission feasible on the part of the Namibian authorities thanks to a meeting that took place on the second day between the Portuguese delegation and the Namibian delegation, which was participating in the conference as an observer. At this informal encounter, we presented a proposal to carry out a new mission immediately after the Cape Town event[34], as well as the how the mission would be conducted, with Portugal assuming responsibility for the cost of the mission and Namibia for the logistics, given the infrastructures needed for the archaeographic recording. This proposal was once again well received and was eventually fully approved from the Namibian authorities. On the Portuguese side, once again the excellent cooperation between the Ministry of Culture and the Ministry of Foreign Affairs, through IGESPAR, came into play, and this time they were joined by the Instituto Camões, with the cost of the mission being split between the two.

The third Portuguese mission in Namibia: Archaeography of the remains of the Oranjemund ship hull still structurally connected

The Portuguese team was again composed of the author and Miguel Aleluia, and the Namibian team included Ashton Sinamai and Fouzy Kambombo, already mentioned above, and by students Alina Shikongo, Joram Shiinda and Lazarus Shiimi. As supporters of the mission, special mention must be made of Dirk Hoebel, a technician in the Namdeb Department of Topo-Cartography, Dieter Noli, the archaeologist responsible for the initial phase of the rescue, Johan Weber, Namdeb foreman, Mike Alexander, local resident, Paul Brandt, an enthusiast of Portuguese shipwrecks in South Africa with whom the author had become friends during his visit to CNANS several years earlier, and Thomas Parkhill, manager of the residential lodging and work spaces in Oranjemund, all of whom were enthusiastic about the archaeological rescue of the ship, and in their various capacities provided valuable support to the mission.

[33] Alvim, D., 2009.

[34] The meeting about the UNESCO Convention held in April 20-21th.

Introduction

In light of the scheduled length of the mission – approximately a month and a half – the primary objective of the mission consisted of recording, in mosaic photography and full-scale drawings (1:1) of the four sides of the two sets of framing from the ship designated as St1 and St2, situated just north of set St3. This objective naturally included the initiation and training of the Namibian member of the team in these recording techniques, as well as familiarizing them with the various aspects of scientific management of a nautical archaeology project of this specific nature.

Meanwhile, the author, despite having submitted detailed schematics for the construction of the equipment to be used for the archaeographic recording (the wheeled platform and respective light metal rails and the two tables, one with an acrylic top, for the full-scale drawings) to the Namibian delegation in Paris at the end of March and to Dr. W. Ndoro, general director of the Oranjemund ship project, was informed by the latter that it would be preferable to have this equipment built under his direct supervision, particularly since the technical support team would be arriving in Oranjemund more or less at the time as our team. We therefore agreed with this suggestion.

It should be mentioned that, with regard to the technical equipment, the author's main concern during the first quarter of 2009 was to ensure that the mission was supplied with transparent film of the Mylar or Melinex type, which was absolutely essential for executing the drawings in question. Even in Portugal, this product can only be obtained by direct import. The author therefore expected that in the days following the UNESCO conference in Cape Town (April 20-21) he would have to seek out and acquire a spool of this material, whatever it cost. As luck would have it we were able to achieve this objective thanks to the efforts of Paul Brandt, mentioned above, another participant in the conference, who managed to acquire the material from Johannesburg. It arrived in Oranjemund a week after our arrival.

The author was thus able to bump up his departure to Oranjemund to the day following the conference, which made it possible to make preparations for our stay and organize all the logistics of the mission's workshop-atelier site, including construction of the abovementioned equipment. This objective was achieved over the next two weeks largely thanks to three people who has been pivotal in our friendly relations since the previous mission in Oranjemund: government archaeologist Ashton Sinamai, the owner of *Tom's Cabin* motel (where we again stayed), Thomas Parkhill, and Namdeb foreman, Johan Weber, our liaison with the company and coordinator of construction of the equipment.

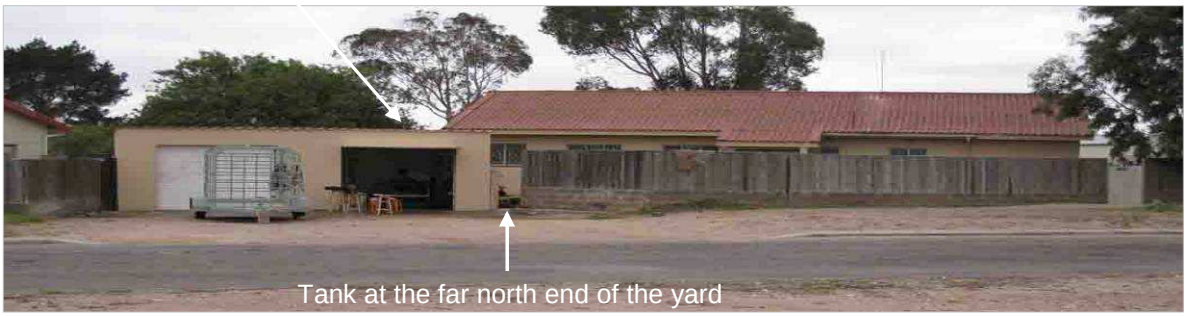
Meanwhile, a week after the author's departure from Lisbon, Miguel Aleluia arrived in Oranjemund on April 27 as expected. The Namibian team had also already arrived. The initiation and training of this team in all stages of the archaeographic work was done as a *working process*, under the guidance and direct supervision of the author and Miguel Aleluia, with particular emphasis on the cleaning and preliminary preparation of each timber and the respective drawing.

The mosaic photography was executed exclusively by Miguel Aleluia, except for taking detail measurements between points by marked by white tacks place at the edges of the upper faces of each timber to be photographed. These measurements were all rechecked by the two of us.

Logistics of the installation and moving the timbers

Although complex, namely due to the important prior agreement between representatives of the government and Namdeb and the need to coordinate all the parties in the various phases of the process, all aspects of the overall logistics of the mission worked perfectly. In first place, because our staying in the same motel where we had stayed during the previous mission was ideal, since with the blessing of the Namibian authorities we were able to set up the workshop-atelier in one of the garages of the home adjacent to the motel, which had a large yard that proved to be ideal for carrying out the preliminary stages of maintenance and advance preparation of all the timbers to be archaeographically recorded. Secondly, because of the agreement made between these authorities and Namdeb regarding the complex operation of moving the hull timbers that were immersed in a water tank located a dozen kilometers away from Oranjemund, inside the high security zone, which meant that a strict protocol had to be established the pieces to be removed and returned in batches, which we ended up being able to accomplish with only three runs.

Setting up the workshop-atelier



The work of transforming the garage into the workshop-atelier began with the installation of an alarm system against intruders and a "campaign" tank, which was set up against the wall on the garden side of the garage to hold the timbers to be archaeographically recorded.

This improvised tank was simply constructed of brick and cement and the inside was lined with sheets of Styrofoam and the edges were protected with corrugated cardboard to prevent tears in the black plastic inner lining and covering, but it was specifically designed for the job it was to do and it served its purpose very well, which was to protect the wooden timbers by keeping them wet while awaiting preliminary cleaning and archaeographic recording. The garage's electrical system was then reinforced and the mosaic photography equipment was set up. This equipment, which had already

been built, consisted of a double light rail system for sliding the six-wheeled platform where the timbers were placed for the mosaic photography process.

Since the system required that the photographs be taken on the vertical at 30 cm intervals, a measuring stick was placed along the outside rim of the platform, and the fixed positions of the professional tripod were marked on the floor. The drawing tables were finished about the same time; we needed only to trim 10 cm off the legs of the lower table (that would hold the timbers and the acrylic-topped table) and polish the acrylic boards that had meantime arrived from Winhoek. Also ready were three other essential accessories for the proper functioning of a workshop of this kind: wooden slabs of three different thicknesses used for calibrating the height and horizontal orientation of the timbers to be drawn and photographed; an axle made of a metal tube and rollers held up by two tripods to enable easy dispensing of the heavy 50 m roll of *Melinex* sheeting (175mic, the only thickness available[35]); and PVC tubes cut to a little longer than the width of the *Melinex* sheeting for storing the completed drawings.

As soon as all the infrastructures of the workshop-atelier were ready, the first timber transfer operation was made to move timbers from the tank in the high security zone where they had been stored since October 2008. The author remembers saying at the time: "*Everything worked with the precision of a Swiss watch*". The mission could now begin in earnest. It was none too soon, and the fact demonstrated how right we were to be concerned about the conservation of this type of timber, especially with respect to the need to ensure immediate preservation by continuous immersion in order to completely preserve their formal functional and structural details. If our second objective was now within reach, even though it was more than a year since their discovery and six months after their recovery and preliminary watery preservation, the facts showed that the author's persistence in warning of the urgent need to undertake the detailed archaeographic recording. Because you never know what might happen. And more. As Murphy's Law states, "if anything can go wrong, it will". And so it almost did. Happily, it was just a close call: when the team finally went to get the first batch of timbers, the level of water in the tank they were in had dropped more than half a meter, enough for all the timbers to be hallway out of the water! The tank was promptly topped up and, fortunately, the Portuguese wood was sturdy stuff even after more than five centuries. Although the exposed surfaces showed some dryness, no irreversible damage had been done.

[35] The ideal thickness is 125 mic.

The archaeographic record

The daily and constant preoccupation of the mission was to avoid any drying out of the frame timbers during the archaeographic recording process, whether or not they were immersed in the tank we had built. Whenever the timbers were out of the tank they were

always kept wrapped in wet blankets and completed enclosed in black plastic sleeves cinched with air chamber ties, until the transport phases and the unavoidable exposure for the photography and drawing, during which they were regularly wetted down and sprayed (using regular commercial sprayers).

The archaeographic recording by full-scale drawing and mosaic photography was naturally preceded by a thorough cleaning of each timber. This began by carefully eliminating most of the concretions and dirt that covered the timbers and finished with a "surgical" cleaning – with all stages of the process being done under our close supervision, which was only relaxed a bit once we felt that each member of the team had acquired the confidence and practical skills to perform the tasks properly. Each timber was taken from the garden and placed on a metal table (the "autopsy table") resting on its blanket-wrapper, which was kept wet at all times.

The timber was then thoroughly cleaned with running water and soft-bristled paint

brushes. Then, under the supervision of Miguel Aleluia and/or the author, the concretions were slowly and carefully removed with the aid of appropriate tools, a process which could take several hours to complete. During this stage, small fragments of wood were periodically recovered as samples; sometimes small objects or remains, primarily fruit stones, which frequently popped out during the cleaning. Next, after careful examination of the tiniest details of all the faces of each timber, all nail holes, both open and closed, were marked, and an assessment was made of whether the concretion was too hard or difficult to remove – this being the absolute starting point for the operation to fully preserve the timber and the traces of the original work. Then small grill spits or chopsticks were inserted in the nail holes, depending on what section the holes were in; whenever we were unable to remove all the concretion from the holes and the chopsticks would not stay in place, we secured them with modeling clay.

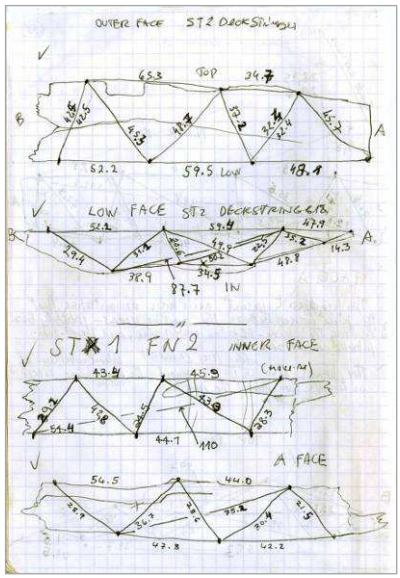
After that, the pieces were labeled and photographed peripherally in sections corresponding to eighths of a circle (the four basic shots being those of the sides and tops, and the remainder being perspective shots).

Mosaic photography

The mosaic photography and full-scale drawing operations were carried out at the same time, with the different timbers moving successively from one modality to the other, requiring careful labeling of the timber and the face in question. The mosaic photography requires adequate illumination and a camera mounted in a fixed position exactly vertical to the axis of the mobile platform on which the timber is placed on each of its sides in succession. In order to control the photographic sequence (photos are taken at 30 cm intervals) a measuring stick was mounted along the front edge of the platform.

The zero mark coincided with the medial axis of the first photo corresponding to the extremity of each timber to be photographed, which after laying out each photographic sequence, by superimposition, an image with a smaller parallax axis is obtained. Naturally, the platform with the timber laid out sideways slid from right to left. Before executing the mosaic photography, white-headed tacks were stuck in the cracks on the upper faces of each timber piece, in a side-to-side zigzag pattern and at an oblique angle so that they would be visible when the lateral faces were recorded.

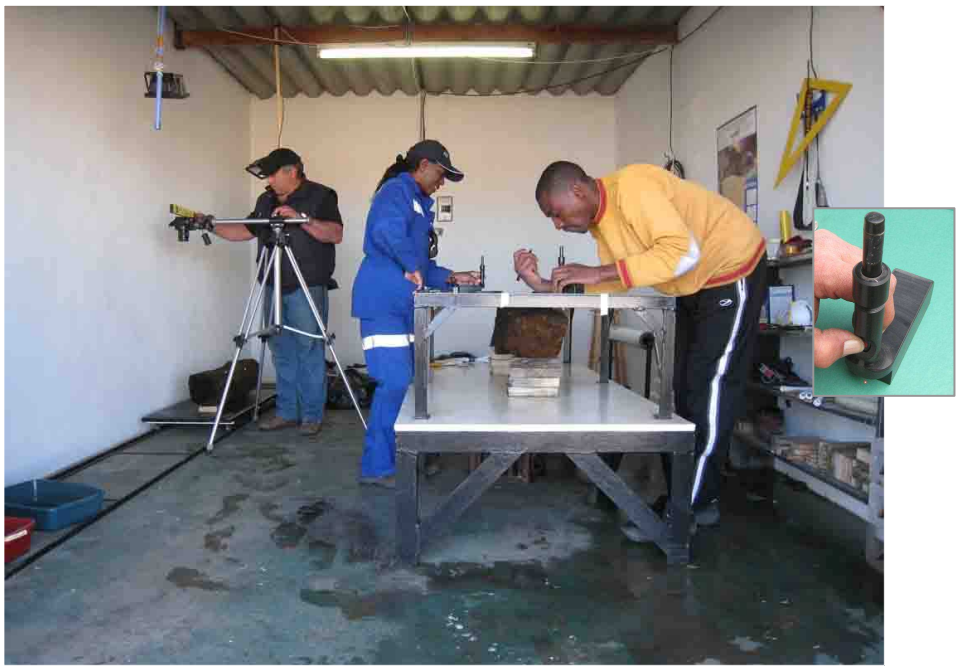
The reason for placing them thus was because to the need to accurately measure linear distances (with a cross-validation accuracy of 1mm or less) between the tack heads in order to later obtain a three-dimensional reconstitution of each timber using a suitable software tool – in this case the well-known program *Site Recorder*[36].



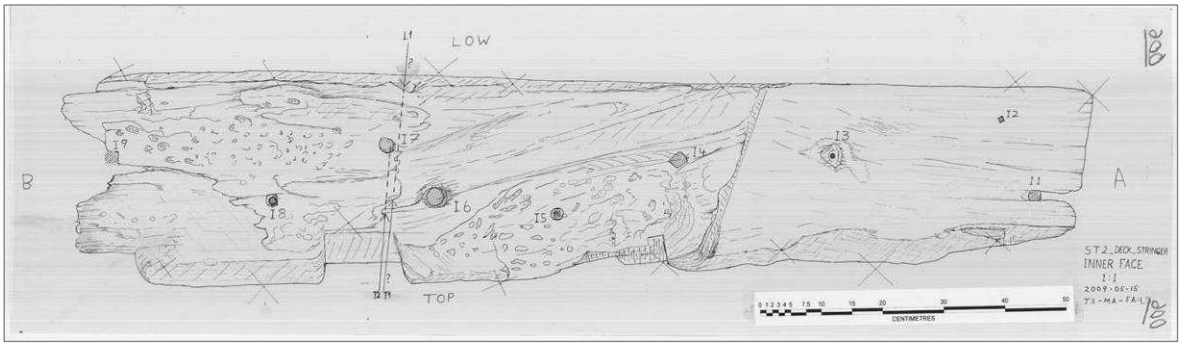
[36] Text from Monteiro, P. in Alves, F., Monteiro, P. and Pinheiro, S., 2008.

Full-scale (1:1) drawings

The full-scale drawing was done according to a technique that has been used by CNANS since the 1990s, which was inspired in the model used at Roskilde, Denmark, by the team investigating the Viking ships there. This technique involves using a special "mouse" consisting of a flat base with a tube at one end that is exactly vertical to the base where a laser pointer pen is inserted[37]. The mouse sits directly on top of the transparent drawing sheet, which is mounted onto a transparent acrylic board that serves as the top of a drawing table. The timber to be drawn is placed under this board as close to the drawing surface as possible.

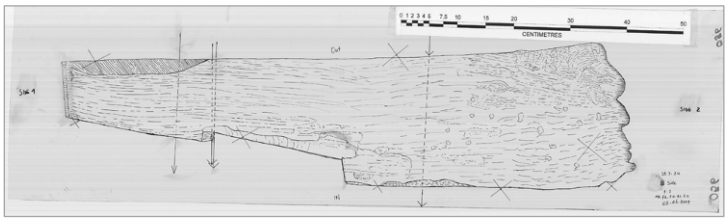


The drawing is then executed by marking the contour and the details of the timber point-to-point on the *Melinex* sheet with a fine or superfine indelible ink pen, since the contact point of the laser ray on the timber itself is simultaneously visible on the drawing sheet mounted on the acrylic table top. In the lower right-hand corner the drawing is labeled, from top to bottom on separate lines, with the name of the timber, the name of the face, the scale (1:1), the date of final execution and the name of the operators and the advisors/certifiers (the author and Miguel Aleluia). The respective side or face of the timber is indicated on each of the four sides of every drawing (in the middle and near the edge) perpendicular to the drawing plane.



[37] See macro photos *supra*.

On the vertical timbers, the reading face was the inside face (in its functional position, looking from inside to the outside of the ship). According to convention, we labeled the left side “A” and the rights side “B”. On these drawings, the nail hole entry points were marked on the lateral faces of the timber with the respective direction indicated by an arrow (a solid line on the outside and continuing with a dotted line on the inside to the full depth of the hole, the Portuguese so-called “mid-wood” penetration), with maximum penetration always being marked with a very visible perpendicular line (about 1 cm long). Each of these arrows was labeled next to its entry point with its respective serial number on the respective face. The numbering followed a linear sequence from bottom to top and left to right on the deck stringer of this last timber – the only longitudinal timber among the St1 and St2 structures.



The drawings of all the timbers from the St1 and St2 structures and of the small pieces from St3 (parts of “curves” or “curvatures”?) selected for the final stretch of the mission due to their important structural significance, but also because of their small size, were, were then scanned in Namdeb’s department of cartography and topography, to which we are grateful for this important assistance[38].This allowed us to keep the respective digital copies that would be essential for continuing our research, since we always left all the original drawings in Oranjemund[39] along with a copy of all the photographic documentation done[40]. We also left two tools there that would be indispensible for continuing the archaeographic work: a laser mouse and a profile bender.

[38] Many thanks to Anthony Goosen, head of the department of topo-cartography at Namdeb, and to Dirk Hoebel, a technician in that department, who were kind enough to do the scanning.

[39] In the care of A. Sinamai

[40] As we had done at the end of the September-October 2008 mission.

In all, 61 drawings were made of 13 timbers, six of which were from St1 (originally made up of five timbers, one of which was broken in two pieces which were recorded separately), five from St2 and two from St3 – as can be seen in the corresponding Excel list[41].

Relationship between observation and interpretation and the respective document record

Interpretation of archaeological remains, as in any document of this nature, begins in the field and continues in the office in an on-going interaction between previously acquired knowledge and evidence gained by observation until all remaining questions have been answered, which of course must be postulated as an infinite period of time. In this process, all the details of this evidence, without exception, are important and complementary. They must be analyzed both individually, tentatively, according to different levels of significance, hierarchical or not, and as a whole. The material premise of this itinerary, which is like the scientific method, is the record, which is constantly revised and added to. For this purpose, the basic tool of a piece of composite evidence like the one we have here – a fragment of a ship's hull – consists of the descriptive documentation of each of its constituent parts, which in the case of St1 and St2, are individual frame timbers, structurally connected, with the exception in St2 of the timber identified as a deck stringer during the field phase of the research because of its various distinctive characteristics. This premise, the record, expressed a set of basic parameters materially gathered together in a single supporting document – a "fact file" – a paradigm of which is that of the St1 deck stringer[42] due to the formal complexity of the piece and the depth of analysis prompted by the examination of it.

Also worthy of mention is the scheme used in the abovementioned fact file to describe the nails (see next page), which uses a simple and innovative descriptive mechanism based on a table of numerical and symbolic attributes listed from top to bottom according to the sequential number in question and in four columns that correspond to the faces of the piece of timber in contiguous pairs corresponding to each face/side of each timber. In this case it was the nail holes which remained that attested to the positions of the nails, since the original iron hardware had been completely dissolved and reduced to dust, or nearly so, since they almost always remained as residual concretion on the surfaces in contact with the timber. On rare occasions, however, everything was conglomerated in a hard concretion that completely obliterated the respective holes, which contrasts what was the norm in a number of internationally well-known cases. The four columns corresponding to each face/side are arranged in pairs, bringing together the opposite sides – specifically those where the holes correspond to the same nail hole (In/Out, A/B, or Top/Bottom, A/B).

[41] See Appendix A2.

[42] See Appendix A3.

This way, from a descriptive standpoint, it was easy to show the relationship of each of these units with the corresponding opposite face by lining them up across from each other, without regard to the spacing between them, but keeping them in their respective sequential order.

Table

*The two pairs of columns (Inner-Outer and Bottom-Top) list the serial numbers of the nails along the central axis of the two columns along, a sign indicating their direction of penetration: (< or >) **in bold** when it's clear that the nail was inserted from that side; and (> < =) when it nail penetrated both sides, with a question mark "**?**" when we don't know from which direction. When applicable, the depth of penetration is indicated (**in centimeters**) with "=" beside the serial number. At the outer edge of each column, the shape and size (**in millimeters**) of the cross-section of the nail is given: the diameter when they are round ∅, and the two dimensions then they are square.*

Inner	Outer	Bottom	Top
20x17 1<	**<1** 20x17	ø17 1>?	?<1 ø17
10x15 2>?	?<2 10x10		**<2**=16 15x15
	?<3 10x10		
ø35-ø6 conc 3>?	?<4 conc ø23-		
18x20conc12,5=4>	<5=1,8 conc 16x18		
	<6=7 1x1		
ø1 >7	>7 5x15		
	<8=9,5 1,3x1,5		
ø3x3,2 riveted =6>	<9 ø3,2		
ø20 7>?	?<10 ø20		
ø18 8>?	?<11 ø18		
18x18,5reserved9>?	<12 reserved? 18x18		

Deck stringer description table (see Appendix 3)

All that remained was to choose and define the descriptive symbols to be used. We started by indicating the direction of each penetration using the symbol, "<", ">" or "?" if there is a doubt about the direction of penetration is or when the size and shape of the nail hole cross-section were the same (based on the principle that the smaller cross-section of a nail hole will that closest to the tip of the nail), or when the initial point of penetration is not discernable, which is rare since you can usually see the mark of the head of the nail on the timber surface. These symbols and their respective numbers were bolded on the penetration side when the hole did not go through the entire timber; in this case the symbol "=" was used to note the depth of the respective penetration in centimeters. Finally, the square sections were indicated by giving the length of their sides (10x10mm, for example), or when the section was circular, by the symbol ∅ followed by the respective diameter.

This method of recording is concise, easy to understand and can be updated on an on-going basis as new certainties or questions emerge, making it a very useful tool for reference, analysis and comparison. This is especially true when it is used in conjunction with the drawings and photo mosaic documentation, which together make it possible to detect errors or insert updated data whenever necessary during the long investigative process, particularly when we do not have the archaeological document in front of us – as we will

show in the chapter "**Early results of the office research**", with regard to the functional reconstitution of the St2 set during the course of the investigation. Finally it should be mentioned that the value of the fact file is measured by the interplay between this recording tool and the others. We cannot overemphasize the importance of the chapter on "Description", which as an exercise in inductive simplification is the corollary of analytical and communicational clarity, but it also plays a role in detecting gaps in the research, namely in its interpretive facet.

Scientific management structure

The written, graphic and photographic documentation from the archaeographic recording mission was saved in electronic format in a directory entitled *Scientific Management*. The directory organizes the files hierarchically by subject matter listed in the **Table of contents** of this report – and will be reproduced in its entirety in the Section B Appendices in various formats and scales.

Scientific management structure

1st level files	*2nd level files*	*3rd level files*
– Site_draws_and_pool_plan	– Site_drawings – Wood_plan_in_pool	
– Headquarters_photos	– Environment – Outside_views	
	– Preliminary_tasks	– Alarm_security – Drawings_archive – Electricity_preparation – Photography_preparation – Preliminary_panoramics – Tables_preparation
	– Water_tank_preparation – Water_tank_transport – At_the_door – Working_at_the_door – Drawing_and_photography – Visits – Mosaic_measures	
– Timbers_records	– Archaeography_criteria – Drawing_and_photography_panoramics – Drawings Melinex_archive – Drawings_panoramics – Drawings_preparation – Photo_mosaics_measures – Photo-mosaics_assembled – Photo-mosaics_panoramics – Photo-mosaics-individuals – Scanningd_drawings – Scanning_panoramics – Timbers_description_files – Timbers_details_images – Timbers_perspectives – Timbers_preparation	
– Samples_records	– Samples_archive – Samples_photos	
– Isolated_finds_records	– Isolated_finds_archive – Isolated_finds_photos	

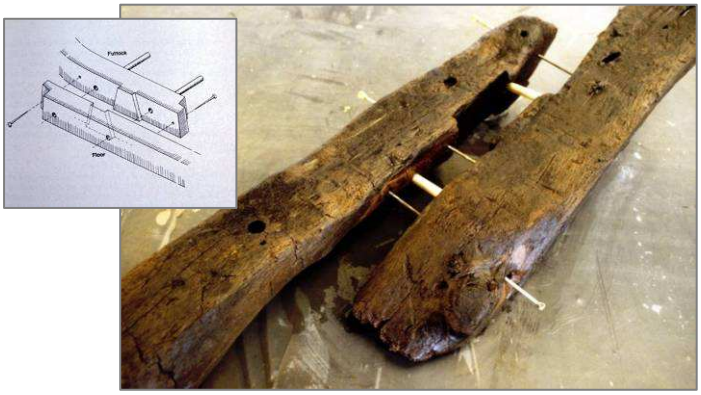
RESEARCH ITINERAIRIES

Interpretive itinerary during the field mission in 2008

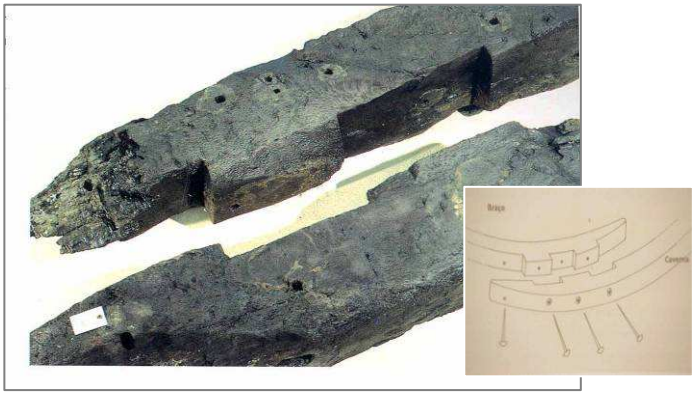
St1 Structure

1. This structure consists of two and a half pairs of framing timbers found *in situ* lying approximately on the horizontal, with the usual structural elements of contact juxtaposed perpendicularly to it – the outer hull planking beneath it and the inner planking on top.

2. Since the terminal parts of the alternating thinner framing timbers in contact with the soil (to the west) were intact, these corresponded to the areas of the upper extremities. However, although these were precisely the terminal points of these timbers, parts that corresponded to areas of contact and union with their lower pairs, this joint did not include the respective dove tail scarfs or double-toothed scarfs, technical details of floor timber-futtock connections that have previously been attested to in archaeological sources of the Iberian-Atlantic ship-building tradition, e.g., on the *Ria de Aveiro A* ship and on the presumed *Nossa Senhora dos Mártires*. And although "lack of evidence does not prove it doesn't exist", the fact is that in St1, if the preserved joint areas were indeed situated at the floor timber-futtock joint, appear to be long enough to admit the possibility of their originally having had this type of scarfing in contiguous areas that were not preserved.



Ria de Aveiro A: dove tail scarfs, wood pegs and iron nails.



Nossa Senhora dos Mártires: double-toothed scarfs and iron nails.

However, in addition to this possibility being controversial due to the limited transversal size of St1, we must also point out that the dove tail scarfing process is also attested to archaeologically, not only at the level of the floor timber-futtock connection, but also between futtocks – namely on the *Angra D*[43]. For these two reasons, the lack of evidence of this joining process between pairs of framing timbers is not a conclusive indicator for

[43] Information from Paulo Monteiro, co-head of the archaeological intervention on these important remains, which included fully dismantling them – See Note 30.

establishing the level of connections patent in this structural set, even though the possibility of their belonging to a second level of joint, that of the first futtock with the second, appears to be consistent with the other observations made, which will be described below.

3. The thinness of the inner planking (between 16 and 18mm) seems to indicate that this is not planking suitable for the floor of a bilge, but rather for an areas above the turn of the bilge corresponding to the floor timber-futtock connection, which would corroborate the previous assumption that we were dealing with a joint area between the first and second futtock.

4. The presence of lead caulking and strips of lead sheathing and protection of the remaining hull planking below this set of framing also corroborates this assumption, since the joint area between the first and second futtock situated above the turn of the bilge, still corresponds to an area of the ship hull that lies below the waterline, making it vulnerable to *Teredo navalis*.

5. The presence of structural parts of the ship hull, both coherent and dispersed, in a well-delineated area associated with non-structural remains typical of cargo, which included more than 20 tons of copper ingots forming a continuous trail of destruction in a south-north / south north-easterly direction, also appeared to corroborate the preceding supposition.

6. During this phase of this preliminary research, the exact final position of the ship hull still cannot be determined with certainty from the set of structural and non-structural, coherent and dispersed remains present. However, considering the greater breadth of the extremities of the rupture of the framing timbers in question which were found on the seaward side (pointing west), we can conclude that the ship's axis– the keel – lay east of the structural set in question on an axis somewhere between the abovementioned south-north / south east direction.

St2 Structure

1. This structure consists of four framing timbers which, unlike, were lying directly on a thin layer of sedimentary soil covering the rocky substrate, due to the lack of outer planking, which had obviously been lost before or during its deposition *in situ*. The front of this frame, which was facing northwest and covered crosswise by a large timber almost completely covered by stony concretion, was immediately identified after a preliminary cleaning as being an incomplete segment of a deck stringer. In contrast, the back of this frame, facing south, was covered, also crosswise, by inner planking identical to that found in St1. Curiously, the first plank of the series was on the vertical, butting up against the deck stringer, undoubtedly due to being loosened and dragged during the final phase of deposition of the set.

2. The deck stringer had an irregular quadrilateral section that presented:

- An outer face, the largest of them all and slightly curved longitudinally toward the support rest on the inner face of the frame, relatively well preserved and with no other special characteristics;

- An inner face (turned upwards *in situ*) irregularly extensively corroded in a large part of its length, but which shows on its largest preserved thickness that it was carved obliquely in relation to the outer face, so that the lower face was originally wider than the upper face. On its right extremity (looking from the axis of the inside of the ship outward), there is a flat vertical scarf, oblique-toothed, showing that this was a composite timber (its length was extended by another timber);

- An upper face, the narrowest, which shows a well-defined central dove tail scarf, as well as similar lateral dented scarfs, though the latter were poorly or semi-preserved. The horizontal base of these scarfs, by establishing the functional position of the timber, in turn helps determine the slope of its outer face and, by extension, the slope of the frame on which it rests – this being an essential factor which may eventually help establish the position of the structural sets in question on the ship hull;

- A lower face, level but relatively deteriorated, with no other distinguishing characteristics.

3. The abovementioned set of scarfs appear to attest to the dual structural and functional nature of a deck stringer: to serve as inner longitudinal reinforcement of the ship's skeleton and simultaneously to serve as support for the transverse slot-mortise system of this skeleton, as well as transverse support (through the deck beams) of the longitudinal covering forming the floor of a deck.

4. Based on this, all of the preliminary conclusions made in the field fit perfectly, bolstering our belief that the St1 and in particular the St2 structure do not belong to the bottom of the ship but rather to one of its sides immediately above the bilge, which would place it precisely in the area of the first deck, thus constituting fragments of the upper lateral area of the ship's bilge[44] – a hypothesis also consistent with the presumed model of the ship's sinking and final destruction.

5. The assumption that the pairs of framing timbers that made up the two structures St1 and St2 corresponded to the joints between the first and the second futtock – precisely those that are reinforced by the deck stringer, which simultaneously supports the cross beams of the first deck and forms the ceiling of the bilge, was supported right from the start.

[44] This was the interpretation documented and presented by the author at a conference at the Naval Academy on April 7, 2008.

Interpretive itinerary during the 2009 archaeographic mission

1. After cleaning the framing timbers from St2 we were finally able to see that the four framing timbers had an obvious "tooth-like" depression, which immediately led us to suppose that it served as a rest to support the underside of the deck stringer, which would have butted up against it crosswise.

Individual photo-mosaics of the inner faces of St2 to St4 with the teeth lined up horizontally (from left to right, approximate scales). Layout by Miguel Aleluia.

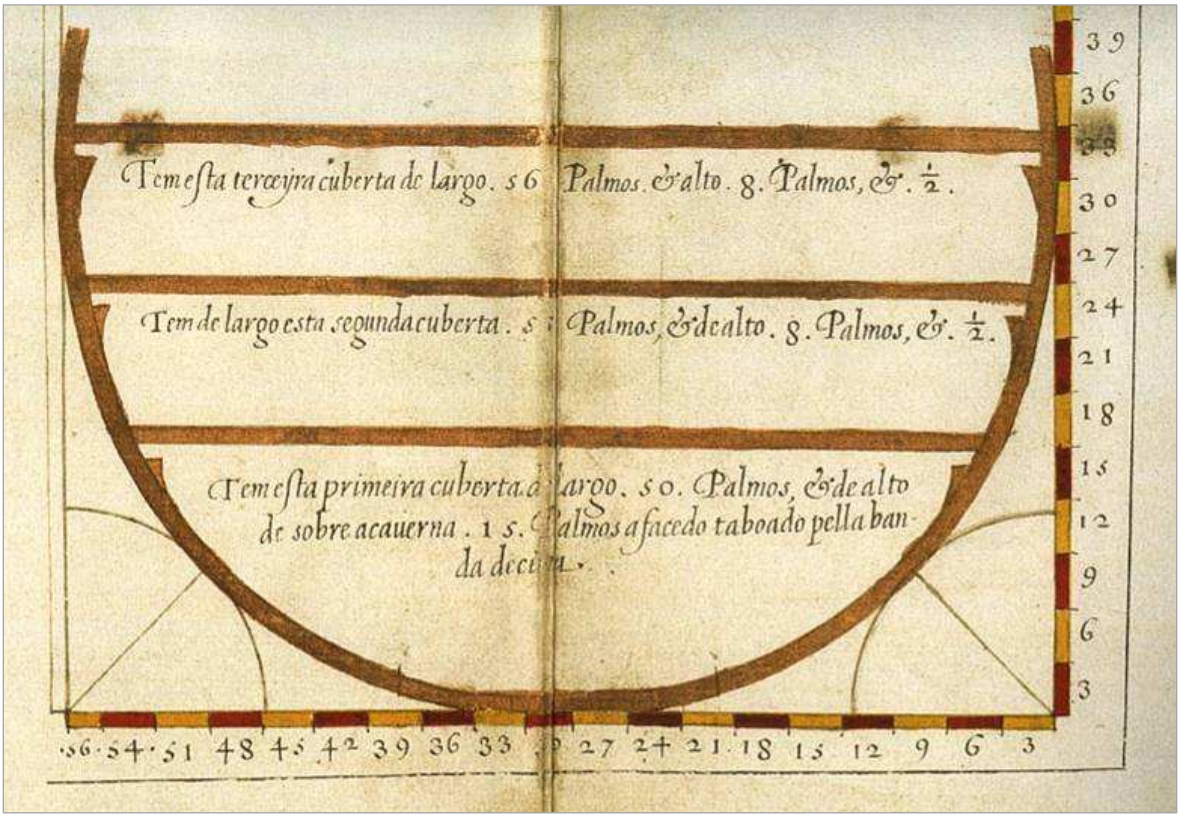
We should also mention that written sources document the functional association between the tooth and the deck stringer on which it rests ("*descança*").

"(…) *e a postura tres palmos acima do couado chegará a ponta da cauerna e tres palmos abaxo do couado, chegará a ponta do braço e por cima do dormente da primeira cuberta serão dous palmos ate alli chegará a* [fl. 8] *forma abaxo do ponto da altura da cuberta marcaras o dente para o descanço do dormente e a este dente para baxo darás o embaraçamento da forma da postura conforme for o nauio desta cuberta para cima deitará o 3* (…)".

"(…) and the top futtock three palms above the bilge point will reach the floor timber top and three palms below the bilge point, will reach the futtock top and over the deck stringer of the first deck will be two palms until there will reach the [fl.8] form below the level point of the deck you will mark a tooth for the deck stringer repose and to this tooth below you will place the connection of the top futtock form depending of the ship [type/tonnage] from this deck above you will place 3 [the third one?] (…)"

Regimento *Regra geral para Nauios de alto bordo de setenta ate trezentas toneladas.*
("Regimento" *General rule for the construction of large ships, from seventy to three hundred tons*).
In Francisco Contente Domingues, 2004: 327.

Also worth mentioning is the expressive representation of these teeth in the iconography of the *Livro de Traças de Carpintaria* by Manuel Fernandes (1616).

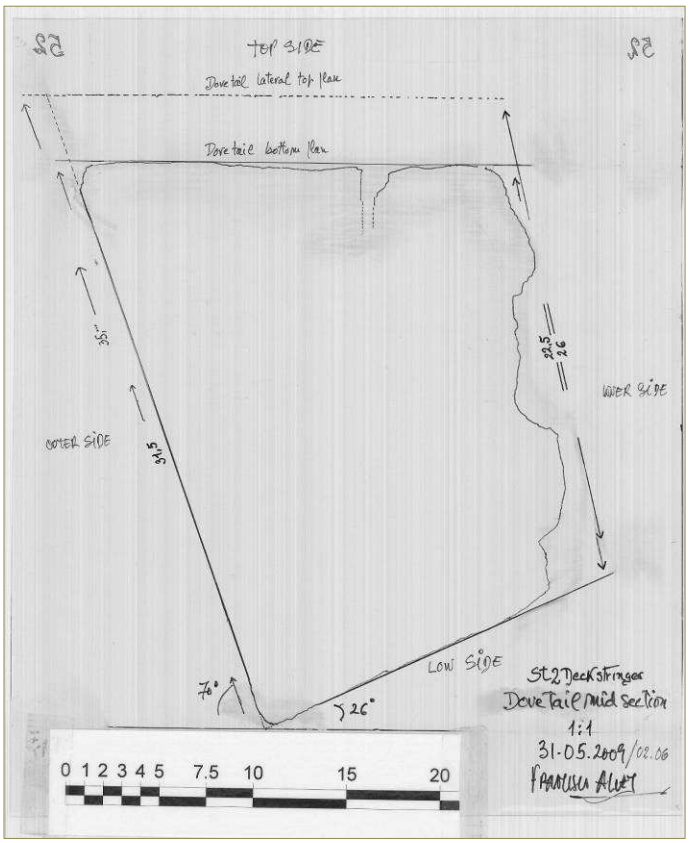


2. We had not, however, been able to demonstrate yet whether that segment of deck stringer rested on those specific framing timbers – which would be an extraordinary stroke of luck given the obvious violence shown in the model of the destruction of the ship as it reached its terminal impact point. Nevertheless, the most feasible manner and time to check this would be in the post-archaeography, office research phase.

3. Subsequently, during the detailed inspection of the first framing timber of St2 immediately before the archaeographic records were made, when we laid the timber on the its lower extremity to determine the horizontal position of the tooth using a level, we found that the timber in this position would originally have had to be angled slightly outward – as one would expect given the presumed original location.

4. During this same phase, when we inspected the deck stringer, already having established its original position based on the face of the dovetailed joint with the rest placed exactly horizontal, we found that the plane of its outer face formed an angle of approximately 70º with the horizontal plane of the rest on the edge of that side. This angle, which was perfectly consistent with the slope of the St2 framing timbers de St2 that the deck stringer rested on and butted up against (or on other equivalent timbers that had meantime disappeared) – which corresponded with the original positions of these two distinctive types of timbers of the structure of the ship.

5. At the same time, we observed that the original position of deck stringer (also established by placing the face of the dovetailed rest perfectly horizontal), the plane of its inner face formed a 26º angle with the horizontal plane of the rest at the edge of that side – which was perfectly consistent with the angle measurement of the outer face of referred to above.



Interpretive itinerary back in Lisbon

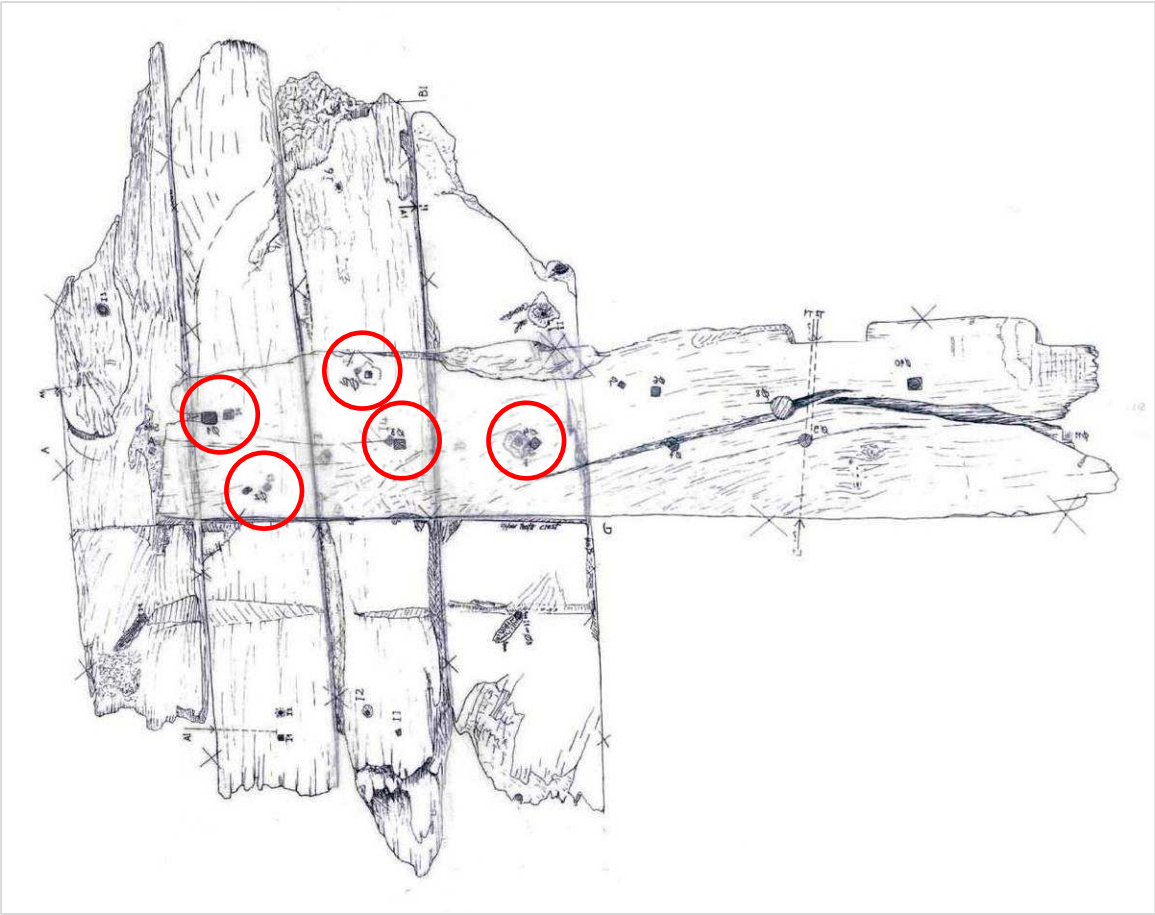
Subsequent research, although still in the preliminary phase, enabled us to definitively answer the question of the position of the deck stringer in relation to the framing timbers on which it lay.

To accomplish this, the drawings of the inner faces of the four framing timbers and outer face of the deck stringer were printed on parchment paper, in a smaller scale, in order to try

superimposing the nail holes in the timbers – the only way to prove whether the set was in fact in structural connection.

Two studies were then carried out. The first involved mounting the individual drawings of the inner faces of the four framing timbers by laying them side-by-side and lining them up horizontally using the edge-plane of the teeth as a guideline.

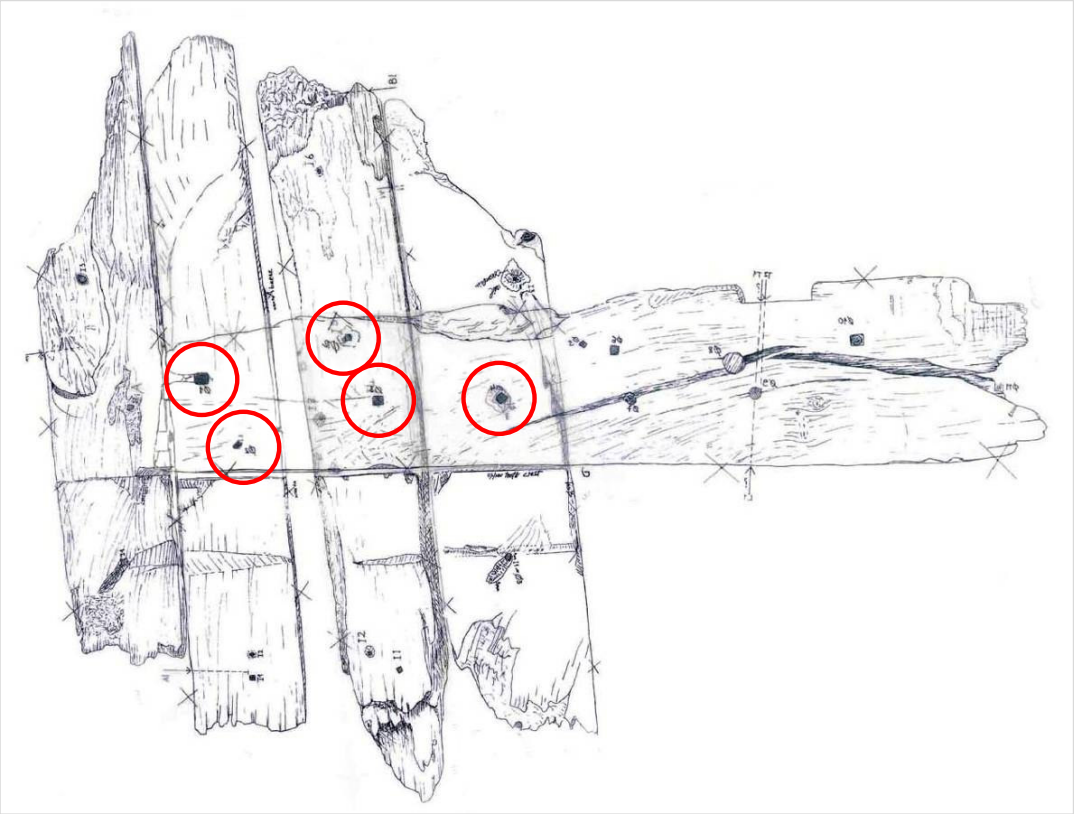
Next the drawing of the outer face of the deck stringer was laid on top, since this would be the face in contact with the frame timbers – for a horizontally inverted effect, like a mirror. In this first test, going through the drawing of the deck stringer horizontally from one side to the other with its base perfectly lined up with the teeth of the four timbers as though it fit into them, no overlapping of the nail holes was found, as can be seen in the drawing below.



In the second test, contrary to the first in which the drawing of the framing timbers were mounted and the deck stringer was moved on top of them, the deck stringer drawing was mounted and the framing timber drawings were moved under it in all the possible combinations.

It was when moving them in pairs and separating them slowly and progressively, but always moving them with the teeth precisely lined up with the base of the deck stringer

that we found several holes that exactly or nearly exactly coincided with each other[45], enough to precisely establish the original position of the set. In this case, the drawings of the holes lined up exactly (in three cases) or nearly so (in two cases)[46].

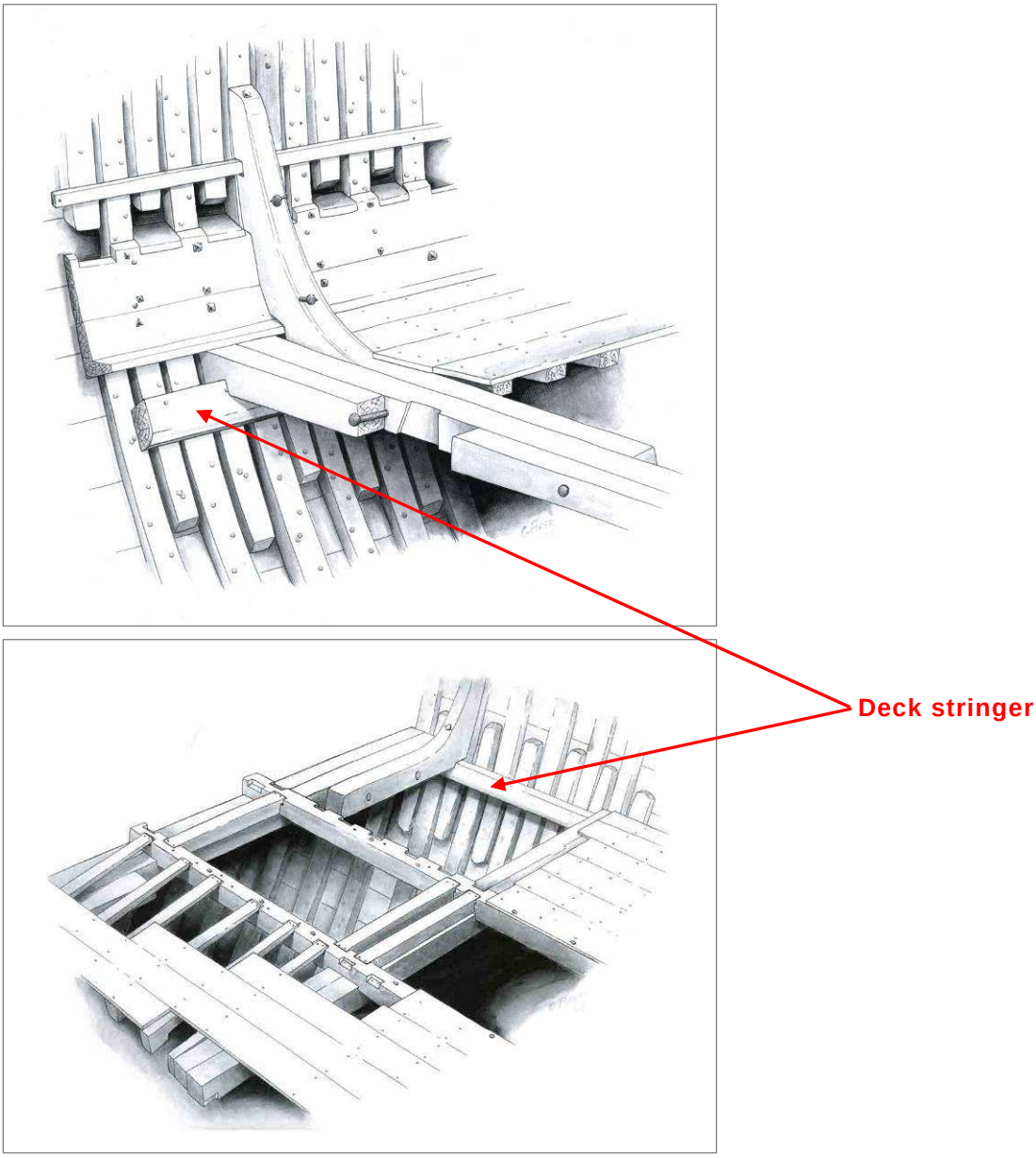


The proof was clear, and with it, the confirmation that the method adopted, empirically designed, and experimentally tested was perfectly achieved: This deck stringer part has been only slightly dislocated from the framing during the wreckage.

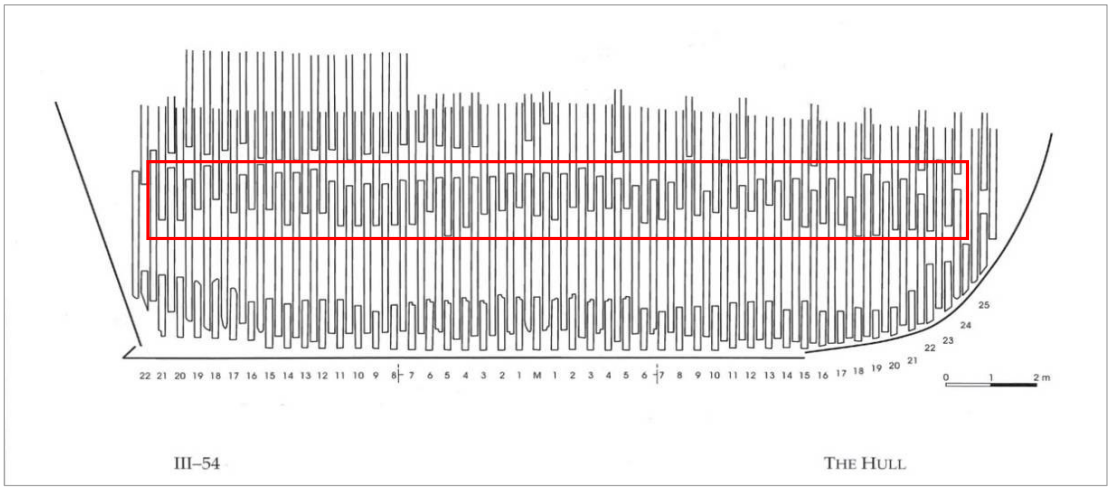
[45] Or with a level of accuracy that can be considered perfectly sufficient, which means inversely that the respective level of error that can be considered negligible. This is implicit in the fact that any manual drawing technique, as with any other human activity, can never attain absolute accuracy. That is why there are statistical and electronic criteria based on parameterization of these indices. See, for example, the DMS method (*Direct Measure System*) for treating measures of hypsometrically corrected trilateration according to Pythagoras's theorem, in this case in software form in the program *Site Recorder*.

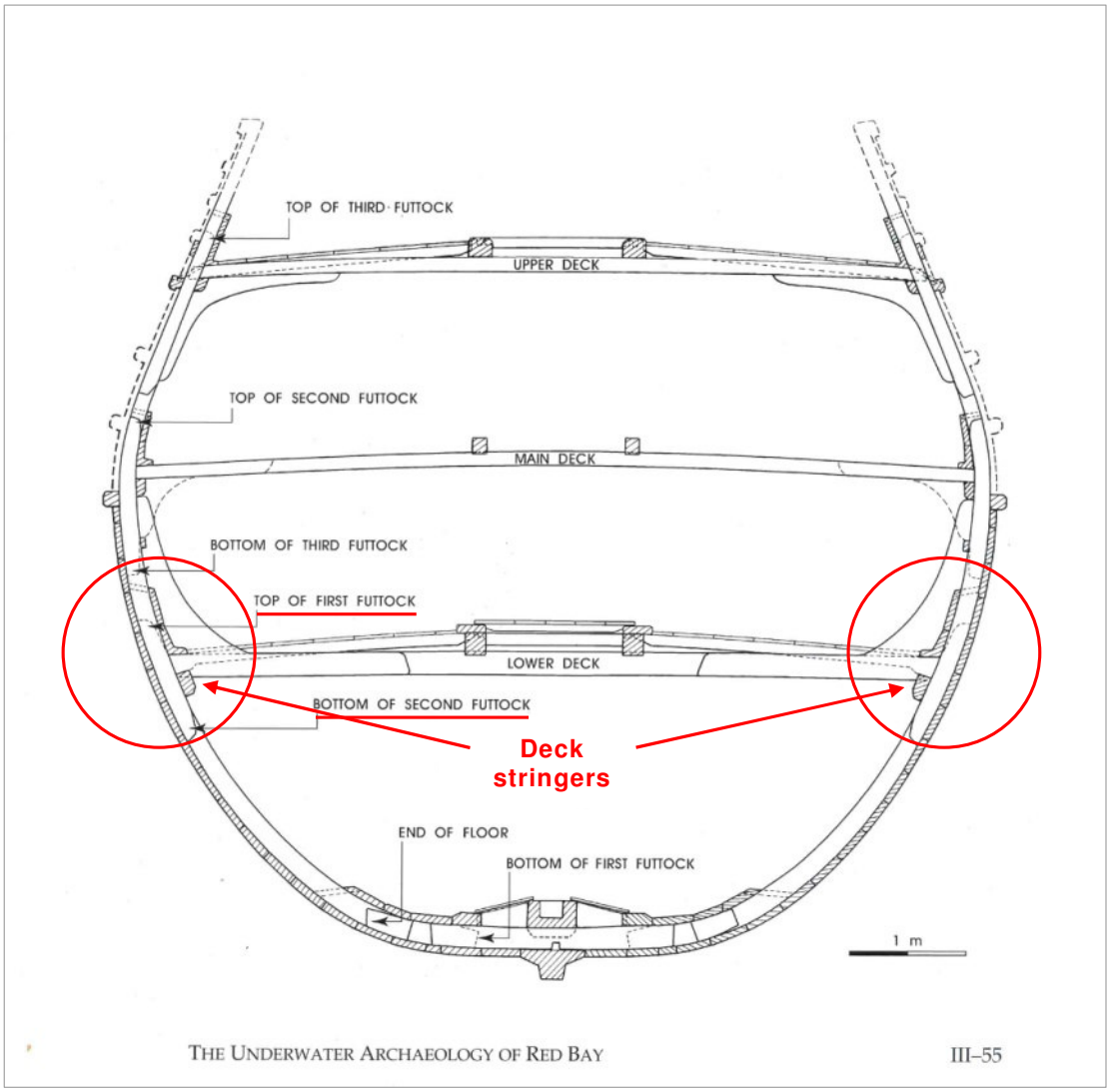
[46] The fact that the two pairs of framing timbers are not strictly parallel is irrelevant, since their slight deviation is perfectly acceptable, particularly in light of the difficulty of determining the exact original position of the timber at the time it was recorded by full-scale drawing – the reason why the timber was drawn several times in approximate positions. This is not to even mention the fact that carving and assembly of pieces of timber in a 16th century naval shipyard, as with any human endeavor, is not likely be the embodiment of absolute perfection.

With the completion of this first test based on the archaeographic documentation created, and after obtaining these preliminary results, the research project on the Portuguese shipwreck at Oranjemund had taken a great leap. We knew that the next steps would be to undertake the full exploration of all the information it holds in store and enhance it. And to finish the technical part of this report, two detailed schematic views and two drawings are shown of the presumed Basque whaling ship, the *San Juan*, shipwreck in Red Bay, Labrador, Canada in the mid-16th century, which are the most complete and well preserved remains in the world of a vessel of the Iberian-Atlantic tradition. The remains were excavated by the Parks Canada underwater archaeology team, and the images shown here are taken from their extraordinary final report which was recently published[47], and which, despite some differences in details, well illustrate the structures from the preserved areas of the Oranjemund ship.



[47] Grenier *et al*., 2007, Vol. III: 180 and 181. The work, published in English and French, is contained in six volumes.





In red, for comparison: areas that the St1 and St2 structures of the Oranjemund ship came from.

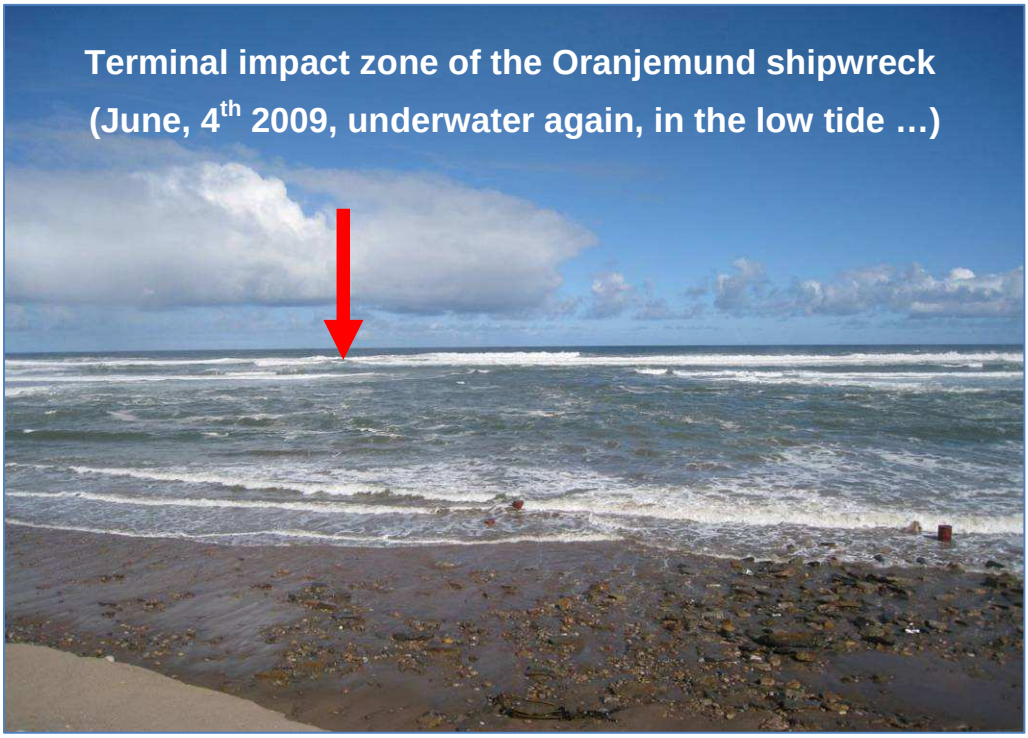
Provisional conclusion

Portugal's participation in 2008 and 2009 in the two technical phases of the archaeological rescue of the 16th century Portuguese shipwreck at Oranjemund was more than important – it was essential. The first phase focused on the excavation and dismantling of two unique fragments of the ship's hull whose elements were still structurally connected, while the second involved executing the archaeographic record through full-scale drawings and mosaic photography of the four faces of each piece of the two sets of fragments.

This participation was essential because it also provided a structural interpretation that marks the beginning of a transition into the investigative realm: from a technical phase to an analytic and interpretive phase. A transition that means a window of knowledge has opened – or is beginning to open – about Portuguese naval architecture, thanks to these fragile and rare witnesses that are the archaeological documents themselves.

However, although some strides have been made in the course of the project, but there is still much work to be done, if not the lion's share. Exemplifying this is the fact that, even if we consider only the remains of the ship's hull, the present study was unable to encompass all of the artifacts of an architectural nature. Many important isolated pieces of the ship's hull (St3) have yet to be added to the archaeographic record – those that have no apparent structural context, but which nevertheless convey precious information.

This is more than enough reason to justify organizing, as soon as possible, a truly Portuguese mission – to ensure that all these artifacts will speak for posterity. Which would unquestionably establish this cooperation between Portugal and Namibia as a modern paradigm of international cooperation around this priceless heritage held in common by both countries and by all of humanity.



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Appendices

Appendix A1

Portugal's State Declaration

Portugal's State Declaration in the framework of the UNESCO draft Convention on the Protection of Underwater Cultural Heritage

Lisbon 2000

This text is the result of work meetings between representatives of the Centro Nacional de Arqueologia Náutica e Subaquática do Instituto Português de Arqueologia [the National Center for Underwater and Nautical Archaeology of the Portuguese Institute of Archaeology] and the Gabinete de Relações Culturais Internacionais [Office of International Cultural Relations (Ministry of Culture), the Directorate-General of the Navy (Navy – Ministry of Defense), the Directorate-General of Multilateral Affairs and the Direcção de Serviços das Organizações Económicas Internacionais [Department of Services of International Economic Organizations](Ministry of Foreign Affairs).

1. Notwithstanding the fact that UNCLOS does not contain any specific mention regarding the sovereign immunity of sunken war ships and state ships, Portugal considers that this consecrated principle – according to which the flag state has sovereign rights over the said remains – shall be universally respected wherever they are located. Naturally, this respect shall be extended to the principles stated in the ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia 1996), which have inspired the Annex of the current UNESCO Convention project.

2. Also, Portugal – notwithstanding the fact that it will strongly respect this principle in what concerns other state's ships or warships, located in areas under its maritime jurisdiction – will not claim this principle from other States, although the vast majority of its historical heritage is spread worldwide, in the sea bottom of all continents.

As a matter of fact, Portugal, does not consider the compliance to this ethical and cultural principle fundamental for the safeguard of its interests; nor to be this the most important or the most urgent issue on scientific, political or cultural points of view in the frame of this draft Convention.

Portugal considers on the contrary that its best contribution to the protection and valorisation of his nautical heritage located in the sea bottom of all continents is not to claim for himself his historic and cultural heritage – that historically and culturally he shares with the countries that have jurisdiction over those areas – because his basic claim and affirmation in any relationship with those countries is just based upon the principles and the ethics underlined in the project of this draft Convention. Therefore, Portugal:

<u>Claims</u>, above all, that those remains must be protected, researched, studied and valorised in the exclusive behalf of Science, Culture and Mankind (which by inherence requires the primordial respect of the interests of the site, flag or cultural origin countries), in accordance with the 1996 ICOMOS Sofia Charter principles, that inspired the annex of the

present UNESCO Draft Convention. By “site country” we mean the country in which sea or marine bottom those remains are located; by “flag country” we mean the country whose nationality is historically and archaeologically identified; and by “cultural origin” if such identification is based on strong archaeological presumption.

Declares, as stating point, its entire availability to cooperate with any country in whose sea bottom *[under their jurisdiction]* lay remains of a common historical and cultural heritage.

3. Such are the principles that inspire Portugal’s behaviour in this domain and that explain its position in the frame of the present draft Convention. Principles that are expressed by the fact that the archaeology, the protection and the valorisation of underwater cultural heritage have begun in Portugal concerning French and Spanish ship remains, such were the cases of the *Océan* and the *San Pedro de Alcantara*, wrecked in the Portuguese territorial sea in 1759 and 1786; and by the fact that Portugal has always cooperated unselfishly when the remains of Portuguese ships lying in other countries territorial sea were studied under archaeological good practices (that is, according to the principles that were later adopted by the Sofia Charter), as has happened in the case of the *Santíssimo Sacramento* galleon (1666), in Brazil, or the case of the *Santo de António de Tana* (1697), in Kenya.

4. Portugal considers, independently of the said questioning, that the universality principle must inspire the application of the instrument that constitutes the present draft Convention. This means that, at its base, the Convention must contemplate all underwater cultural heritage, whatever be its nature (sites with nautical remains or others, or, if these are ships, whatever its “class” may be – state, men of war, “civilian”, etc.).

5. Portugal welcomes, in the context of the present draft Convention, all definitions capable of mitigating any divergences or promoting consensus around core issues. In that manner, Portugal proposes that article no 2 of the present draft Convention be written so that universality permits it, expressively stating only the ethical and methodological assumptions of contemporaneous archaeology (expressed in the Sofia Charter) and those requiring for a necessary and desirable cooperation between countries; leaving as a side issue – regulated by bi or multilateral cooperation agreements – all questions pertaining only to the authorities directly involved, such as the issue regarding sovereign immunity over war and State shipwrecks, with presumable or recognized archaeological importance.

Appendix A2

Table of archive drawings

Table of archive drawings

A	B	C	D	E	F	G	H	I	J	K
Drawing number	Field Number	National Inventory number	Detail	Tube number	Base	Size	Marker	Scale	Final date	Operators
001	St2FS4	B7897	Inner side	01	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	16-May-2009	FA-MA-AS-JS-SA-BD-LS
003	St2FS4	B7897	Outer side	01	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	16-May-2009	FA-MA-AS-JS-SA-BD-LS
002	St2FS4	B7897	A side	01	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	16-May-2009	FA-MA-JS-LS-AS
004	St2FS4	B7897	B side	01	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	16-May-2009	FA-MA-AS-JS-SA-BD-LS
005	St2FS4	B7897	Inner side tooth profile	01	Melinex 175micra	0,45x0,26m	Water proof ink pen	1:1	11-May-2009	FA-MA
006	St2_Deck-stringer	?	Inner side	01	Melinex 175micra	1,9x0,54m	Water proof ink pen	1:1	16-May-2009	FA-MA-JS-LS-AS
007	St2_Deck-stringer	?	Outer side	01	Melinex 175micra	1,9x0,54m	Water proof ink pen	1:1	16-May-2009	FA-MA-LS-JS-AS
008	St2_Deck-stringer	?	Low side	02	Melinex 175micra	1,9x0,54m	Water proof ink pen	1:1	16-May-2009	FA-MA-JS-LS-AS
009	St2_Deck-stringer	?	Top side	02	Melinex 175micra	1,9x0,54m	Water proof ink pen	1:1	16-May-2009	FA-MA-JS-LS-AS
010	ST1FS4	B7917	Outer side	02	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	18-May-2009	FA-MA-JS-FK
011	ST1FS4	B7917	Inner side	02	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	18-May-2009	FA-MA-JS-FK
012	ST1FS4	B7917	A side	02	Melinex 175micra	1,5x0,36m	Water proof ink pen	1:1	18-May-2009	FA-MA-JS-FK
013	ST1FS4	B7917	B side	02	Melinex 175micra	1,50x0,36m	Water proof ink pen	1:1	18-May-2009	FA-MA-JS-FK
014	St2FS2	B7898	Outer side	03	Melinex 175micra	1,57x0,36m	Water proof ink pen	1:1	19-May-2009	FA-MA-JS-FK
015	St2FS2	B7898	A side	03	Melinex 175micra	1,57x0,36m	Water proof ink pen	1:1	19-May-2009	FA-MA-JS-FK
016	St2FS2	B7898	B side	03	Melinex 175micra	1,57x0,36m	Water proof ink pen	1:1	20-May-2009	FA-MA-JS-FK
017	St2FS2	B7898	Inner side	03	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	20-May-2009	FA-MA-JS-FK
018	St2FS3	B7899	Outer side	03	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	20-May-2009	FA-MA-JS-FK
019	St2FS3	B7899	A side	03	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	20-May-2009	FA-MA-JS-FK
020	St2FS3	B7899	Inner side	03	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	21-May-2009	FA-MA-JS-FK-LS-AS
021	St2FS3	B7899	B side	03	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	21-May-2009	FA-MA-JS-FK-LS-AS
022	St1FS2.1	B7920	Inner side	04	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	21-May-2009	FA-MA-JS-FK-LS-AS
023	St1FS2.1	B7920	B side	04	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	21-May-2009	FA-MA-JS-FK-LS-AS
024	St1FS2.1	B7920	Outer side	04	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	22-May-2009	FA-MA-JS-FK
025	St1FS2.1	B7920	A side	04	Melinex 175micra	1,65x0,36m	Water proof ink pen	1:1	22-May-2009	FA-MA-JS-FK
026	St1FS3	B7918	B side	04	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	22-May-2009	FA-MA-JS-FK
027	St1FS3	B7918	Inner side	04	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	22-May-2009	FA-MA-JS-FK
028	St1FS3	B7918	A side	04	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	23-May-2009	FA-MA-JS-FK
029	St1FS3	B7918	Outer side	04	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	23-May-2009	FA-MA-JS-FK-LS-AS
030	St1FS2.2	B7920.2	A side	05	Melinex 175micra	1,2x0,36m	Water proof ink pen	1:1	25-May-2009	FA-MA-JS-FK-LS-AS
031	St1FS2.2	B7920.2	B side	05	Melinex 175micra	1,2x0,36m	Water proof ink pen	1:1	25-May-2009	FA-MA-JS-FK-LS-AS
032	St1FS2.2	B7920.2	Outer side	05	Melinex 175micra	1,2x0,36m	Water proof ink pen	1:1	25-May-2009	FA-MA-JS-FK-LS-AS
033	St1FS2.2	B7920.2	A side	05	Melinex 175micra	1,2x0,36m	Water proof ink pen	1:1	25-May-2009	FA-MA-JS-FK-LS-AS
034	St2FS1	B7902	Outer side	05	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	26-May-2009	FA-MA-FK-AS
035	St2FS1	B7902	A side	05	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	26-May-2009	FA-MA-FK-AS
036	St2FS1	B7902	Inner side	05	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	26-May-2009	FA-MA-FK-AS
037	St2FS1	B7902	B side	05	Melinex 175micra	1,45x0,36m	Water proof ink pen	1:1	26-May-2009	FA-MA-FK-AS
038	St2_Deck_stringer	?	top side 2	06	Melinex 175micra	1,95x05m	Water proof ink pen	1:1	27-May-2009	FA-MA-FK-AS-JS
039	St2_Deck_stringer	?	top side hz	06	Melinex 175micra	1,95x05m	Water proof ink pen	1:1	27-May-2009	FA-MA-FK-AS-JS
040	St1FS1	?	Inner side	06	Melinex 175micra	1,6x0,36m	Water proof ink pen	1:1	30-May-2009	FA-MA-FK-AS-JS-LS
041	St1FS1	?	A side	06	Melinex 175micra	1,6x0,36m	Water proof ink pen	1:1	30-May-2009	FA-MA-FK-AS-JS-LS
042	St1FS1	?	Outer side	06	Melinex 175micra	1,6x0,36m	Water proof ink pen	1:1	31-May-2009	FA-MA-FK-AS-JS-LS
043	St1FS1	?	B side	06	Melinex 175micra	1,6x0,36m	Water proof ink pen	1:1	1-Jun-2009	FA-MA-FK-AS-JS-LS
044	St1FS5	?	Inner side	07	Melinex 175micra	1,00x0,36m	Water proof ink pen	1:1	1-Jun-2009	FA-MA-FK-AS-JS-LS
045	St1FS5	?	A side	07	Melinex 175micra	1,00x0,36m	Water proof ink pen	1:1	1-Jun-2009	FA-MA-FK-AS-JS-LS
046	St1FS5	?	Outer side	07	Melinex 175micra	1,00x0,36m	Water proof ink pen	1:1	2-Jun-2009	FA-MA-FK-AS-JS-LS
047	St1FS5	?	B side	07	Melinex 175micra	1,00x0,36m	Water proof ink pen	1:1	2-Jun-2009	FA-MA-FK-AS-JS-LS
048	St2_Deck_stringer	?	Mid transversal section of the preserved dove tail (preliminary draw)	07	Millimetric paper	2xA3	spherografic pen	1:1	31-May-2009	FA
049	St2_Deck_stringer	?	Top profile at mid transversal section of the preserved dove tail	07	Mylar 175micra	0,315x0,13m	Water proof ink pen	1:1	27-May-2009	FA
050	St2_Deck_stringer	?	Inner profile at mid transversal section of the preserved dove tail	07	Mylar 175micra	0,28x0,12m	Water proof ink pen	1:1	28-May-2009	FA
051	St2_Deck_stringer	?	In and out low side angles at mid transversal section of the preserved dove tail	07	Mylar 175micra	0,275x0,125 m	Water proof ink pen	1:1	28-May-2009	FA
052	St2_Deck_stringer	?	Tanversal section at mid-bottom of the preserved dove tail (definitive draw)	07	Mylar 175micra	0,425x0,36m	Water proof ink pen	1:1	2-Jun-2009	FA
053	St3.24	?	Inner side	07	Mylar 175micra	1,26x0,36	Water proof ink pen	1:1	2-Jun-2009	FA-MA-FK-AS-JS-LS
054	St3.24	?	Outer side	07	Mylar 175micra	1,26x0,36	Water proof ink pen	1:1	2-Jun-2009	FA-MA-FK-AS-JS-LS
055	St3.24	?	A side	07	Mylar 175micra	1,26x0,36	Water proof ink pen	1:1	2-Jun-2009	FA-MA-FK-AS-LS
056	St3.24	?	B side	07	Mylar 175micra	1,26x0,36	Water proof ink pen	1:1	2-Jun-2009	FA-MA-FK-AS-LS
057	St3.23	B7923	A side	07	Mylar 175micra	0,9x36	Water proof ink pen	1:1	3-Jun-2009	FA-MA-FK-AS-LS
058	St3.23	B7923	Outer side	07	Mylar 175micra	0,9x36	Water proof ink pen	1:1	3-Jun-2009	FA-MA-FK-AS-LS
059	St3.23	B7923	B side	07	Mylar 175micra	0,9x36	Water proof ink pen	1:1	3-Jun-2009	FA-MA-FK-AS-LS
060	St3.23	B7923	Inner side	07	Mylar 175micra	0,9x36	Water proof ink pen	1:1	3-Jun-2009	FA-MA-FK-AS-LS
061	St3.23 transv. section	B7923	Transversal section	07	Mylar 175micra	0,31xo,31m	Water proof ink pen	1:1	3-Jun-2009	FA-MA

Appendix A3

Timber analysis

Timber analysis

1. Code number

Of National overall management (National Museum of Namibia): Not yet.

Field: St2 Deck stringer.

"St2" means Structure 2 – which is composed of four connected frame fragments over which a deck beam fragment lies; "F" means "frame"), "FS4"means '4th frame counting from the south"). St2 was located adjacent to and south of St1. This was the 1st structure discovered in April. It was composed of five frame fragments, also still connected to each other. Unlike St2, St1 included the associated outer planking. In both structures, the remains of the inside floor planking were found in situ, over the frames.

These two structures were the ***only*** *structural remains of the ship hull still in coherent connection.*

Finally, St3 represents an area measuring approx. 5x10m, south of St2, where approximately two dozen timbers of structural significance were discovered, some of them large in size, but all of them simply scattered, without structural connection.

Theodolite positions: E extremity: DPW 5138 (FA-1Oct2008, p.98); W extremity: DPW 5139-40 (FA-1Oct2008, p.98).

2. Designation

Deck stringer, probably from the 1st deck (because it was strongly associated with the cargo displayed *in situ*). This plank simultaneously serves as an internal longitudinal reinforcement of the hull and as the longitudinal base of the transverse deck beams, which were covered longitudinally by the deck floor planking.

3. Description

Dimensions:

Max. length: approx. 1.69m.

Max. width: 0.35m. (in the tooth part): 0.27/0.275; height of the tooth: 0.035m.

Max. thickness: 0.22m (corresponding exactly to the ancient Portuguese *palmo craveiro* measure of length).

General description

Wood plank, slightly bent, which seems to indicate an original longitudinal orientation, the wider side corresponding to the outer side, which would have originally been in contact with inner side of the framing.

The plank has an irregular quadrilateral section: the planes of the two narrower sides are not parallel and between them they form an angle of approx. 26º. One of the sides shows traces of three carved scarves spaced approx. 0.3/0.35m apart (approx.11/2 *palmo*), but only the middle one, shaped like a dove tail, has both square sides preserved.

Although it is impossible to know the original width of the other two partially preserved scarves, it is reasonable to expect that they were similar to the middle one. This led to the hypothesis that the timber is a deck stringer that supported the deck beams, which would explain why the dove tail scarves were obviously situated on its top side.

Originally and functionally, the bases of the dove tail scarves were horizontal to the larger turned out side. Based in this evidence, the original position of the plank was oblique, the outer edge forming an angle of approx. 70º with its lower horizontal plane.

This led to the hypothetical conclusion that this deck stringer had belonged to a low part of the hull, somewhere not far above the bilge, and therefore corresponding to the 1st deck support system guaranteed by the deck stringers. This assumption is also corroborated by the spatial correlation of this plank with St2 and St1 structures, which can be presumably be identified as assemblages between the 1st and 2nd futtocks rather than between the frame and 1st futtock, especially St2 due to its inner step support tooth.

The underside of the plank is flat and has no special characteristics. The inside is almost completely corroded by *Teredo navalis*, making it impossible to know whether it was parallel to the outer side or not – based on comparative examples, it may not have been.

The extremity called “A” by convention *(see Archaeography criteria)* presents vertically (except for its top side), a very well preserved long flat scarf with an oblique tooth, whose horizontal mid-section is triangular in shape. The tooth, preserved along approx. 0.29m, is approx. 0.04/0.045m high, is oriented at a 109º angle in relation to the horizontal lower inner edge of the plank. Longitudinally, the vertical plane of the scarf is preserved approx. 0.6m, along the plank’s top edge, approx. 0.53m along its lower edge. Its terminal square extremity, which is in its original contact position in relation to the opposite tooth (of the next, but not preserved plank), measures approx. 0.02m thick.

This kind of scarf is typical in naval construction, especially that of the Iberian-Atlantic tradition, where it is consistently used in long timber assemblies, like keels, not only because keels require sizes that cannot be found in nature in singles trees, but also because in the 16th century all of Atlantic Europe was already facing a significant scarcity of mature tall trees.

Final remarks:

1. The partially preserved side of one of the dove tail scarves (of the three mentioned above) and its square-angled horizontal base are situated in the upper inner sides of the plank terminal part.

2. As a result of the transformation that wood in composite artifacts undergoes during the wreckage. the original composite deck beam that this plank was attached to was broken – as usual – through the scarves, which are the most fragile parts.

Detailed description of the sides

Inner side

This is the worst preserved side of the plank, having been almost completely destroyed by *Teredo navalis* probably because this side was more exposed. In fact, in the field, this timber was lying transversally over the St2 frames, with the corroded side turned up.

This side has **9** nail holes, which are described below in Table ***3.3 Fastenings***. The 9th hole (from left to right, B extremity) is exactly in the fracture zone, and naturally contributed to the weakening effect referred to above (3.1-Final remarks, point 2).

Outer side

This is the best preserved side of the plank, probably because it was less exposed (this side was lying transversally directly over the St2 frames). Nevertheless it shows two long and wide transverse-oblique fissures, and it is substantially corroded on the top side, even though the dovetail scarf design mentioned above is still preserved.

It has a slightly curved/convex face, and along its medial axis, there is a slightly irregular line of **11** holes as described above. The 11th hole (from left to right/B extremity) transverses exactly at the bottom plane of the 3rd scarf (the half preserved terminal scarf).

Bottom

This side is the best preserved plane, like the outer one, and has **1** single nail hole.

Top side

This side shows four distinct areas, which are described from inside to out and left to right:

1 - a roughly preserved triangular section of the flat tooth scarf, continued inside with a preserved surface, the end of which is the linear oblique crest of a 1st scarf;

2 - a corroded area corresponding to the flat bottom plane and to the other crest side of this 1st scarf, both non-existent;

3 - a 2nd scarf with both crest sides relatively preserved,– the left one worst, less than 0,1m longitudinally the right one better preserved, c. 0,3m; and

4 – a 3rd scarf, whose crest is the very end of the least preserved surface and whose flat bottom is incomplete because this badly preserved scarf is the exact right extremity of the plank.

This side has **2** nail holes near the preserved scarf area (the 2nd one).

4. Fastenings

Preliminary remark: The observations presented here result from a first manual cleaning of the timbers after their preliminary preservation and desalinization by immersion in fresh water, before any kind of other laboratory conservation treatment. Therefore, all measurements taken and some of the observations made are relatively inaccurate and must be considered provisional.

Iron

All of the fastenings of this plank were made of iron.

Wood

Not yet identified.

Table

The two pairs of columns (Inner-Outer and Bottom-Top) list the serial numbers of the nails along the central axis of the two columns along, a sign indicating their direction of penetration: (< or >) ***in bold*** *when it's clear that the nail was inserted from that side; and* **(**> < =*) when it nail penetrated both sides, with a question mark "***?***" when we don't know from which direction. When applicable, the depth of penetration is indicated (****in centimeters****) with "=" beside the serial number. At the outer edge of each column, the shape and size (****in millimeters****) of the cross-section of the nail is given: the diameter when they are round ∅, and the two dimensions then they are square.*

Inner	Outer	Bottom	Top
20x17 1<	**<1** 20x17	ø17 1>?	?<1 ø17
10x15 2>?	?<2 10x10		**<2**=16 15x15
	?<3 10x10		
ø35-ø6 conc 3>?	?<4 conc ø23-		
18x20 conc 12,5=4>	<5=1,8 conc 16x18		
	<6=7 10x10		
ø1 >5	>7 0,5x15		
	<8=9,5 13x1,5		
ø3x3,2 riveted =6>	<9 ø32		
ø20 7>?	?<10 ø20		
ø18 8>?	?<11 ø18		
18x18,5 reserved 9>?	<12 reserved? 18x18		

5. State of preservation

The outer and underside side surfaces are the best preserved. The inner surface is the worst preserved, being deeply corroded by *teredo navalis*. The top surface is very eroded and poorly preserved.

6. Sampling

(see respective archive)

One sample was collected.

7. Archive records *(to be completed)*

Photos

Drawings

8. Recording dates

14-16 May 2009

9. Operators

Alina Shikongo - Ashton Sinamai - Berzick Dube - Francisco Alves - Joram Shiinda - Lazarus Shiimi - Miguel Aleluia

10. Certifications and dates

FA, 16 May 2009 / Last correction: 16 November 2009