EXHIBIT A

DR. SEAN A. KINGSLEY

EXHIBIT A-1

DR. SEAN A. KINGSLEY

PART 1

AFFIDAVIT AND REPORT

UNITED STATES DISTRICT COURT
MIDDLE DISTRICT OF FLORIDA
TAMPA DIVISION
IN ADMIRALTY

ODYSSEY MARINE EXPLORATION, INC.	:	
	:	
Plaintiff,	:	CIVIL ACTION
	:	
v.	:	
	:	Case No: 8:07-CV-00614-SDM-MAP
THE UNIDENTIFIED, SHIPWRECKED VESSEL, if any, its apparel, tackle, appurtenances and cargo located within a five mile radius of the center point coordinates provided to the Court under seal,	:	
	:	
Defendant; *in rem*	:	
and	:	
	:	
The Kingdom of Spain and the Republic of Peru,	:	
	:	
Claimants.	:	
_____/	:	

AFFIDAVIT OF SEAN A. KINGSLEY
IN SUPPORT OF ODYSSEY MARINE EXPLORATION, INC.'S RESPONSE TO CLAIMANT, SPAIN'S, MOTION TO DISMISS OR FOR SUMMARY JUDGMENT

This AFFIDAVIT is being filed in case 8:07-CV-00614-SDM-MAP.

1. My full name is Sean A. Kingsley. I reside in London, United Kingdom. I am competent to testify as to all facts and issues addressed in the report attached hereto as Exhibit A.

2. I prepared the attached report for Odyssey Marine Exploration Inc. in support of its Response to Claimant, Spain's, Motion to Dismiss or for Summary Judgment in this case.

3. I have personal knowledge regarding the information contained herein and hereby swear that the information is true and accurate to the best of my knowledge.

I CERTIFY THAT THE ABOVE IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE

Sean Kingsley

Sean A. Kingsley

The foregoing instrument was acknowledged before me this 13th day of November, 2008, by

Jeroen Janssen, who is personally known by me.

Witness

Printed Name: JEROEN JANSSEN

Title: Solicitor at bar of Amsterdam

The Black Swan Site: Archaeological Characterization

Sean A. Kingsley

1. Introduction

I am a marine archaeologist with 21 years' experience specializing in shipwrecks, ports and trade patterns. I hold a Bachelor of Arts degree in Archaeology and Classical Civilizations from the University of Wales, Lampeter, and a doctorate in shipwrecks and trade patterns from the Institute of Archaeology at the University of Oxford. For the last four years (ending September 2008), I have been a Visiting Fellow at the Research Centre for Late Antique and Byzantine Studies at Reading University, England, although the current report is written in a private consultancy capacity. Previously I have been a member of the Register of Professional Archaeologists, USA, and received a Leonard and Katharine Woolley Fellowship from Somerville College, University of Oxford.

I have conducted fieldwork in Britain and directed cultural resource management projects on the coastal heritage of Montenegro at the request of its government, in collaboration with the Institute of World Archaeology, University of East Anglia. Off Israel, in 1991-92 I discovered the largest concentration of coherent and scattered shipwrecks in the eastern Mediterranean (9 sites) inside the port of Dor/Tantura. I have studied and recorded Phoenician, Roman, Byzantine, Islamic and Napoleonic and early modern shipwrecks of the 18th to early 20th centuries, which have structural parallels with the Black Swan site. On behalf of the Earl of Argyll and the Advanced Research Institute of England, I conducted a desk-based evaluation of the wreck and site-formation of the Spanish Armada warship *San Juan de Sicilia*, blown up off Scotland in 1588.

Simultaneously, I am a pottery specialist who focuses on statistical analyses of wares of all dates between the Late Bronze Age and the early 20th century and have served as a consultant for Rutgers University, New Jersey, the Centre National de Recherche Scientifique, France, the Israel Antiquities Authority and Bar-Ilan University, Israel. I

have been appointed a non-executive company director of the Palestine Exploration Fund and have peer-reviewed reports and articles on maritime subjects for the Israel Science Foundation and the *International Journal of Nautical Archaeology*. I frequently appraise and advise on historical and archaeological television programming (BBC, Channel 4, Channel 5, History Channel, Discovery Channel).

I am the author of 29 articles in peer-reviewed scientific journals, 6 books on shipwreck archaeology and trade, including *Shipwreck Archaeology of the Holy Land* (Duckworth, 2004) and *Barbarian Seas. Late Rome to Islam* (Periplus London, 2004). My 1999 excavation of a 6th-century AD shipwreck off Israel has been published as A *Sixth-Century A.D. Shipwreck off the Carmel Coast, Israel. Dor D and Holy Land Wine Trade* (Archaeopress, Oxford, 2002).

As Managing Editor of *Minerva*, the international review of ancient art and archaeology, for 7.5 years I was charged with tracking legislative, technological and operational developments in the field of marine archaeology across the world, and published many articles on the management of underwater cultural heritage. I also served as a series consultant for a scheduled 22-volume encyclopaedia of underwater archaeology produced by Periplus Publishing London and contribute to the *Times Higher Education Supplement* and *History Today.* I lecture extensively and internationally, most recently in Madrid at the invitation of Carlos III University and Oxford University at the conference 'Maritime Archaeology and Ancient Trade in the Mediterranean Madrid', 18-20 September 2008.

2. Summary

This report addresses the archaeological character of the Black Swan site in order to characterize its date, form and nationality. It responds predominantly to James Delgado's testimony (document 131-9, exhibit D), but also corrects factual inaccuracies presented in the Kingdom of Spain's Motion to Dismiss (document 131) and by Teodoro de Leste

Contreras (document 131-3, exhibit A) and Hugo O'Donnell Y Duque de Estrada (document 131-8, exhibit C).[1]

The report is based on the detailed examination of 59 hours of video coverage (from which 152 frame grabs were blown up to A3 size for further study), the 1.28 Gb master photomosaic (Annex 2.1) scrutinized on a 41-inch plasma television screen (with all details blown up by 100% and specific archaeological features cropped into individual photographs), and 660 colour photographs. From this extensive scientific database I will demonstrate that the above-referenced declarations are not merely alarmingly inaccurate about their major points, but appear to be deliberately deceptive in places. It is my opinion that it would be impossible for a professional archaeologist to arrive at many of the conclusions without having submitted to a pre-conceived political agenda.

Rather than supply subjective opinion, in this report I have adopted a qualitative and statistically quantitative approach to enable the data to 'speak for itself'. The following 8 specific facts will be proven:

1. No stamped or incised epigraphic evidence has been recorded on the cannon, ingots, rigging elements or pewter/silver wares on the seabed to identify the Black Swan site either unequivocally or tentatively as the *Nuestra Señora de las Mercedes* (henceforth *Mercedes*).

2. A defining characteristic of a blown-up ship is the survival underwater of large, inter-connected sections of a ship's hull. No such structure or even a single intact plank exists on the Black Swan site in any state of preservation.

3. The topography and environment of the seabed (matrix and currents) make it physically impossible for wooden hull sections to be buried beneath sand

[1] In this report all references to the Counsel for Spain's exhibits, annexes, points and photograph numbers are listed with lower-case numerals. References to Odyssey's Exhibits, Points and Annexes bear upper-case letters. Henceforth, only point numbers or page numbers within the Counsel for Spain's declarations are cited as a cross-reference.

blankets; this hypothesis is geologically impossible. What is visible on the seabed is what exists archaeologically on the site.

4. No traces of burning amongst the archaeological assemblages expose the presence of an exploded shipwreck, which would be expected for the *Mercedes.*

5. No certain iron spikes, essential to secure a wooden hull together, and no more than 2 certain copper ship's bolt, are attested.

6. As extensively traded and distributed commodities, cannon are renowned weak indicators of a ship's nationality and provenance. The cannon consignment on the Black Swan site does not correspond numerically or typologically to the historically-attested armament of the *Mercedes*.

7. Despite my sincere sympathy with the death toll inflicted on the *Mercedes*, the proposition that the shipwreck in question is a war grave filled with human remains – irrespective of whether or not she is the *Mercedes* - is a regrettable fallacy that distorts preservation realities. All professional marine archaeologists are fully aware that bones are extremely rare on wrecks of all dates in this type of environment, and there is no visible sign of any remains at this site.

8. At the current level of site reconnaissance and study, there is no valid archaeological evidence with which to identify the site in question as the *Mercedes*. At best, the data is circumstantial.

My comparisons with other sets of artifacts and wrecks derive solely from wooden ships of the 16th to 19th centuries that incorporate similar shipbuilding philosophies and cargo formations to the Black Swan site and from textual evidence for the *Mercedes*. No misleading parallels are drawn with modern iron-built ships such as the *Titanic* or *Bismarck* or to airplane debris scatters (cf. Delgado, points 32, 36, 79, 132) because their medium of construction, and thus process of wreckage, decomposition rates and site

formation processes are entirely different to the site formation expected for wooden ships. As Ward *et al*. have emphasized in the *Journal of Archaeological Science*, 'Iron wrecks and wooden wrecks do not break down in the same way… Iron wrecks are more likely to deteriorate as a result of physical and chemical processes, whereas wooden wrecks are more influenced by physical and biological processes'.[2] Delgado's reference to such vessels is misleading.

3. Black Swan Site Formation

The Black Swan site is located some 100 miles west of the Straits of Gibraltar, outside the 24-mile boundary of Portugal's contiguous zone, at a depth of approximately 1,100 meters.[3] The archaeological remains are very widely strewn across an enormous area, 368 meters long and 110 meters wide, with the main assemblages (cannon, ingots, coin clumps and concretions) distributed across 252 x 110 meters. The artifacts and structural remains range from durable metallic objects of at least several tons weight (iron cannon) to organic material such as rope and wooden coin crate fragments. The environment is conducive to optimum preservation.

My quantitative analysis of the Black Swan site through a detailed examination of the master photomosaic and video coverage exposes the visible archaeological remains to consist of:

i. A wide scatter of 286 copper ingots
ii. 481 4-handled ingots, possibly tin
iii. Hundreds of concreted coins clumps and clusters
iv. 5 bronze cannon
v. 13 probable and 3 possible iron cannon
vi. 1 ceramic olive jar (and 1 base of a probable olive jar)

[2] Ward, I.A.K., Larcombe, P. and Veth, P., 'A New Process-based Model for Wreck Site Formation', the *Journal of Archaeological Science* 26 (1999), 564.
[3] For the sake of accuracy, dimensions given in this report repeat the original metric and non-metric formulas cited in the sources consulted. Dimensions taken from the photomosaic (Annex 2.1) are provided in meters.

vii. Hundreds of large amorphous iron concretions on top of corrosion pedestals
viii. 1 concentration of high-value domestic table ware (8 pewter/silver plates, 2 tray handles, 4 spoons, 4 probable silver/pewter candlesticks, 1 gold candlestick)
ix. 1 bronze rudder pintle
x. 1 miscellaneous bronze reinforcement unit
xi. 1 bronze rope pulley
xii. 1 certain, 1 probable and 2 possible copper hull bolts
xiii. 1 strip of copper tubing or copper hull sheathing crumpled into the form of a tube
xiv. Miscellaneous copper artifacts
xv. 2 crumpled lead tubes
xvi. Several sections of lead sheet
xvii. 6 areas of dense iron concretions, probably rigging
xviii. 3 sections of rope, plus 3 possible sections of rope
xix. 2 possible fragmentary wooden planks
xx. Several brick fragments

Odyssey's limited excavation recovered from the seabed (Annex 3) 14.513 tons of silver coins and various small finds, including ammunition (iron cannonballs), rigging (1 bronze rope pulley, 3 circular bronze rigging discs) and personal belongings (3 gold boxes, 3 metal belt buckles, 1 set of gold cufflinks, a golden chain section, 1 glass decanter stopper, 7 probable metal cutlery parts).

It must be emphasized that the sole remains possibly associated with a hull recovered are some three-dozen copper tacks apparently used to nail copper sheathing onto hull planking (Annex 3, no. 59). There is no way to be certain, however, that this material was not spares that came from a carpenter's chest: no wood is attached to the tacks and wear-analysis has not been conducted.

Zero sections of inter-connected wooden hull planks are identifiable on the Black Swan site: no keel, no keelson, no strakes, no ceiling planking, no frames, no stringers, no

stanchions, no knees, no mast-step, no sternpost, no prow. The only wooden remains identified are sections of chests in which the commercial coin cargo was transported.

In marine archaeology, site formation refers to the spatial preservation of a shipwreck on a seabed through cultural (jettison, salvage), biological (marine worms, octopus burrows) and chemical (wood decomposition, metal corrosion) influences and processes. The theory on the subject is relatively slender and uncomplicated.[4] Sites associated with wooden wrecks can be subdivided into 5 main classes (Annex 4.1):[5]

Muckelroy Class 1: extensive structural remains; many organics; numerous artifacts coherently distributed.

Muckelroy Class 2-3: elements/fragments of structural remains; some organics; many scattered artifacts.

Muckelroy Class 4-5: No structural remains; few organics; some/few scattered/disordered artifacts.

More recent theory (Annex 4.2) complements this picture by subdividing shipwrecks into:

Intact Shipwreck: fairly coherent; loss of buoyant material on deck.

Disintegrated Shipwreck: very scattered; loss of buoyant material on deck and within the hull.

[4] This summary and interpretation is based on the key archaeological literature on wreck forms: Muckelroy, K., 'A Systematic Approach to the Investigation of Scattered Wreck Sites', *International Journal of Nautical Archaeology* 4.2 (1975), 173-90; Muckelroy, K., *Maritime Archaeology* (Cambridge University Press, 1978), 157-96; Stewart, D.J., 'Formation Processes Affecting Submerged Archaeological Sites: an Overview', *Geoarchaeology* 14.6 (1999), 565-87; Ward, I.A.K., Larcombe, P. and Veth, P., 'A New Process-based Model for Wreck Site Formation', the *Journal of Archaeological Science* 26 (1999), 561-70.
[5] Muckelroy, K., *Maritime Archaeology* (Cambridge University Press, 1978), 164, table 5.3.

Wreck of a Capsized Ship: widely scattered cargo; hull substantially intact, possibly in a different location; loss of most lighter material.

Merchant vessels sailing at the time of the *Mercedes* generally measured 25-30 meters in length, while the largest warships of the age, such as the French 118-gun *L'Orient* (wrecked 1798), was 65.2 meters long, and the 102-gun HMS *Victory* (fought in the Battle of Trafalgar, 1805) measured 69.3 meters. In total the Black Swan site is over 5 times longer than the greatest warships of the time. The main scatter alone is 3.6 times longer than the largest contemporary ships. The distribution of artifacts on the Black Swan site cannot be taken to be indicative of the presence of a 161 foot-long (49-meter) Spanish frigate, such as the *Mercedes.*

In no way can the site be judged to be a coherent or even a minimally structured shipwreck. No pattern exists amongst the archaeological material, which is discontinuous and incoherently scattered. The copper ingots are widely diffused between grid nos. K22 and AK30 and the tin ingots between K30 and AJ29, a minimum distance of 144 meters. Similarly, the iron cannon lie at random between grid nos. J11 and AG39 – some 183 meters apart. The 18 guns' positions display no ship-shape coherency; their muzzles all lie in different directions:[6] 4 muzzles are oriented to the northwest, 2 to the west, 4 to southwest. 1 to south and 3 to the southeast (Annex 5).[7] The random cannon pattern does not signify the presence of a structured vessel, as can be observed on the wrecks of the *Sacramento*, lost off Brazil in 1668 (Annex 6.1),[8] the *Hazardous* that foundered off England in 1703 (Annex 6.2)[9] and on the *Conde de Tolosa*, lost in 1724 in Samaná Bay, Hispanola (Annex 6.3).[10] The Black Swan bronze guns are scattered towards the south of the site, 107 meters apart, between grid nos. V21 and AH38 (Annex 2.1). The iron concretions are scattered abundantly across the entire site.

[6] The terms cannon and guns both define the same type of object in naval terminology.
[7] Based only on those cannon whose muzzles are clearly visible.
[8] Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *International Journal of Nautical Archaeology* 8.3 (1979), 213.
[9] Owen, N.C., '*Hazardous* 1990-1991 Interim Report', *International Journal of Nautical Archaeology* 20.4 (1991), 328.
[10] James, S.R., 'A Reassessment of the Chronological and Typological Framework of the Spanish Olive Jar', *Historical Archaeology* 22 (1988), 47, fig. 3.

The Black Swan site is enigmatic because technically it does not fit into any of the shipwreck classes categorized above. Its cargo is incoherently scattered, there is no hull (see Section 4 below), yet organic rope and coin chests are preserved. In even the most hostile of seabed environments, including reefs and natural stone boulders, parts of hulls survive (Annex 4.3). The absence of hull remains, yet presence of some delicate organics (rope, wooden coin chests) and extensive quantities of artifacts, does not fit into any of Muckelroy's 5 classes.

The only conclusion to be derived from the Black Swan data set is that the site consists of a highly scattered and scrambled set of cannon, iron concretions of undetermined character, and is dominated by a large cargo of coins. The domestic assemblage (personal belongings) is extremely limited, with only 1 intact ceramic jar (Annex 2.13), 1 base (Annex 2.14) and 7 sherds represented.[11] Hundreds of intact pots or thousands of sherds ought to denote the shipwreck of the *Mercedes.* The shortest distance between a single class of structural fitting, the bronze cannon, is 2.2 times longer than the length of the *Mercedes*; the furthest distance, between the iron guns, is 3.7 times greater than the size of this Spanish frigate. The pattern of deposition is random; no structure to an original ship's vessel is manifested.

Delgado and the Counsel for Spain, however, seem to interpret the Black Swan site as a partly coherent Class 1 wreck, with chests of coins, ingots, cannon, and fittings and equipment 'ejected in a focused lens or concentrated area' (Delgado point 33). Further, the same point emphasizes that 'Major sections of the ship came to rest in pieces as a result of the explosion, and these sections, as well as other artifacts, at the site extend to the east and north of the area with the densest concentration'.

Contrary to this supposition, there is no structure to the site and absolutely no visible remains of a wooden hull. Arguing that the wreck of the *Mercedes* can be seen on the seabed is an example of acute misdirection. Following the above theory, the current status

[11] See Annex 3, *Black Swan Project. Gibraltar Artifact Summary* (nos. 23, 25, 26, 29, 31, 34, 35).

leads to the conclusion that the site most closely resembles cargo and artifacts from a capsized ship.

4. Environmental Analysis

Delagdo's major argument that substantial hull remains and artifacts remain encapsulated within a shipwreck at the Black Swan site is based on an inaccurate supposition that the seabed is composed of mobile sandbanks concealing myriad archaeological remains (ie. the rest of the wooden ship). Accordingly, he states that there are 'active currents at the seabed which produce lateral movements of bottom sediments. One effect of the bottom current is "scouring," in which localized eddies around an exposed artifact produce a shallow depression around the artifact… It is also evident that many artifacts, including cannon and vessel remains, are wholly or partially buried, either because their weight drove them into the sediment or because lateral movement of sediment has covered them… This movement of sediment has alternately exposed and buried artifacts and the ship's remains' (Delgado, point 32).

Elementary archaeological observations disprove beyond a shadow of doubt the idea that vast sections of wreckage underlie the seabed. The flat seabed consists of compact, heavy gray clay with the consistency of medium-grade plasticene covered by minimal sediments and crossed by limited currents. The depth of transportable sand in some places is non-existent because the hard clay strate is visible as the seabed. Elsewhere, intermittent pockets of thin sand extend downwards to a maximum depth of about 30 centimeters, sufficient to cover small numbers of ingots and the ends of 4 of the 18 cannon. The evidence for this is overwhelming (Annex 2.4-2.7).

The 'scouring pits' around concreted pedestals interpreted by Delgado as proof of extensive sand movement by currents are in the majority of cases impact craters created when extremely heavy chests of coins and cannon weighing several tons smashed into the seabed with great velocity at their time of loss. The compactness of the seabed, the very

shallow sediments overlying it and the incorrect interpretation of impact craters as scour pits are proven by 7 points:

1. The classical form of concretion shells that surround iron artifacts in marine environments, as recorded on the majority of shipwrecks deposited in sandy environments across the world (Annex 7), is absent on the Black Swan site. This pattern proves that insufficient sand cover exists for leaching iron to attract adjoining sediment and form hard crusts. Instead, on the Black Swan site the iron has decomposed downwards and outwards into the consolidated mud substrate, in turn attracting the softer mud molecules towards the pedestal, which accentuates the size of the impact craters.

2. The iron and bronze cannon on the Black Swan site must have weighed up to 2.5 tons each when lost. Gravity dictates that such extremely heavy objects will displace vertically downwards until they penetrate strata sufficiently solid to hold their weight. On the Black Swan site the cannon have undergone precisely such a process, yet are still visible on the site's surface. In the bluntest of terms, arguing that these guns lie on thick loose sand, while a wooden hull has penetrated more deeply would require them to have defied the laws of gravity.

3. The stiff matrix of the clay seabed is demonstrable by a single bronze cannon that protrudes vertically out of the seabed (Annex 5, C22). This gun hurtled through 1,100 meters of water at the time of the cargo's loss to become literally stuck in the mud by one-quarter of its length. No loose sand surrounds or engulfs the gun; it is embedded within a stiff layer of mud.

4. If a combination of mobile sand movement and significant current existed, resulting in the kind of scouring suggested by Delgado, then the majority of artifacts would be partly covered by fluid sediment at the interface between the object and sand flow/current. Down-current, the opposite side of the artifact protected from current motion would be free of sand. This bipolar pattern is

simply not present on the Black Swan site: both sides of artifacts display equal and consistent sedimentological patterns (see Annex 2.13).

5. If present, significant currents within a high-energy environment would be expected to have propelled pottery vessels against hard seabed protrusions, such as the iron pedestals, and to have smashed the pots into sherds. No such pattern is visible.

6. The marine life on the photomosaic consists of 2 stingrays, 5 red starfish, 2 white starfish and 292 sea urchins. The latter are distributed across the whole site, on some artifacts, but mainly isolated on the open seabed. Sea urchins are not indigenous to habitats characterized by areas combining strong currents and mobile sands because they find no solid purchase and are washed away. Their omnipresence across the Black Swan site is again indicative of minimal current and sand motion.

7. The Black Swan site is to my knowledge in fact unique in its level of archaeological preservation. With widespread evidence of impact craters and stains, where iron and copper ingots can be seen deteriorating in their original points of deposition (Annex 2.8-2.12), anatomically the seabed and artifacts appear to be 'frozen in time' in the precise locations where they were originally deposited. The environment is hydronamically stable.

5. Exploded Warships

In the opinion of Delgado, the configuration of 'wreckage' on the Black Swan site is consistent with the explosion of the *Mercedes*. Accordingly (point 24), he asserts that 'The pattern of artifacts at the site includes dispersion of heavy as well as lighter artifacts away from a central, more concentrated area of dense and heavy objects. This is consistent with an explosion so violent that a heavy cannon was broken apart and a large

fragment of it was blown onto another ship, followed by the dispersion that occurs as the remains sank in waters deeper than a kilometer'.

Delgado (points 24, 41) introduces the comparative case of *L'Orient* as his primary testimony that the Black Swan site holds the remains of the exploded *Mercedes*, which blew up under similar circumstances. *Ipso facto*, the two sites should resemble one another archaeologically. *L'Orient* blew up during the Battle of the Nile, a military engagement with Britain and France in Aboukir Bay, Egypt, on 1 August 1798. Delgado (point 24) accurately reports that excavations by Franck Goddio, Director of the Institut Européen d'Archéologie Sous Marine, discovered a widely scattered site where objects were dispersed up to 820 feet away from 'the fragmentary remains of the bottom of the hull, which lay in silt… among the artifacts recovered was the rudder and a disassociated pintle as well as a wide array of other artifacts from the ship's construction, fittings, armament, and crew'.

The shipwreck of *L'Orient* is of the utmost relevance to the archaeology of the *Mercedes*, although comparisons are complicated by the absence of a preliminary scientific publication or a final report. However, popular reports of the wreck's excavation in newspapers, in L. Foreman, E.B. Phillips and F. Goddio's popular *Napoleon's Lost Fleet: Bonaparte, Nelson and the Battle of the Nile* (Discovery Books, 1999) and on Goddio's website[12] reveal some basic facts (Annex 8):

1. An inscription on the rudder of the wrecked warship reads 'Royal Dauphine', the former name of *L'Orient* before the French Revolution. This provided the precise kind of evidence needed to prove the name and nationality of a sunken vessel unequivocally (that is sorely lacking on the Black Swan site).

2. Clearly identifiable wooden sheave blocks from the rigging survived the blast.

[12] http://www.franckgoddio.org/sitemap/project/Napoleon/Default.aspx.

3. The first of two explosions propelled *L'Orient* forward 'like a rocket' by about 30-35 meters. The intact central 25 yards of the severed ship survived a second blast. An enormous section of the wooden hull survives on the seabed.

4. A 3-ton cannon was twisted out of shape by the force of the blast.

5. The wrecked artifacts include weaponry, ammunition and personal belongings (tobacco pipes, shoes, buckles, uniform buttons, glass bottles and pharmacy objects).

To summarize the data derived from the excavation of *L'Orient*, a large section of coherent wooden hull was preserved; the severity of the explosion bent bronze cannon; a rich variety of personal belongings was discovered, as well as an inscription proving the nationality and name of the warship; the status of the wreck as a war grave can possibly be argued by the presence of regiment buttons, although no human bones have been reported. Crucially, not one of these archetypal features of an exploded warship are present on the Black Swan site, especially extensive wooden hull remains.

The anatomy of an exploded warship, and the anticipated archaeological remains to survive, can be examined in greater detail through comparisons with the *San Juan de Sicilia*, a Spanish Armada warship that blew up in Tobermory Bay on the Isle of Mull, Scotland, on 8 August 1588. Rich contemporary sources suggest that the ship was deliberately blown up by John Smolett of Dumbarton, an undercover vitals supplier/spy in the employ of Sir Francis Walsingham, head of the English Secret Service.[13]

The records of Spain's Chief of Supplies, Baltasar de Navarete, verify that the ship carried 279 soldiers, 63 sailors and was equipped with 26 guns, 1,300 round shot, 69 powder quintals, 19 lead powder quintals, 100 arquebuses, 20 muskets and 40 calfskin powder pouches. The food provisions included 2,580 *arrobas* of wine in 94 pipes of

[13] According to Cotton MSS, Caligula D 1, f. 232, the British Museum; Kostic, V., *Ragusa and the Spanish Armada* (Belgrade, 1972), 219.

wood with 540 hoops of iron, 6,000 sardines from Setubar and octopus. The domestic assemblage included an iron steelyard, 350 Portuguese *quintals* of pine firewood, 38 wooden bowls, 70 wooden plates and six wooden lanterns.[14]

The explosion on the *San Juan de Sicilia* was so severe that:

1. A memorandum of 1677 'Information anent the Spanish "wrack" ship which the Earl of Argyle hath a right to' reported that the ship 'was burnt and so blown up that two men standing on the cabin were cast safe on shore'.[15] A map in the collection of the Duke of Argyll, drawn by Mark Tiddeman in 1730, depicts the wooden skeleton of a ship (keel and frames) on a north/south axis, some 400 meters off the northeastern point of Tobermory Bay. This gives an indication of how far the crew members were catapulted by the explosion. The catastrophic explosion of the *San Juan* was evidently enormous.[16]

2. Other than 15 men on shore at the time of the explosion, all hands were killed.

3. The fire burnt three-quarters of the ship's superstructure, with the sterncastle collapsing into a great heap of timber. The ship foundered onto the seabed.

Despite the scale of the massive explosion, as in the case of *L'Orient* extensive and coherent hull remains were excellently preserved. Over 25 salvage operations conducted on the wreck of the *San Juan de Sicilia* between 1676 and 1982 provide the most detailed historical and archaeological understanding in existence of the impact of a massive explosion on a Spanish ship and its structure. To summarize the wreck's changing formation down the centuries:

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[14] Martin, C., *Full Fathom Five: Wrecks of the Spanish Armada* (Chatto & Windus, London, 1975), 274; McLeay, A., *The Tobermory Treasure. The True Story of a Fabulous Armada Galleon* (Conway Maritime Press, 1986), 61, 167, 171, 176; Kingsley, S., *The Tobermory Armada Shipwreck Project* (London, unpublished, 2006).
[15] Hardie, R.P., *The Tobermory Argosy. A Problem of the Spanish Armada* (Oliver & Boyd, Edinburgh, 1912), 18.
[16] Kingsley, S. *The Tobermory Armada Shipwreck Project* (London, unpublished, 2006), 7.

A. During the 1676 salvage operation of Treilaben and Captain Adolpho Esmith, the *San Juan de Sicilia* was a coherent wreck site with an intact lower hull and a relatively nucleated debris field. The stern and sterncastle of the wreck survived as a tangle of timbers rising 12-18 feet above the seabed. The entire superstructure between the bowsprit and the mizzenmast was destroyed, leaving the hull exposed. Cannon were lifted from around the wreck. The original text reads:

‘The fore part of the ship that was above water is quite burnt, so that from the mizzen mast to the foreship there is no deck left, but the hull full of sand, which the Early of Argyll caused search a little found nothing but a great deal of cannon ball about the mainmast, and some kettles and tankers of copper, and such like in other places. Over the hindship where the Cabin was, there is a heap of great timber, which will be a great task to remove, but under this is the main expectation – and it is thought the deck under the Cabin is still entire. The great timber lay in great confusion, and in the middle there is a voyd place, which the Earl durst not try with the bell and the workmen did not give a perfect account of it.[17]

B. A letter sent by Archbald Miller to King James of England on 20 November 1683 (Bodleian, Rawlinson Papers A, 189, f.423) details the contextual discoveries of the time, confirming the survival of extensive wooden hull remains and a central ballast heap. Miller reported that ‘There is no Deck upon her except in ye Hinder part, there is one great heap of Timber which I take to be the Cabbin. I did see one doore there which I take to be the Steerage doore, and within that doore I did see a number of Dishes both great & small of a White blewish Colour… In the forepart of the Ship lyes many great Ballast stones & some shot amongst them, & there wee found one Silver bell about 4*l* weight, wee got without the Ship at a pretty distance the said great Gun with other two (all Brass Gunns)… we also got two

[17] McLeay, A., *The Tobermory Treasure. The True Story of a Fabulous Armada Galleon* (Conway Maritime Press, 1986), 42.

Demy Culverins, two Falcons, two Slings all Brass. Wee lifted three Anchors, whereof one was eighteen feet of length, th'other was fifteen, and the third was ten, I got two brass Sheaves, weighing Sixty pounds, I lifted also a Rother [rudder], & took eight Iron pykes of it…'[18]

C. In October 1729, Captain Jacob Rowe, a pioneer salvor who invented a diving engine and the first underwater lamp, wrote excitedly to Robert Graham of Glasgow, one of his investors: 'Typpermorry… Since my Last to You we have been Very Busie… at Work and Under ye Ballast of ye Wreck we have discovered a Large Platform Covered with Boards Under which we Discovered a Great Number of Casks and Chists but they being semented hard together we have not as yet been Able to take up a Specimen to prove whether ye Same be Treasures'.[19]

According to these sources, despite a violent explosion on the *San Juan*, equally as ferocious as on the *Mercedes,* the wreck was archaeologically coherent. Only following Rowe's use of gunpowder to break up the wreck in 1729 did references to its hull disappear. The last recorded sighting of the wooden superstructure of the Tobermory shipwreck dated to 1740. However, consistently into the mid-20th century wooden planks were recovered from the site. In total, 40 bronze and iron cannon,[20] copper kettles, inscribed pewter plates, a silver bell, part of the rudder, an iron strongbox, silver and gold coins, a silver flagon, gold ring, a broken sword blade in its leather scabbard, a copper strainer, brass navigation dividers, porcelain vessels, small arms, pikes, a silver

[18] *Letter of Archbald Miller to King James, 20 November 1683* (Bodleian, Rawlinson Papers A, 189, f.423).
[19] McLeay, A., *The Tobermory Treasure. The True Story of a Fabulous Armada Galleon* (Conway Maritime Press, 1986), 57.
[20] Spanish lists prepared in Lisbon in May 1588 refer to *San Juan* as a 26-gun ship, but dispatched sent by the Duke of Medina Sidonia to the king of Spain from Corunna reported that her captain, Don Diego Tellez Enriquez, took onboard at least half the guns of the leaking *Casa de Paz*: McLeay, A., *The Tobermory Treasure. The True Story of a Fabulous Armada Galleon* (Conway Maritime Press, 1986), 177.

candlestick, leather, pottery, glass and stone ballast were clustered together on the seabed.[21]

The extensive salvage history of the *San Juan de Sicilia* reveals the categories of artifacts and extent of hull remains and ballast to be expected to be preserved on the wrecks of exploded warships. In the cases of both *L'Orient* and the *San Juan de Sicilia*, as well as the coherent Napoleonic warship *Mercure* blown up in battle off Lignano, Italy, in 1812 (Annex 9),[22] masses of domestic assemblages belonging to the officers and crew, coupled with clearly visible interconnected sections of wooden hulls, survived the blasts. In the cases of the *Orient* and *San Juan de Sicilia*, this included the rudder.

The absence of such artifacts (notably the ubiquitous pottery found by the ton on shipwrecks) and wooden hull structure on the Black Swan reflects very different wreckage and site-formation processes in action. Particularly considering the fact that the *Mercedes*' hull was copper-sheathed, which would have served to keep large sections of the hull intact, significant sections of hull should characterize the wreck site of the *Mercedes*. They do not exist on the Black Swan site.[23]

6. Shipwrecks & War Graves

The proposition that Odyssey is deliberately violating a national war grave on the Black Swan site is the most disconcerting of several vicious lines of enquiry forwarded by the

[21] Campbell, Lord A., *Armada Cannon* (London, 1899), 6, 8, 10; *Letter of Archbald Miller to King James, 20 November 1683* (Bodleian, Rawlinson Papers A, 189, f.423); McLeay, A., *The Tobermory Treasure. The True Story of a Fabulous Armada Galleon* (Conway Maritime Press, 1986), 57, 58, 61, 104, 106, 127, 176; Veselin, K., *Ragusa and the Spanish Armada* (Belgrade, 1972), 223; Lewis, M., *Armada Guns. A Comparative Study of English and Spanish Armaments* (George Allen & Unwin Ltd, London, 1961), 140.

[22] Beltrame, C. and Gaddi, D., 'Report on the First Research Campaign on the Napoleonic Brick, *Mercure*, wrecked off Lignano, Udine, Italy in 1812', *International Journal of Nautical Archaeology* 31.1 (2002), 60-73.

[23] Hull remains are common on deep-sea wrecks such as the Tortugas site of 1588 off Florida (Annex 13.5) and the Pina Colada wreck (Sinclair, J. *Coconuts of the Deep*, 2002: http://web.mit.edu/deeparch/www/events/2002conference/papers/Sinclair.pdf). Water temperature and other climatic differences are not barriers to excellent preservation of hull remains at depth.

Counsel for Spain. Document 131 (p. 3) considers the Black Swan site a ‘gravesite of Spanish servicemen’, while De Leste Contreras (point 4) states that ‘The underwater resting place of the *Mercedes* is also the gravesite of more than 250 Spanish Navy personnel’ and ‘Therefore, Odyssey has taken, without authorization, part of Spain’s historical patrimony and has desecrated the gravesite of hundreds of Spanish citizens’ (point 43). In an identical vein, Delgado (point 38) confirms that ‘many artifacts at the site likely are not exposed and are buried beneath the bottom. This would include organic materials such as human remains that would be preserved by being covered’.

One of the most inaccurate myths of marine archaeology is the presumption that bodies and skeletons litter shipwrecks. This is a ‘Disneyesque’ fantasy, as all marine scientists are fully conscious. This suggestion within a legal document is profoundly worrying and highlights the extent to which the Counsel for Spain is misrepresenting the truth through emotional special pleading.

As G. Arnaud, S. Arnaud, A. Ascenzi, E. Bonucci, and G. Graziani reported in their article ‘On the Problem of the Preservation of Human Bone in Sea-water’ (*International Journal of Nautical Archaeology* 9.1, 1980: 53), ‘In submarine archaeology, the discovery of human bone remains is a very rare event.’ For this reason, the subject receives no individual treatment within Wendy Robinson’s classic *First Aid for Underwater Finds* (Nautical Archaeology Society, London, 1998) or in Colin Pearson’s *Conservation of Marine Archaeological Objects* (1988: 53-4), where the absence of human bones compels the world expert on the subject to restrict his observations to artifacts of carved animal bone.

The vast majority of shipwrecked sailors either survived a tragedy or, after death, their bodies swiftly floated free of wreckage. Human bones are only discovered as and when an unfortunate soul was trapped beneath decks, typically beneath cannon on warships. This creates a sealing layer and, under anaerobic conditions depleted of oxygen, small quantities of bone can be anticipated.

Of the 135-crew that manned the fifth-rate English warship HMS *Dartmouth*, for instance, wrecked off Scotland in 1690, only a few human bones from 1 foot were preserved inside 1 shoe trapped under a cannon.[24] The bones of only 3 men from the 135-strong crew on HMS *Pandora* have been excavated off the Great Barrier Reef,[25] and 60% of the bones of a single male caught beneath deck during the act of wreckage were documented on the 60-crew Cromwellian wreck of the *Swan* lost off Duart Point, Scotland, in 1653.[26] The experimental deposition of modern human bone near this site found that the material 'showed extensive softening' even after 52 weeks, plus the precipitation of phosphates, which negatively affected the bones structural stability.[27]

Only 1 jawbone from the 1,040-strong crew that perished on the *Orient* in Aboukir Bay, Egypt, in 1798 has been discovered, leading Goddio's team to conclude that 'Underwater archaeologists rarely find actual human remains – typically not even bone can withstand the salt water, marine life, and other destructive elements'.[28] Limited skeletal presence typifies wrecks located in sandy and hard mud environments, as opposed to fluid mud contexts like the *Mary Rose*, *Kronan* and *Vasa*, where human bones should be expected and are common.[29]

Analysis of the video, still photographs and close-up scrutiny of the photomosaic from the Black Swan site reveals not a single bone – animal or human. No buttons from naval uniforms have been recovered either. Shipwrecks are neither graves nor national cemeteries, but are concentrations of abandoned wood and artifacts. Inaccurately

[24] Adnams, J.R., 'The Dartmouth, a British Frigate Wrecked off Mull, 1690', *International Journal of Nautical Archaeology* 3.2 (1974), 271.
[25] http://www.qm.qld.gov.au/features/pandora/human.
[26] Martin, C., *Resurrecting the Swan: Archaeology of a Cromwellian Shipwreck, 1653* (http://www.historyscotland.com/features/resurrectingtheswan.html).
[27] Gregory, D., 'Experiments into the Deterioration Characteristics of Materials on the Duart Point Wreck Site: an Interim Report', *International Journal of Nautical Archaeology* 24.1 (1995), 62.
[28] Only 60 of the 1,100 men on-board *L'Orient* survived the explosion: Foreman, L., Phillips, E.B. and Goddio, F., *Napoleon's Lost Fleet: Bonaparte, Nelson and the Battle of the Nile* (Discovery Books, 1999), 54, 140, 204.
[29] Mays, S., 'Human Remains in Marine Archaeology', *Environmental Archaeology* 13.2 (2008), 127, table 1.

appealing to the hearts and minds of a judge or jury in this instance, and using this argument in a public arena, is consciously manipulative and intellectually dishonest.

7. Cannon

The technical terms of cannon components cited in this section are illustrated in Annex 10.1.

The Black Swan site contains 13 iron and 5 bronze cannon, whose locations and orientations display no ship-shape coherency (see Section 3 above and Annex 5). Within the composition of the cannon visible on the Black Swan site, the Counsel for Spain asserts that the specific guns of the *Mercedes* are identifiable. Apart from the possibly coincidental transport of antique guns on *Mercedes* – an extremely common naval policy – the composition of the ordnance on the seabed and that of the *Mercedes* categorically does not dovetail.

As de Leste Contreras explains (point 22), the *Mercedes* was armed according to navy regulations. According to Estrada (point 15), Navy Ordinances applied only to warships and were applicable to the *Mercedes*. The official registry attached to her Squadron Leader's letter (document 131-3, exhibit A, point 22), demonstrated by a letter from Squadron Leader Ugarte to the Minister of the Navy written at Montevideo on 8 June 1804, confirms that in line with 'Spanish Navy regulations' she carried:

- 26 x 12 pounders
- 4 x 6-pounders
- 8 x 24-pounders (*obuses* or *pedreros*)
- 12 x 3-pounder (*obuses* or *pedreros*)
- 1,040 cannonballs of 12 pounds each

De Leste Contreras (point 32) testifies that the 'artillery of the *Mercedes* before leaving Montevideo met these regulations, as demonstrated in the official registry attached to the

Squadron Leader's letter' and identifies one cannon on the Black Swan site as a definite 'Spanish Navy *pedrero* of the 1784 specification; twelve of which were on board the *Mercedes* when it sank in 1804… The presence of Spanish-regulation cannons that were part of the artillery of warships of the Spanish Navy – and specifically of the *Mercedes* when it was attacked and sank in 1804 – in the place where Odyssey extracted the artefacts confirmed that the shipwreck is that of the *Mercedes*.' De Leste Contreras (point 22) defines a *pedrero* as a 'short-barrel anti-personnel weapon that principally used stone projectiles.'

The Counsel for Spain further testifies that at El Callao, the *Mercedes* is recorded as having taken on board 2 obsolete bronze cannon, known as *culebrinas* (culverins), for transport to Spain (de Leste Contreras, point 37, annex 15, Delgado points 106-107, annex 9.29-9.32). Apparently 'Both of these highly distinctive and readily identifiable cannons are at the site' (document 131, p. 15). O'Donnell Y Duque de Estrada (point 26) concurs that 'The presence of these culverins at the site of the *Mercedes* is, in my opinion, an unquestionable proof of identity of the shipwreck'.

In the following comments, I wish to emphasize that cannon are renowned amongst naval historians and marine archaeologists as very weak indicators of the nationality and date of a ship. This is because cannon remained in circulation as both armament and antiques for decades and, in the case of highly prized bronze guns, often for more than a century. Nations did not rely exclusively on ordnance manufactured in their own countries or colonial dependencies, but more commonly exploited ordnance seized as prizes from enemy craft. To complicate matters further, monarchs also ordered cannon to be manufactured in overseas foundries. England, for instance, was a renowned center of gun production for foreign markets, including the Portuguese Navy.[30] It is the rule rather the exception to encounter guns on Spanish, English, French, Dutch and Portuguese warships that do not reflect a vessel's direct nationality.

[30] Baker, H.A., *The Crisis in Naval Ordnance* (National Maritime Museum Greenwich, Maritime Monographs and Reports No. 56, 1983), 9, 34.

In the case of the Black Swan site, the difficulty of provenancing the bronze ordnance – and the impossibility for the iron guns – site is compounded by 5 key facts:

1. No inscriptions on any Black Swan gun are visible revealing dates, royal crests, nationalities or maker's marks.

2. No foundry marks are visible on any trunnions. Guns bore these features to control production and distribution. The trunnions on the late 18th/early 19th century 'Forty Cannon' wreck off Quintana Roo were incised with the letters 'E', 'F' and 'C', similar to those found on the right trunnion of a British 4-pounder recovered from York River, dating to 1782 and manufactured by Graham and Sons in Mexico.[31]

3. The 5 bronze and 13 iron cannon on the Black Swan site (total 18) do not correspond with the 50 with which the *Mercedes* was armed, according to de Leste Contreras. A deficit of 64% thus exists between the reality of *Mercedes* and Black Swan. Even though a quarter of the culverin has penetrated the seabed's clay substrate and cannon C1 is half buried, as demonstrated above there is no thick mobile sand on-site capable of concealing these missing guns. This either proves that the Black swan site is not the *Mercedes* or that the archaeological material on the seabed only represents 36% of the site. In this regard it is notable that no wooden cannon carriages with their distinctive circular wheels are present.

4. Historical records refer to 2 culverins on the *Mercedes.* Only one is present on the Black Swan site.

5. Even though only 4 of the 20 bronze *obuses* or *pedreros* are present on the Black Swan site, and are listed as fully functional cannon, one example (Cannon C18, Annex 5) has the cascable sawn off, rendering it inoperative. The transport of

[31] Irion, J.B., 'The Forty Cannon Wreck, Chinchorro Banks, Quintana Roo, Mexico. A Preliminary Report 1978', *International Journal of Nautical Archaeology* 9.1 (1980), 29, fig. 1.

defunct *obuses* or *pedreros* is not listed within the *Mercedes*' ordnance itinerary. Similarly, 16 of these cannon listed on the *Mercedes*' manifest (80%) are absent from the Black Swan site.[32]

The inability of cannon to define a ship's nationality and date is typified by the *Sacramento*, the flagship of a convoy of 50 Portuguese ships lost off Brazil in 1688 when bound for Bahia, Sao Salvador. The ship carried 42 bronze guns of Dutch, English and Portuguese origin of far earlier date than the final voyage, and manufactured in the mid-16th century, 1590, 1596, 1597, 1622, 1634, 1649, and 1653 (Annex 10.2).[33] Some were over 100 years old when the ship sank.

The reliance on foreign guns on Spanish ships is demonstrated by the *Santa Maria de la Rosa*, the 945-ton flagship of the Armada's Guipuzcoan squadron from northern Spain, which carried a 6-pounder Venetian gun bearing the maker's mark of the founder 'ZA', Zuanne Alberghetti of Venice.[34] Reuse of antique cannon is again exemplified by a 15-inch Spanish bronze mortar cast in 1724 in Barcelona and captured by American forces in 1898 during the Spanish-American War.[35]

The idea that culverins are exclusive expressions of Spanish ordnance is once more inaccurate. This gun form was produced as a standardized shape and in various sizes from 16-20-pounders in France and England, as well as Iberia.[36] Within the trading orbit of Spain, a 3.02 meter-long French culverin has been discovered by the Grupo de

[32] These statistics are based on de Leste Contreras' argument that the *Mercedes*' left Montevideo with her full compliment of cannon. However, contemporary documents describe some of the *Mercedes*' guns as being removed to make extra space for passenger accommodation and the commercial cargo. The precise quantity of ordnance removed is not reported.
[33] Smith, R., *Treasure Ships of the Spanish Main: the Iberian-American Maritime Empires'*. In G.F. Bass (ed.), *Ships and Shipwrecks of the* Americas (Thames & Hudson, London, 1988), 105. Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *International Journal of Nautical Archaeology* 8.3 (1979), 217-8.
[34] Martin, C., *Full Fathom Five. Wrecks of the Spanish Armada* (Chatto & Windus, London, 1975), 206; Martin, C., 'Two Armada Wrecks'. In K. Muckelroy (ed.), *Archaeology Under Water* (McGraw-Hill Book Company, NY, 1980), 94-5.
[35] Meide, C., *The Development and Design of Bronze Ordnance, Sixteenth through Nineteenth Centuries* (College of William & Mary, 2002), 5.
[36] Manucy, A.C., *Artillery Through the Ages* (1994), 34-5

Arqueologia Subaquática off Terceira Island in the Azores.[37] Incised with the coat-of-arms of Francis I of France (1515-1547), this culverin displays the precise kind of epigraphic information required to collate an objective case for the nationality of a shipwreck, which is so sorely missing on the Black Swan site.

Elegantly sculpted dolphin handles of the type visible on the Black Swan culverin are erroneously considered diagnostic features of Spanish culverins by Delgado (point 107), but again are a cosmopolitan trait that is not unique or even typical of Spanish warships. Dutch, English, Spanish, Portuguese and even Malaysian cannon were equipped with dolphin handles between 1623 and at least 1769 (Annex 10.3).[38] The evidence is overwhelming and, almost at random, dolphins on non-Spanish guns include the French Enkhuizen gun captured from a Dunkirk privateer in 1622, but cast as early as 1551 for King Charles V by the founder de Halut,[39] 6 guns from the 850-ton Dutch East Indiaman *Reigersdaal*, which ran aground on an offshore reef at Springfontein Point, South Africa, in 1747,[40] and an 18th-century example manufactured in northern Borneo.[41]

While 4 of the bronze cannon on the Black Swan site are typologically similar to unadorned late 18th-century guns in the Naval Museum, Madrid, and the culverin certainly share stylistic traits with Spanish examples in the same institution, it must be stressed that no inscriptions have been detected on the Black Swan site cannon to confirm origins. The anatomy of the Black Swan bronze *pedreros*/*obuses* are in fact very close to a series of late 18th-century English bronze cannon without handles (Annex 10.4): a 4'6" 4-pounder of 1785 (Roth No. 361), a 4'0" 3-pounder (Roth No. 483) and stylistically similar to a 3'6" Armstrong/Fredrik design of 1780 (Roth No. 511).[42]

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[37] Monteiro, P. 2002., The *Nautical Archaeology of the Azores. 2 - Terceira Island: Report on the Underwater Archaeological Activity, 1996-1998. French Culverin (circa 1520)*: http://nautarch.tamu.edu/shiplab/angra12-gun.htm.
[38] Nos. 5, 52, 134, 180, 235 and 241 in Blackmore, H.L., *The Armouries of the Tower of London I. The Ordnance* (London, 1976), 50, 73, 115, 141, 169, 171.
[39] Roth, R., 'The Cannon from Dunwich Bank, Suffolk', *International Journal of Nautical Archaeology* 25.1 (1996), 28-9.
[40] http://www.vocshipwrecks.nl/out_voyages7/reigersdaal.html.
[41] http://www.powerhousemuseum.com/collection/database/?irn=249163&img=42770.
[42] http://www.cannons.ch/verkaufe.htm.

By De Leste's Contreras admission (point 22), 20 highly distinctive, fully functional *pedreros*/*obuses* (short-barrel anti-personnel weapons that principally used stone projectiles) armed the *Mercedes*. Yet 80% of the listed *pedreros* are missing and not one custom-designed stone projectile is present on the Black Swan site. If, as the Counsel for Spain proposes, the site in question is the *Mercedes*, this absence is inexplicable.

Amongst 17 cannon-sized iron concretions on the Black Swan site, 13 display features indicative of probable cannon manifested in various stages of deterioration (Annex 5), from relatively good preservation of guns within concretions, which retain the object's anatomy (cannon C1, C5, C7, C8, C15, C17), to examples where part of the shape survives, but the other half is fully corroded (cannon C3, C4, C6, C10, C12, C14, C16). Three foci of elongated iron are so completely decayed that identification is merely speculative based on the sizes of corrosion pedestals (C2, C9, C11). The latter examples are not included in this report's cannon quantification.

Cannon C5 is the best preserved iron gun on the site (Length 2.2m, Width 0.4m). Yet apart from the swelling of the muzzles and cascable ends, identifying the types (nationality and production date) of any of the iron cannon on the Black Swan site, is quite impossible. Delgado's supposition (points 102-103; annex 14-15) that 2 of the very heavily corroded iron cannon are of Spanish manufacture, with 1 example (annex 9.25) a 12-pounder (see Annex 5), pushes the very weak evidence beyond any realm of acceptable archaeological interpretation. Delgado's annex 9.25 corresponds to cannon C17 in Annex 5. Other than in the straight sides of this gun, no diagnostic feature (muzzle, cascable, trunnions, reinforce positions) is visible. Even if it were, without access to the original nuances of the cannon's design or an inscription, which would require recovery of the gun, meticulous removal of the concretion (see Annex 10.6) and opportune iron preservation, it would be impossible to designate the object to a specific century, let alone a nationality. The supposed 'Spanish' shape of cannon C17 was actually common currency in Holland, England, France and Spain between the mid-17th

and 19th centuries (Annex 10.5).[43]

8. Pottery

The defining character of a ship's nationality is the pottery assemblage found on a wreck. Since fired clay is virtually indestructible, it is found in large quantities on the majority of shipwrecks of all date, geographical locations and environments. Spanish warships were no different, and examples studied as far apart as Ireland and America display rich collections of storage vessels and glazed wares indicative of the social status and nationality of a vessel's officers and crew. A ship undergoing even a short-haul voyage would require hundreds of storage jars to keep victuals edible and hundreds of plates for dining. On its outward journey in 1803, the passage to El Callao from El Ferrol took 162 days (according to Captain Goycoa's letter to Grandallana, 9 August 1803: de Leste Contreras annex 13). This gives an indication of the gargantuan victual demands and storage vessels required to feed a crew of some 250 people.

The meagre quantity of pottery wares on the Black Swan site is implausibly low for a classical shipwreck site. The *Mercedes*, for instance, was stocked with '3400 ordinary rations for 104 days in accordance with 345 positions' when she arrived at the port of Montevideo on 5 June, 1804 (de Leste Contreras, annex 15). Delgado identifies only 3 olive jars on the Black Swan site: 1 spherical jar with a short rim (point 132; annex 9.50); a jar with a flat base and no visible rim (point 133; annex 9.51); and a dubious rim and neck (point 134, annex 9.52). To these may be added the rim of a fourth olive jar and 7 small sherds from unknown pot types (Annex 3, *Black Swan Project. Gibraltar Artifact Survey*, nos. 10, 23, 25, 26, 29, 31, 34, 35). Without recovery of the intact jar to examine its rim and base profile, close dating is impossible. The form remained morphologically unchanged from 1588 to 1724 and beyond.[44]

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[43] Caruana, A.B., *The History of English Sea Ordnance 1523-1875. Volume I, the Age of Evolution, 1523-1715* (Jean Boudriot Publications, Rotherfield, 1994), fig. 44, 46, 57, 58.
[44] The post-1800 'Late Style' in Goggin, J.M., *The Spanish Olive Jar: an Introductory Study* (Yale, New Haven, 1960), 23, pl. 6c. Type B of 1588-1724 in Marken, M.W., *Pottery from Spanish Shipwrecks 1500-1800* (University Press of Florida, 1994), 135, fig. 4.56.

By the early 19th century, middle- and upper-class Europe was swamped by Chinese and Orient-inspired ceramics decorated with delightful scenes of humans, animals, idealized landscapes and animals. These tastes are reflected in their prevalence within Spanish and English shipwrecks from the 1730s onwards:

1. The crew of the Havana fleet wrecked off the Florida Strait in 1733 enjoyed Chinese porcelain.[45]

2. The *Maidstone*, a 1000-ton English warship sunk off Noirmoutier, France, on 8 July 1747, carried blue-and-white embellished Tsing dynasty porcelain depicting rural scenes, weeping willows and floral scenes.[46]

3. Hand-painted blue-and-white oriental porcelain was excavated from the wreck of *El Nuevo Constante*, a merchant vessel in the New Spain Fleet sailing from Veracruz in Mexico to Spain and lost off the Louisiana coast during a hurricane in September 1766.[47]

4. 'Oriental-style' stamped blue-and-white ceramics, produced either in China or imitated in England, comprised the exclusive table-ware on the wreck of HMS *Swift*, a British sloop-of-war sunk off the coast of Patagonia, Southern Argentina, in 1770.[48]

[45] Peterson, M.L., 'Traders and Privateers Across the Atlantic: 1492-1733'. In G.F. Bass (ed.), *A History of Seafaring Based on Underwater Archaeology* (Thames & Hudson, London, 1972), 264.
[46] De Maisonneuve, B. 'Excavation of the *Maidstone*, a British Man-Of-War Lost off Noirmoutier in 1747', *International Journal of Nautical Archaeology* 21.1 (1992), 22.
[47] Pearson, C.E. and Hoffman, P.E., *The Last Voyage of El Nuevo Constante. The Wreck and Recovery of an Eighteenth-Century Spanish Ship off the Louisiana Coast* (Louisiana State University, 1995), 178.
[48] Elkin, D., Argueso, A., Grosso, M., Murray, C., Vainstub, D., Bastida, R. and Dellino-Musgrave, V., 'Archaeological Research on HMS Swift: a British Sloop-of War Lost off Patagonia, Southern Argentina, in 1770', *International Journal of Nautical Archaeology* 36.1 (2007), 43.

5. Chinese pottery was recovered from the *Bounty*, wrecked off Pitcairm, Australia, in 1790.[49]

6. The 194-ton Australian barque *Elizabeth*, wrecked off Cottesloe Beach, western Australia, in 1839, contained Chinese porcelain.[50]

Delgado neglects to explain the complete absence of such Oriental pottery – the calling card of ships of the age – on the Black Swan site. Since ceramics are virtually indestructible and patently have not been broken up by strong currents and washed offshore (proven by the presence of the 3 olive jars), the only logical rationalization is that the wreck represented by the Black Swan cargo site must lie elsewhere, along with extensive sections of the rest of the vessel.

Contrary to de Leste's Contreras conclusion (point 35) that 'In addition, the shipwreck site contains samples of the type of large clay bottles – called *aceituneras* or olive jars – used by Spanish Navy sailors on board Spanish warships at the time of the *Mercedes*', regrettably olive jars are also not exclusively representative of a Spanish-controlled ship like the *Mercedes*. Examples accompanied the Portuguese ships *Sacramento*, lost off Brazil in 1669,[51] and the *Santo Antonio de Tanna*, lost off Mombasa in 1697.[52] The Danish ship *Sainte Dorothea*, lost off Villefranche-sur-Mer near Nice in 1693, also

[49] Erskine, N., 'Reclaiming the *Bounty*', *Archaeology* 52.3 (1999).
[50] Henderson, G., *The Wreck of the Elizabeth* (Studies in Historical Archaeology, No 1, Australian Society for Historical Research, Sydney, 1973): www.museum.wa.gov.au/collections/maritime/march/shipwrecks/Metro/elizab /elizab.html.
[51] Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *International Journal of Nautical Archaeology* 8.3 (1979), 220.
[52] R.C.M. Piercy, 'Mombasa Wreck Excavation. Preliminary Report, 1977', *International Journal of Nautical Archaeology* 6.4, 345, fig. 17.

contained identical olive jars (Annex 11).[53] Some 150 olive jars were stowed on the Australian wreck the *Elizabeth,* wrecked in 1839.[54]

Even Spain's perennial nemesis – England – enjoyed the international 'Spanish' olive jar, with examples recovered from the Thames foreshore at Wapping.[55] A Tudor merchant vessel wrecked in the Thames estuary *c.* 1574, and built of English oak, also carried Spanish olive jars.[56] Bearing these facts in mind, using a mere 3 olive jars from Black Swan to label the ship Spanish and date it with precision would be imprudent.

9. Wooden Hull

The Counsel for Spain's core argument to define the Black Swan site as the *Mercedes* envisages substantial remains of this wooden vessel lying marooned on the seabed. Thus, 'The site contains remains of the wooden hull and other wooden assemblages, especially thicker wooden members such as beams and reinforcing timbers, while thinner wooden elements such as planking have largely been consumed or are buried' (Delgado, point 22). Document 131 (p.13) similarly concludes that 'The site contains, *inter alia,* hull remains in precisely the condition to be expected of a wooden-hulled warship that exploded and sank two centuries ago… Large complexes of wooden hull sections torn by the explosion, some with ship's rigging still attached…'

More specifically, Delgado identifies wooden hull remains in the following cases: wooden hull remains (points 73-5, annex 9.3-9.5); a possible portion of the hull at gun deck level (point 73, annex 9.3); 'remains of the hull of a large wooden ship… densely

[53] L'Hour, M., 'La Sainte Dorothéa (1693). Un Vaisseau Marchand Danois en Rade de Villefranche', *Cahiers d'Archéologie Subaquatique* 11 (1993a), fig. 9.1-2, fig. 10; L'Hour, M., 'The Wreck of a Danish Merchant Ship, the Sainte Dorothea (1693)', *International Journal of Nautical Archaeology* 22.4 (1993b), figs. 5-7.
[54] Henderson, G., *The Wreck of the Elizabeth* (Studies in Historical Archaeology, No 1, Australian Society for Historical Research, Sydney, 1973): www.museum.wa.gov.au/collections/maritime/march/shipwrecks/Metro/elizab /elizab.html.
[55] Middlewood, R., 'Mewstone Ledge Site. B. Oil Jars', *International Journal of Nautical Archaeology* 1 (1972), 147, fig. 6.
[56] J. Auer and A. Firth, 'The "Gresham Ship": an Interim Report on a 16th-century Wreck from Princes Channel, Thames Estuary', *Post-Medieval Archaeology* 41.2 (2007), 232.

associated patterns of deposits of wood, corroded and concreted iron fasteners and fittings' (point 79); iron and bronze bolts and spikes with wood remains attached (point 80, annex 9.9); a largely buried section of wooden hull remains with copper sheathing from the lower sections of the hull (below the waterline) (annex 9.4); in association with an anchor (points 83, 112, annex 9.13); 'lines of cobble and pebble ballast stones' associated with a section of the bottom of the ship's hull – in one plank a socket for a late 18th century iron stanchion that extended vertically from bottom of the hull to the gun deck' (point 86, annex 9.5); hull with concreted bolts and spikes (point 85, annex 9.14); likely decking with bolts and spikes (point 83, annex 9.12).

These individual photographs are presented in Annex 12. Here, however, I wish to certify and emphasize that with the exception of two thin and fragmented possible planks in grid no. T17, none of the images cited above by Delgado display any wood remains whatsoever. The 20 boxes of *cascaria* wood and the petrified willow branch transported by the *Mercedes*, according to the ship's manifest, are also nowhere to be seen. The case regarding the existence of wooden hull remains, either single members or inter-connected structure, is a mirage. Delgado claims to see ships' rigging and from that extrapolates the presence of 'phantom' timbers that he believes should be present, all without visibly identifying them. In all instances, there is zero archaeological evidence of wood underlying sediment at these locations.

Wooden hull remains are extremely common finds underwater due to the anaerobic conditions encountered in the world's seas – indeed, access to ships' timbers through outstanding preservation is the most important archaeological revolution provided by wreck studies. Bearing in mind the natural tendency for material to float away from a ship at its moment of crisis, for a ship's superstructure to break apart, the impossibility of salvage before now due to the site's depth, preservation realities, seabed movement (which has been minimal) and the intrusion of modern rubbish, the survival of delicate rope and wooden chests demonstrates that the environment in which the Black Swan site has settled is conducive to the survival of wood. The archaeology of exploded warships confirms that extensive hull remains survive explosions, which is to be expected since a

ship's hull actually acts as a 'shape charge', focusing the energy of a blast upward, away from the density of the water pushing against the hull.

In the simplest of terms, if a hull foundered at the Black Swan site we would observe substantial traces of its structure on the seabed because Spanish hulls, centuries older than the *Mercedes*, have survived the ravages of time to be excavated as far a field as Ireland (the *Santa Maria de la Rosa* and *La Trinidad Valencera*; Annex 13.1)[57] and America (the *Atocha* and *El Nuevo Constante*; Annex 13.2, 13.3).[58] Wood even occurs in particularly poor environments, such as the hull of the *Nuestra Señora de Balvaneda*, wrecked off Florida in 1733, which settled amongst stone boulders without anaerobic sand blanketed condition (Annex 13.4).[59] If a hull survives here, comparable planking would be highly conspicuous on the Black Swan site – if the ship itself was truly wrecked here. The depth of the site in question is not an environmental barrier against the preservation of wood: extensive wooden hull remains from a Spanish galleon lost in 500 meters in 1622 have been recorded on the Dry Tortugas site, Florida (Annex 13.5)[60] and at depth on the Mardi Gras wreck in the Gulf of Mexico.[61]

A letter written by Squadron Leader Ugarte to the Minister of the Navy at Montevideo on 8 June 1804 describes the company of the *Mercedes* as comprising 319 officers and marines (de Leste Contreras, annex 15). To this was added 'several Spanish gentlemen and 19 ladies, with their families, from Lima, returning to Old Spain',[62] as well as

[57] Martin, C., *Full Fathom Five. Wrecks of the Spanish Armada* (Chatto & Windus, London, 1975), 101, fig. 8.
[58] Mathewson, R.D., *Treasure of the Atocha* (Key Largo, 1986), 106, C52-C57; Pearson, C.E. and Hoffman, P.E., *The Last Voyage of El Nuevo Constante. The Wreck and Recovery of an Eighteenth-Century Spanish Ship off the Louisiana Coast* (Louisiana State University, 1995), 117, 120, 123, figs. 20, 21, 22.
[59] http://www.flheritage.com/archaeology/underwater/galleontrail/ShipwreckPages/12_Infante.htm.
[60] Kingsley, S., 'Odyssey Marine Exploration and Deep-Sea Shipwreck Archaeology: the State of the Art', *Minerva* 14.3 (2003), fig. 12.
[61] Ford, B., Borgens, A., Bryant, W., Marshall, D., Hitchcock, P., Arias, C. and Hamilton D., *Archaeological Excavation of the Mardi Gras Shipwreck (16GM01), Gulf of Mexico Continental Shelf* (New Orleans, 2008), 161-3.
[62] Tracy, N., *The Naval Chronicle. The Contemporary Record of the Royal Navy at War. Volume III 1804-1806* (Chatham Publishing, London), 71. See Delgado annex 3.

Captain Alvear's family (wife, 7 children, 1 nephew). Of this 347-strong company, 50 people were rescued from 'the ruins and logs which remained afloat from the unfortunate *Mercedes*' (Squadron Leader Bustamente's account of the Battle of 1804 in de Leste Contreras, annex 17). This figure, correlated to a person per area occupation coefficient for the entire ship, gives an indication of the estimated volume of ship's structure possibly left afloat to which the 50 survivors would have been able to cling to. One could draw the conclusion that at least 86% of the hull must have sunk (excluding any remaining sections of the superstructure above the turn-of-the-bilge).

In the environmental catchment zone of the Black Swan site, wrecks with wooden hulls abound: 22 of the more than 900 ships wrecked off the Azores up to depths of 60 meters have been documented underwater and display outstanding levels of preservation (Annex 13.6). These include ships built in Spain and Portugal between the first half of the 16th and 19th centuries and enormous wooden hulls, 35 meters long and 9 meters wide (Angra D, 15th century), and 40 meters in length and 8.1 meters wide (Angra A, 19th century).[63]

While no single comparative wreck has been scientifically published from Spanish waters, closer to the Black Swan catchment zone an enormous ships' graveyard exists at the mouth of the River Tagus, where wrecks include the possible remains of the Spanish *Nuestra Señora del Socorro* lost in 1611 and 19th-century vessels. Some 14 wrecks have been studied and the wooden hull remains are excellently preserved.[64] The coherent wreck Arade 1 (Annex 13.7), dating to the second half of the 16th or first half of the 17th century,[65] leaves no doubt that wood remains over 200 years earlier than the Black Swan site are preserved in the geographical catchment zone under enquiry and should be expected.

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[63] Monteiro, P., 2002., *The Nautical Archaeology of the Azores. 1. Shipwrecks in the Azores* (http://nautarch.tamu.edu/shiplab/indexacores.htm).
[64] http://nautarch.tamu.edu/shiplab/parade-03ships.htm.
[65] Castro, F., 'The Arade 1 Shipwreck. A Small Ship at the Mouth of the Arade River, Portugal'. In Blue, L., Hocker, F. and Englert, A. (eds.), *Connected by the Sea: Proceedings of the Tenth International Symposium on Boat and Ship Archaeology, Denmark 2003* (Oxbow Books, Oxford, 2006); Loureiro, V. and Gachet Alves, J.G., 'The Arade 1 Shipwreck: Preliminary Results of the 2004 and 2005 Field Seasons', *International Journal of Nautical Archaeology* 37.2 (2008), 278, fig. 6.

As Delgado and the Counsel for Spain have testified, extensive hull remains should be present on the Black Swan site, in line with preservation levels recorded on other exploded ships like *L'Orient*. The comparative examples of the Azores and Arade wrecks substantiate this reality, proving that a hull ought to be a wreck's defining feature on the seabed. As demonstrated above, the clay seabed and minimal mobile sediment on the Black Swan site means that the hull should be visible on the site's surface. No such coherent or even scattered planking is present. The Black Swan site does not even adhere to the lowest rate of hull survival on a shipwreck site (Annex 4.3).[66]

The most logical conclusion to be drawn is that the hull of any shipwreck associated with the Black Swan site must lie elsewhere. In turn, the site under investigation does not encapsulate the structural vessel of the *Mercedes*.

10. Iron Knees

A ship's knee is a timber or iron bracket fashioned into a right-angle to strengthen and support the junction of major hull components (especially frames and deck beams) in a wooden vessel (Annex 14.1).

Delgado recognizes iron knees in the following contexts: a 'complex artifact', an 18th or 19th century iron reinforcing member from a large wooden military vessel (point 52); iron knee of a type introduced into warships in the late 18th century (point 80, annex 9.9); an iron knee 'with attaching bolts still in place that has particularly graphic evidence of blast damage… two large bolts on the curved leg of the knee are in their original position. However, one of the two bolts on the straight leg of the knee has been deformed and bent. The bend in one arm also indicates a strong force deformed this heavy piece of metal. This is not damage that occurs during sinking. This piece therefore may have been located close to the site of the explosion' (point 96, annex 9.24); small iron lodging knee

[66] Ward, I.A.K., Larcombe, P. and Veth, P., 'A New Process-based Model for Wreck Site Formation', the *Journal of Archaeological Science* 26 (1999), 567, fig. 5.

(point 84, annex 9.13); angled iron knee (point 82, annex 9.11); iron deck knees that once supported the gundeck and corroded fasteners (point 81, annex 9.10).

These identifications raise two questions of perception: how to identify the structural character of an amorphous iron concretion underwater and the issue of when iron knees replaced the wooden equivalent. Firstly, interpreting concreted iron on the seabed is an established archaeological nightmare because this metal is highly unstable. Large and heavy objects, such as cannon and anchors, can retain their original shape within concretions, facilitating accurate interpretation, but rigging, carpenters tools and myriad other artifacts assume improbable amorphous shapes through electrochemical forces in marine environments as corrosion products migrate away from an object, causing multiple artifacts to concrete together into random shapes (Annex 13.3).

For this reason, taking x-rays of concretions to determine their contents and to assist methods of conservation is standard best practice.[67] In some cases, like the 1588 wreck of the Spanish Armada ship *La Trinidad Valencera*, concretions had to be lifted whole and excavated on dry land to determine their contents (Martin, 1979, fig. 8, in Annex 13.1). Without such a procedure, all interpretations of the Black Swan encrusted structural fittings listed by Delgado above are scientifically unverifiable.

This cautionary reality aside, Delgado's testimony is simply inaccurate. By blowing up the video frame grabs sequestered by Delgado for his testimony to A3 size, it is clear that most of his identifications are cases of mistaken identity. A 'late 18th century' knee (Delgado, point 80, annex 9.9) very clearly consists of two separate, individual linear concretions of unknown cultural origin (Annex 14.2), whose ends are not even joined (as is necessary in knees), but lie on top of one another; the two objects lie at right-angles coincidentally and are not connected together to form a single structural unit.

[67] Robinson, W., *First Aid for Underwater Finds* (Nautical Archaeology Society, London, 1998), 51, 56.

What Delgado calls the heavily bent 'iron knee' from close to the site of the explosion, with bolts attached (point 96, annex 9.24), is very clearly crafted of bronze, not iron, and retains its cupreous bluish-green colour (Annex 2.29, 14.3); its function remains undetermined, but it is possibly related to an endpost reinforcement system. It is categorically not an iron knee. The supposed iron lodging knee (annex 9.13) ought to be L-shaped, but is in fact U-shaped, which does not typify ships' knees. The concretion zone around another supposed angled iron knee (annex 9.11) is too dense to offer any reliable identification. For similar reasons, iron knees 'from the gundeck' (annex 9.10) could be absolutely anything, such as iron ballast. In no instance for any of the above is it possible to clearly see a joint at a right-angled juncture proving that an object's connection is deliberate rather than caused by different objects concreting together on the seabed.

Secondly, the dating of the transition from traditional wooden knees towards more robust iron examples remains ambiguous. Only one scientific study of the subject has been published to date (Annex 14.1).[68] Experimentation with this iron technology was a French innovation begun in the mid-18th century as a substitute for wooden crooks, which were becoming scarce due to the over-exploitation of forests. The earliest examples have been recorded on the wreck of the French warship *Invincible*, lost off Portsmouth in 1758.[69]

The date of the transition towards iron knee technology – which was certainly not restricted to warships – on non-French vessels has not been resolved. The strategic decision was dictated by the abundance or deficiency of wood reserves. The largest concentration of iron knees recorded on a ship of comparable date to *Mercedes* are the 24 examples documented on the *Earl of Abergavenny*, an outward-bound English East Indiaman wrecked in Weymouth Bay, England, in 1805. The knees varied from 2 x 2 feet to 4 x 4 feet and 7-inch cross-sections and were very much experimental. Not only were

[68] Stammers, M.K., 'Iron Knees in Wooden Vessels – an Attempt at a Typology', *International Journal of Nautical Archaeology* 30.1 (2001), 115-21.
[69] Bingeman, J.M., 'Invincible (1744-1758)'. In M. Bound (ed.), *Excavating Ships of War* (Oswestry, 1998), 169.

many being transported as ballast, but the *Abergavenny*'s loss was attributed to the inferior quality of these iron knees.[70] The main shift to iron knees on East India Company merchant vessels only started in 1810, while North American shipbuilders' access to surplus timber supplies kept iron components to a minimum into the 1850s. By contrast, Canadian shipbuilders adopted iron knees at Quebec in 1811.

The clearest archaeological evidence on the subject as a whole comes from English warships. The excellently preserved hull remains of wreck YO88, sunk in battle off Yorktown in 1781, relied on wooden knees,[71] as did HMS *Colossus*, wrecked off the Scilly Isles, England, in 1798.[72] It was only following the strain on vessels caused by the Napoleonic Wars that the Royal Navy retrospectively started to fit iron knees into wooden warships. Systematic installation of ironwork into new naval craft in England, where wood reserves had been very low since the mid-18th century, only began under Sir Robert Seppings, the Navy's chief surveyor from 1813 to 1832.

Through her alliance with France, it is not impossible – though entirely theoretical – that Spain started imitating French ships' use of iron knees before England. However, historical evidence does not verify this theory (see below), and archaeological data from both merchant vessels and warships involved in the Napoleonic wars display no iron knee technology whatsoever, including: *L'Orient* in Aboukir Bay, blown up during the Battle of the Nile in 1798; a probable 6th-rate frigate, Akko 1, related to the siege of Acre, Israel, in March 1799;[73] and parts of two vessels excavated in Dor harbour, Israel, a Napoleonic naval depot.[74]

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[70] Cumming, E.M. and Carter, D.J., 'The *Earl of Abergavenny* (1805), an Outward Bound English East Indiaman', *International Journal of Nautical Archaeology* 19.1 (1990), 33.
[71] Broadwater, J.D., 'The Yorktown Shipwreck Archaeological Project: Results from the 1978 survey', *International Journal of Nautical Archaeology* 9.3 (1980), 221-235.
[72] *HMS Colossus Survey Report 2002*: 35-36
[73] Cvikel, D. and Kahanov, Y., 'The Akko 1 Shipwreck, Israel: the First Two Seasons', *International Journal of Nautical Archaeology* (2008).
[74] Cvikel, D., 'Archaeological and Historical Evidence in Tantura Lagoon of the Marine Aspect of the Retreat of Napoleon and his Army from Acre', *Recanati Center for Maritime Studies Newsletter* 31 (2005), 21-22.

Having been built in Havana and not Iberia, the question of what medium of knees the *Mercedes* would have used is even more enigmatic, but was bound up with practicalities of wood availability. According to the leading naval historian of the modern era, Brian Lavery, 'Despite the alliance with France, the Spanish tended more towards British style construction'.[75] The plateau of modern, scientific naval construction that persisted in Havana between the mid-18th century until the end of the Napoleonic era was even termed the 'English school of Spanish naval architecture'.[76] At Havana, Spain poached shipbuilding philosophies and practices from Europe, with Richard Rooth of England, Matthew Mullan of Ireland and Jean François Gautier of France all directing this naval yard in the 18th century. This line of enquiry points to the retention of wooden knees on the *Mercedes*, as persisted in England, until 1813.

Unlike Europe, in the New World the Spanish Navy had access to rich wood reserves and cut down an estimated 3 million trees for shipbuilding in the 18th century. Where other European navies relied almost entirely on oak and beech from fast-depleting forests for ships' hulls, the Spanish had unlimited supplies of the longer-lasting mahogany and teak from Cuba and Central America.[77] Control of Cuba's forests was a carefully managed royal concern. By 1773, four main cutting sites were maintained between Sumidero in the Madruga-Coliseo Heights and Alquisar y Guaybacao. All were connected to the sea by rivers and logging routes.[78]

Based on the absence of iron knees in Napoleonic era shipwrecks and the abundant wood reserves accessible in the New World, available scientific data currently leaves little room to argue for the use of iron knees on late 18th/early 19th century Spanish frigates, including the *Mercedes*. This conclusion is supported by the archaic use of iron nails in the proximity of copper sheathing on *Mercedes*, which indicates that her overall

[75] Lavery, B., *Nelson's Navy. The Ships, Men and Organisation 1793-1815* (London, 1989), 282.
[76] Inglis, G.D., 'The Spanish Naval Shipyard at Havana in the Eighteenth Century'. In *New Aspects of Naval History. Selected Papers from the 5th Naval History Symposium* (Nautical & Aviation Publishing Company of America, Baltimore, 1985), 56.
[77] Harbron, J.D., *Trafalgar and the Spanish Navy* (London, 1988), 23.
[78] Inglis, G.D., 'The Spanish Naval Shipyard at Havana in the Eighteenth Century'. In *New Aspects of naval History. Selected Papers from the 5th Naval History Symposium* (Nautical & Aviation Publishing Company of America, Baltimore, 1985), 45.

technological level was at least 21 years behind England and France: the catastrophic corrosion caused by overlying copper on iron was already highlighted within the British navy in 1783, and appropriate measures taken to remove iron in favour of copper bolts.[79]

The *Mercedes*, it seems, was built with wooden knees. The presence of iron examples on the Black Swan site, as postulated by Delgado and the Counsel for Spain, would actually signify the existence of a completely different vessel here.

11. Ballast & Metallic Ingots

The Black Swan site contains various archaeological materials that could comprise ballast (copper and 'tin' ingots as saleable ballast and amorphous iron blocks) or remains of a purely commercial cargo. This section addresses whether these assemblages dovetail with the historically-attested ballast of the *Mercedes*, 150 *quintiles* (6.9 tons) of gravel stone and 549 *quintiles* of iron ballast (25.25 tons), which would signify its final resting place on a seabed.

To balance merchantmen and warships under sail and in battle, vessels were typically loaded with large quantities of ballast. Pottery, ballast and cannon are traditionally considered the most diagnostic assemblages on shipwreck sites. On a wreck of the magnitude of *Mercedes*, her ballast would be expected to be one of the most obvious features of the shipwreck site. *El Buque en la Armada Espanola* breaks down a *navio*'s distribution of weight elements into percentages, demonstrating that ballast comprised as much as 11.2% of a ship's total weight.[80]

The stone ballast of the Spanish Armada ship *Santa Maria de la Rosa*, lost off Ireland in 1588, weighed more than 200 tons.[81] The Iberian ship Angra A, lost off the Azores, is characterized by an oval ballast mound measuring 35 x 11.5 meters, while Angra D

[79] Bingeman, J.M., Bethell, J.P., Goodwin, P. and Mack, A.T., Copper and Other Sheathing in the Royal Navy', *International Journal of Nautical Archaeology* 29.2 (2000), 222.
[80] Harbron, J.D., *Trafalgar and the Spanish Navy* (London, 1988), 26.
[81] Martin, C., *Full Fathom Five. Wrecks of the Spanish Armada* (Chatto & Windus, London, 1975), 98.

contains 10 tons of ballast stones.[82] The ballast heap on the *Marguerite*, wrecked off Newfoundland in 1707, stands 1.5 meters proud of the seabed[83] and on the late 18th/early 19th century 'Forty Cannon' wreck off Quintana Roo, Mexico, the ballast is concentrated across a 40 meter-long stretch of seabed.[84] Individual blocks of ballast on the *Sacramento* weighed up to 50 kilograms.[85] Whether gravel, rock or iron ingots, ballast is always a defining feature of a Colonial-period shipwreck site.

Delgado (points 87-88, annex 9.5, 9.16) identifies one highly limited area of small rocks and pebbles on the Black Swan site as apparently associated with a hull (Annex 2.15-2.16), which is obviously grossly insufficient for a vessel of *Mercedes*' size and sophistication. Further, prevailing theory – validated by archaeological fact – indicates that naval architects during the period of the loss of the *Mercedes* typically relied on rectangular iron ingots to ballast warships. This provided focussed weight that was less likely to shift at sea and during battle, keeping warships fast and true.

The ballast on HMS *Bounty* consisted of 6 inch-square and 3 feet-long cast-iron ballast pigs concentrated over an area of 69 feet square of seabed.[86] HMS *Fowey*, lost off Biscayne National Park, Florida, in 1748,[87] and HMS *Pomone*, wrecked off the Needles in England in 1811, also carried rectangular iron ballast blocks (Annex 15.1, 15.2). This practice was not restricted to English warship, but the French men-of-war *Artois* (built

[82] Monteiro, P., *The Nautical Archaeology of the Azores. 2 - Terceira Island: Report on the Underwater Archaeological Activity, 1996-1998. Angra A Wreck* (2002): http://nautarch.tamu.edu/shiplab/angra06-angraa.htm.
[83] Barber, J.M., Barber, V.C. and Wheeler, R., 'A Trial Excavation of the Marguerite, and a Search for the Murinet, Both St Malo vessels, Sunk in 1707 at Conche, Newfoundland', *International Journal of Nautical Archaeology* (1981),10.1: 29-39.
[84] Irion, J.B. 'The Forty Cannon Wreck, Chinchorro Banks, Quintana Roo, Mexico. A Preliminary Report 1978', *International Journal of Nautical Archaeology* 9.1 (1980), 9.1: 27.
[85] Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *IJNA* 8.3 (1979), 216.
[86] Erskine, N., 'Reclaiming the *Bounty*', *Archaeology* 52.3 (1999).
[87] Skowronek, R.K., Johnson, R.E., Vernon, R.H. and Fischer, G.R., 'The Legare Anchorage Shipwreck Site – Grave of HMS *Fowey*, Biscayne national Park, Florida', *International Journal of Nautical Archaeology* 16.4 (1987), fig.3.

1794) and *Barrosa* (built 1812) shared the same rectangular iron ballast block system.[88] Rectangular cast iron ingots were standard on the Napoleonic warship *Mercure*, which exploded during battle off Lignano, Italy, in 1812.[89] There is no reason to presume Spanish warships like the *Mercedes* did anything different, especially since texts confirm that Havana's shipbuilding philosophy was based on British tried and tested methods.

Such highly visible ballast forms are conspicuous by their absence on the Black Swan site. If the ballast of the ship represented by Black Swan comprised either gravel, stones or iron pig ingots, we would expect them to be highly visible across the seabed. Contemporary historical records attest to 150 *quintiles* (6.9 tons) of gravel stone ballasting the *Mercedes*, which is not evident on the Black Swan site. For reasons discussed above, it cannot lie under an illusionary seabed.

This raises the likelihood that the copper and 'tin' ingots – and not gravel – comprised a significant component of the Black Swan's ballast. I have counted 286 copper ingots across the Black Swan site. Recovered examples have a high copper purity of 96.8%, are 60 centimeters long and each weighs 90 kilograms. This cargo thus has a total weight of 25.74 tons. Some 481 comparable ingots of possible – yet unconfirmed – tin content lie across the site, gray in colour and are characterized by raised handles on each corner. The metal is extremely deteriorated and neither ingot sizes nor weights have been documented. The exploitation of valuable metal as saleable ballast – material that both balanced a ship and could turn a profit at a port of destination – is a typical feature of a commercial merchant venture, not of a warship.

During her final voyage, the *Mercedes* is recorded as having carried 403 copper bars and 1,964 tin bars. The Black Swan site contains only the 30% of this figure for copper bars

[88] Tomalin, D.J., Simpson, P. and Bingeman, J.M., 'Excavation Versus Sustainability *In Situ*: a Conclusion on 25 Years of Archaeological Investigations at Goose Rock, a Designated Wreck-Site at the Needles, Isle of Wight, England', *International Journal of Nautical Archaeology* 29.1 (2000), 17.
[89] Beltrame, C. and Gaddi, D., 'Report on the First Research Campaign on the Napoleonic Brick, *Mercure*, wrecked off Lignano, Udine, Italy in 1812', *International Journal of Nautical Archaeology* 31.1 (2002), 66, fig. 8.

and 25% of the historically-listed tin ingots. This is not representative of the *Mercedes*' metallic cargo, but favors interpretation of these assemblages as representing the Black Swan's saleable ballast.

In any case, manifests verify that the *Mercedes*' main ballast was 549 *quintiles* of iron ballast (25.25 tons). Theoretically, the amorphous iron concretions that litter the Black Swan site could comprise this material. However, as discussed above, the nature of these blocks can only be proven scientifically by their recovery and x-ray. At this stage they could contain almost anything, from broken iron cannon parts (renowned as ship's ballast) to cannon balls or concreted barrel/chest hoops. Dozens of clusters of coins deposited next to large quantities of concretions (Annex 2.2, 2.38) may reflect the transport of specie in chests bound with iron staves that have corroded into some of the concretions.

The common transport of iron ballast as rectangular pig ingots, which retain their shape underwater and are recorded on other European warships, however, does not point towards these concretions being a man-of-war's ballast. The copper and tin ingots on *Mercedes* are specifically labelled as cargo. Either way, the absence of 6.9 tons of gravel stone and of 25.25 tons of iron ballast (that ought to be present as rectangular ingots) does not favor the Black Swan site being the wreck of the *Mercedes.*

12. Copper Hull Sheathing

The declarations used by Spain in support of its Motion to Dismiss identify copper hull sheathing plates on the seabed in a torn and crumpled configuration caused by an explosion (de Leste Contreras, point 34; Delgado points 24, 90, 91, annex 9.17 and 9.18), of a type used by the Spanish Navy (de Leste Contreras, point 34; Delgado, point 21), also in association with a 'largely buried section of wooden hull' (Delgado, point 74, annex 9.4).

The date and cultural background of the introduction of copper sheathing to protect a wooden hull from marine fouling is clearly attested, historically and archaeologically, starting with the experimental coppering of the British navy's *Alarm* in 1761. By 1779 the practice was prevalent,[90] and is familiar from the archaeology of numerous shipwrecks of different nationalities, such as England's HMS *Sirius*, lost off Norfolk island, Australia, in 1790,[91] and the 1.6 meter-long copper sheets excavated from France's Napoleonic warship *Mercure*, blown up in 1812.[92] Royal Navy Board standing orders demanded 32-ounce sheets for bows, 28-ounce on sides and 22-ounce for bottoms. Sheets measured 14 x 48 inches (4.7 square feet). In France, a 120-gun vessel required about 4,700 copper sheets, weighing some 16 tons.[93] Copper was superior to the earlier variant of lead hull sheathing because it was more toxic to all forms of marine life, such as barnacles and xylophagous molluscs.[94] Cleaner bottoms enabled greater speeds and manoeuvrability and thus less time spent in dock.

Records for the *Mercedes* confirm the presence of copper hull sheathing:[95]

> 'The ship is watertight. However, one must not be confident that the head of the ship will remain in good condition for much longer because the nails are iron and the lining is of copper on top of the quick work. The waterways need to be overhauled'.

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[90] Lavery, B., *The Arming and Fitting of English Ships of War 1600-1815* (Conway Maritime Press, London, 1987), 63.
[91] Stanbury, M., 'HMS Sirius 'reconstructed… Pygmy Battle Ship' or 'Appropriate' 6th Rate Vessel?'. In M. Bound (ed.), *Excavating Ships of War* (Oswestry, 1998), 224.
[92] Beltrame, C. and Gaddi, D., 'Report on the First Research Campaign on the Napoleonic Brick, *Mercure*, wrecked off Lignano, Udine, Italy in 1812', *International Journal of Nautical Archaeology* 31.1 (2002), 67.
[93] Bingeman, J.M., Bethell, J.P., Goodwin, P. and Mack, A.T., 'Copper and Other Sheathing in the Royal Navy', *International Journal of Nautical Archaeology* 29.2 (2000), 218-29.
[94] Tylecote, F., 'Durable Materials for Sea Water: the Archaeological Evidence', *International Journal of Nautical Archaeology* 6.4, 277-8.
[95] Report of Squadron Commander Tomas de Ugarte y Liano to Minister of the Navy, Domingo de Gradallana, from Montevideo, 8 June 1804, aboard the frigate *Mercedes*: BRAH, Library of the Royal Academy of History, Ms 11/8305, cited in J. Ignacio Gonzales Aller-Hierro, *Trafalgar Campaign (1804-1805), Volume I*, 150-1.

Cupreous material (copper and bronze) retains an exclusive vivid bluish-green colour on the seabed. The images of metallic material shown as examples in Delgado annex 9.4, which he defined as copper hull sheathing, is patently yellowish-brown, the typical hue of lead in marine environments (see also Delgado annex 9.17, 9.18 and 9.21). It is emphatically not cupreous. Absolutely no copper is visible in any of Spain's images in annex 9 and image resolution certainly does not expose any circular tack holes resulting from plates tacked to a hull. A copper artifact is present in annex 9.20, but without recovery the question of whether it is sheathing or a kettle/cauldron cannot be resolved. Crushed copper is visible at the southern end of a large concretion in grid no. U24 (Annex 2.24, 2.25), but is more tubular than sheet-shaped.

The three dozen copper tacks recovered from the site in question (Annex 3, no. 59) definitively point towards the use of copper sheathing on the Black Swan site, although the limited quantity is more suggestive of spares being stored in a carpenter's chest. The thousands of copper sheets weighing tons and typifying a Spanish warship like *Mercedes* are absent from the archaeology of the Black Swan site, which is another clear indication that there is no identifiable ship's hull present.

13. Rudder

The witnesses for Spain have highlighted the fascinating presence of a bronze pintle on the Black Swan site (Annex 2.27), of a type which was once mounted on the rudders 'of naval vessels at the time of the *Mercedes*' (de Leste Contreras, point 33) and whose curvature indicates installation at 'the ship's bottom at the lower stern' to provide a hinge on which the rudder swung (Delgado, points 50, 109; annex 9.33; annex 19 and 20). A pintle in the Spanish Navy Museum, Cadiz (Delgado, point 110, annex 19), is judged to be of 'the same design' as the pintle from the Black Swan site. This basic type classification is correct, but raises several important points about the archaeological status of the Black Swan site in relation to the *Mercedes.*

Frigates dating to the era of the *Mercedes*, such as the *Diana* built in 1792 (Annex 16), had five rudder hinges, which were composed of two parts (10 elements total): the wide-armed gudgeons bolted to the hull of a ship and the pintles fitted to the rudder.[96] A ring at the back of the gudgeon inter-connected with the pin at the back of the pintle.

If the explosion of the *Mercedes* detached the rudder, as argued by Delgado, then its presence ought be obvious on the Black Swan site. The wreck formation of *L'Orient* in Aboukir Bay, Egypt, wrecked by an enormous explosion, includes a well-preserved rudder, which is fully sheathed in copper with enormous copper bolts (Annex 8). In 1683, Archbald Miller discovered the rudder of the *San Juan de Sicilia* off Mull, Scotland. The warship of comparable date to the *Mercedes* on display near site of Carraca naval dockyard close to Cadiz, and presented by the Counsel of Spain as testimony of *Mercedes*' rudder system, incorporates an identical copper-sheathed exterior (de Leste Contreras, point 33, annex 27). The same level of rudder preservation would characterize the Black Swan site if it were the wreck of the *Mercedes*.

Bronze pintles are by no means unique to Spanish warships, as erroneously claimed by Spain (see above). They are also far from restricted to the era of the *Mercedes,* and it must be strongly stressed that the example from the Spanish Navy Museum (de Leste Contreras annex 25) is undated and thus not relevant to the current case. For example, two typologically similar rudder pintles (each 0.58 meters long), in association with a 0.99 meter-long copper fastening bolt, have been raised from the wreck of the English warship HMS *Pandora*, lost off the Great Barrier Reef in 1791, and the remaining pintles/gudgeons exist on the seabed (Annex 17).[97]

As the cases of *L'Orient* and the *San Juan de Sicilia* verify, whole rudders – including intact gudgeons/pintles – survive explosions on warships because the rudder was structurally isolated and cushioned from the main hull and full force of an explosion. The

[96] Lavery, B., *The Arming and Fitting of English Ships of War 1600-1815* (Conway Maritime Press, London, 1987), 11.
[97] Henderson, G., 'Finds from the wreck of HMS Pandora', *International Journal of Nautical Archaeology* 9.3(1980), 237-9, figs. 1-3.

broken status of the Black Swan pintle is unusual in a wreck context for these reasons. The presence of just a single pintle, and the absence of the 9 other related bronze gudgeon/pintle connectors and the rudder, is inexplicable if the Black Swan site constitutes the full deposition point of a ship's structure or vessel.

At this stage of study, this broken pintle is more likely to be a broken, redundant ship's fitting being transported for melting down and recycling, which was the typical course for any disused fitting or artifact of bronze during the period. This would explain this object's fracture in half, as well as the absence of the missing rudder and other fittings. The possibility that this bronze pintle was already redundant when lost may be confirmed by 2 comparative wrecks. Already by 1766 the gudgeon on the Spanish merchant vessel *El Nuevo Constante* was made of wrought iron, not bronze.[98] The rudder on HMS *Colossus* was similarly bound with iron gudgeons when she sunk off the Scilly Isles in 1798.[99] By the turn of the century, iron rudder components seem to have replaced bronze.

14. Anchors

As a basic rule, around the year 1819 warships and merchant vessels carried 2 bower anchors, 1 spare anchor, 1 emergency sheet anchor, 1 stream anchor and 1 kedge.[100] Delgado identifies 3 iron anchor parts on the Black Swan site: the shank of large anchor with a ring at one end (point 112, annex 9.35); a fluke from a small 18th-century anchor, probably a kedge, with its shank and stock angled downward and buried in the seabed (point 113, annex 9.36 and 9.37); an anchor with shank (point 84, annex 9.13).

Two problems about these observations need highlighting. Firstly, the image in annex 9.35 is clearly not an anchor, but a concreted iron cannon. Iron anchor stocks are straight-sided and were installed onto a protruding tenon nut immediately below the cable ring and extended at right-angles to the shank. The iron artifact in annex 9.35 is 1.7 meters

[98] Pearson, C.E. and Hoffman, P.E., *The Last Voyage of El Nuevo Constante. The Wreck and Recovery of an Eighteenth-Century Spanish Ship off the Louisiana Coast* (Louisiana State University, 1995), 139-40, fig. 32.
[99] Camidge, K., *HMS Colossus Progress Report* (2003), 17.
[100] Lever, D., *The Young Sea Officer's Sheet Anchor* (New York, 1963), 67.

long and tapers from south to north (Annex 2.17). Anchor shanks do not taper. Two iron rings are concreted onto the gun: one onto the eastern side of the cascable tip, the other three-quarters down towards the muzzle on the western flank. The second ring and presence of an undeterminable possible rigging concretion to the west demonstrates that this area contains various unidentifiable concretions.

Secondly, Delgado's proposition that another iron concretion (Annex 2.30-2.31) is a fluke from a 'small 18th century anchor' (point 113, annex 9.36 and 9.37) is a vivid example of deliberate misdirection. Iron anchors are appalling indicators of chronologies. According to Gardiner's *The Line of Battles. The Sailing Warship 1650-1840* (Conway Maritime Press, London, 1992, 139), 'The anchor was probably subject to less variation through the ages than any other feature of a ship. Its best known form originated in classical times, and this can still be seen in use today.' Lavery's *The Arming and Fitting of English Ships of War 1600-1815* (Conway Maritime Press, London, 1987, 30) also emphasizes that 'The proportions of anchors changed very little between 1600 and 1815.'

The Black Swan's anchor palm is identical to Spanish Armada examples wrecked off Ireland in 1588 on the *La Trinidad Valencera* and *Santa Maria de la Rosa* (Annex 18.1, 18.2)[101] and to the six on the *Atocha*, wrecked in 1622 (Annex 18.3).[102] An engraving in the Museo Naval, Madrid, displays the chief types of anchor in use in the mid-18th century (Annex 18.5). Various arm shapes from the gently rounded (u-shaped) to angular (v-shaped) were utilized simultaneously.[103] The inappropriateness of relying on anchor arm shape for dating a vessel is graphically illustrated by the iron anchors on the Spanish ship *El Nuevo Constante*, lost off Louisiana in 1766, where the two arms on a single anchor differ markedly: one is v-shaped, the opposite one gently bowed (Annex 18.4).[104]

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[101] Martin, C.J.M., 'La Trinidad Valencera: an Armada Invasion Transport Lost off Donegal. Interim Site Report, 1971-76', *International Journal of Nautical Archaeology* 8.1 (1979), 31, fig. 16.
[102] Mathewson, R.D., *Treasure of the Atocha* (Key Largo, 1986), 38-9.
[103] Harbron, J.D., *Trafalgar and the Spanish Navy* (London, 1988), 65.
[104] Pearson, C.E. and Hoffman, P.E., *The Last Voyage of El Nuevo Constante. The Wreck and Recovery of an Eighteenth-Century Spanish Ship off the Louisiana Coast* (Louisiana State University, 1995), 133, fig. 28).

Curiously, these anchors were manufactured in Britain, yet again flagging up the complexity of proving a ship's nationality from insecurely dated assemblages.

A related problem to the anchors on the Black Swan site is the absence of the substantial lengths of cable needed – 120 fathoms-worth (720 feet) measuring 22 inches in circumference.[105] Anchor rope presumably treated with pitch and grease to enhance preservation at sea is visible on the Black Swan site in grids N10 and T23-24/U24 (Annex 2.17-2.18). However, these represent a small fraction of the anchor cables necessary for a ship like *Mercedes*, not to mention the rest of her running rigging. Once again, this absence does not point to the Black Swan site containing the necessary rigging of a wrecked Spanish warship.

In summary, there are no anchors visible on this site that would differentiate the site from any other ship – of war or commerce – from a wide temporal period, much less point to the *Mercedes*, as alleged.

15. Ship's Fittings

Several other sets of ships' fittings typical of 17th-19th century shipwrecks are absent on the Black Swan site, indicating that the structural unit of the vessel must lie elsewhere. Pumps were fitted to a rectangular well, principally on the lower deck, to drain bilge water. From the late 18th century, large ships carried four main pumps in addition to bilge pumps. Further small pumps were also fitted for other purposes, such as washing down decks.[106] Frigates had two pumps just forward of the mast.[107]

Delgado identifies what he calls copper tubing/pipe from a late 18th-century ship's suction pump used 'principally in warships' to clear bilges (point 111, annex 9.34). This piping is located in grid O9 and, if straightened, measures 1.0 meters in length (Annex

[105] Gardiner, R., (ed.)., *The Line of Battles. The Sailing Warship 1650-1840* (Conway Maritime Press, London, 1992), 140.
[106] Henderson, G., 'Finds from the Wreck of HMS Pandora', *International Journal of Nautical Archaeology* 9.3 (1980), 240.
[107] Lavery, B., *Nelson's Navy. The Ships, Men and Organisation 1793-1815* (London, 1989), 68.

2.37). A junction flange is visible at the southeastern end. A second section (unobserved by Delgado), 1.1 meter long, extends on a southwest-northeast axis on the western side of Cannon C10 in grid T14 (Annex 2.36). Neither of these sections of tubing displays the bluish-green colour of cupreous artifacts underwater, including ingots. Instead, this piping is, in fact, manufactured of lead.

Bilge pump piping on generally contemporary shipwrecks, including HMS *Pandora*, were made of copper.[108] David Steel's *The Shipwrights Vade-Mecum, A Clear and Familiar Introduction to the Principles and Practice of Ship-Building: Including the more Complex Rules of Arithmetic Made Use of in that Art* (London, 1805) confirms that the standard pump piping on frigates was composed of 1 foot-long copper sections. Not only is the Black Swan piping demonstrably not copper, but the large pump itself and its well are absent. Instead, these pipes are possibly scuppers 'let through the ship's side to convey the water from the decks'.[109] Without stamped maker's marks, these generic objects cannot be dated or attributed to any single European or New World nationality.

Delgado (point 23) identifies large numbers of iron fasteners ('spikes, bolts and other pieces') from disintegrated hull remains across the Black Swan site. As explained above, positively identifying iron concretion contents without x-rays is a recipe for disaster and inaccuracy. Without measurements for pertinent features, confirmation of the character of concreted linear artifacts would be grossly misleading. Thus, the 1-2 distorted iron artifact concretions apparently associated with 'hardware from a ship's yard', a truss and sail-bearing spars attached to a mast (Delgado point 116, annex 9.40), and the preventer plate from a late 18th century chainplate acting for the anchoring base for metal sections leading to deadeyes and standing rigging (Delgado point 115, annex 9.39) are instances of creative wishful thinking. (The photograph of concretions presented in annex 9.40 is so badly blurred that any identification would be especially unrealistic.)

[108] Henderson, G., 'Finds from the Wreck of HMS Pandora', *International Journal of Nautical Archaeology* 9.3 (1980), 240.
[109] Steel, D., *The Shipwrights Vade-Mecum* (London, 1805): http://www.hmssurprise.org/Resources/SteelSWVMLex.html.

What can be identified are large copper spikes because the metal is not concreted and because they retain their original shape. Examples include a 30 centimeter-long copper spike in grid L9 and possible examples in grids K7, Q13, Y17, Z38 (Annex 2.33-2.35). These items are too short to be associated with the rudder,[110] and their distinctive presence on the Black Swan site is confusing if this site is the *Mercedes*, which was built with iron nails and spikes.

What is referred to as a brick from a cooking/heating stove floor of a type dating to the 18th and 19th centuries is also supposedly observed on the Black Swan site (Delgado, point 108; annex 12, p.20, no. 58). While this does seem to be brick, it is undateable. However, after the adoption of Alexander Brodie's patented iron ship's stove in 1780 – and its use across Europe – the age of galley stoves lined with thousands of bricks was over. Iron stoves are highly visible on shipwrecks studied after this date.

On HMS *Swift*, a British sloop-of-war sunk off the coast of Patagonia in 1770, the galley stove was located in the bows and consisted of just such a rectangular iron box, 115 x 75cm.[111] An iron Brodie stove is similarly one of the most recognizable archaeological features on HMS *Pandora* on the Great Barrier Reef (Annex 19.2).[112] Identical ovens are preserved on the early 19th-century deep-ocean Mardi Gras shipwreck on the Gulf of Mexico (Annex 19.2)[113] and on the Pina Colada wreck, which has a *terminus post quem* based on coins of 1810.[114]

Delgado (point 41) draws specific similarities between *Pandora*, where 30% of the original hull has been preserved, and the Black Swan site. However, not only is 1% of a

[110] The single copper fastening bolt raised from HMS *Pandora*, for instance, measures 0.99 meters, far longer than the Black Swan spikes.
[111] Elkin, D., Argueso, A., Grosso, M., Murray, C., Vainstub, D., Bastida, R. and Dellino-Musgrave, V., 'Archaeological Research on HMS Swift: a British Sloop-of War Lost off Patagonia, Southern Argentina, in 1770', *International Journal of Nautical Archaeology* 36.1 (2007), 39.
[112] http://www.qm.qld.gov.au/features/pandora/wreck/03_wreck.asp.
[113] http://www.flpublicarchaeology.org/mardigras/artifacts/stove.
[114] Sinclair, J., *Coconuts of the Deep* (2002): http://web.mit.edu/deeparch/www/events/2002conference/papers/Sinclair.pdf.

wooden hull not quantifiably present on the Black Swan, but *Pandora*'s type of stove is absent, contributing to confusion over the site in question's date, origin and formation.

16. Coins

The mass of coins concentrated on the Black Swan site is its most diagnostic feature (Annex 2.33, 2.38). Odyssey's numismatic report testifies that 595,000 coins have been recovered, with the sample conserved so far dating between 1772 and 1804 (Annex 20). The coins are not nucleated on the seabed, but are scattered in loose deposits and in tripartite clumps, probably reflecting stowage in separate cloth bags stored inside wooden chests, whose remains have been discovered preserved beneath coin clumps. Storage inside crates composed solely of wood is unlikely to have been sufficiently robust. Many coin clumps perceptibly cluster around iron concretion pedestals (Annex 2.38) and, in numerous cases, it may be presumed that the latter are the decayed remains of iron staves that once reinforced wooden chests.

Delgado (point 28) repeats Odyssey's clearly presented evidence that the South American mints on the coins point towards that geographical region for the embarkation point of the Black Swan's final voyage and comes to the conclusion that the site must be the *Mercedes*: 'The reported dates and origins of the coins… corresponds to Nuestra Señora de las Mercedes… there is no logical conclusion except that this site is the shipwreck of that vessel'.

While evidence currently gravitates towards a South American mint for the coin cargo, there are 4 compelling reasons for being cautious about reaching such premature conclusions.

Firstly, the *Black Swan Coin Conservation Status Report* states that 2,135 coins have been formally catalogued. This is a very weak statistical sample. Any definitive judgement on the date and origin of the cargo based on the current data must be

considered tentative. Secondly, the 595,000 coins recovered from the Black Swan only account for 66% of the specie historically attested as transported on the *Mercedes.*

Thirdly, ships of the 17th-to-19th centuries carried, on average, 10-30% contraband on top of officially listed cargoes. When she sunk off Ecuador in 1654, the *Jesús Maria de la Limpia Concepion*, the captain's flagship of the Spanish South Seas Fleet, carried an official 3 million silver pesos of His majesty's treasure, which the contraband commercial cargo had swollen to 10 million pesos. A comparison of records from Lima's Royal Treasury alongside a reconstruction made in 1655 of this ship's real consignment during a Crown investigation, discovered a great scandal: 216 chest of coins had been stowed instead of the 151 official chests.[115] At 2,500 coins per chest this equates to 162,500 coins of contraband – or 43% of contraband. A century later, 200,000 pesos of contraband was discovered stowed where the powder-hold should have been on the *Nuestra Senora de la Luz*, sunk off Montevideo, Uruguay, in 1752.[116]

If we accept the figure of 20% contraband on-board the *Mercedes*, these coins would have boosted the numismatic cargo by 180,000, from between 900,000 and 1.1 million *pesos* (accounts of the cargo differ) to some 1.08 to 1.28 million coins. The 595,000 coins from the Black Swan site thus statistically only represent between 46% and 55% of the specie that should have been carried by the *Mercedes.* This deposition testifies that insufficient sediment covers the seabed to have concealed the curiously missing material. Its absence leaves the question of the site in question's character and origin once again open to subjective interpretation.

Fourthly, a global economy flourished between the 16th and 19th centuries. Spanish coins minted in Peru and elsewhere in South America were legal tender throughout the monetized world, even within countries at war with one another, and were used on a daily basis by governments and merchants in England, the Netherlands, France and every other country in the world that engaged in international commerce. For instance, the Spanish

[115] Horner, D., *Shipwreck. A Saga of Sea Tragedy and Sunken Treasure* (Sheridan House, London, 1999), 23.
[116] http://www.sedwickcoins.com/shipwreck_histories/luz.htm.

Armada wreck of the *Girona*, lost off Northern Ireland in 1588, contained 414 gold, 789 silver and 122 copper coins minted in 6 different countries: Spain, Portugal, the Kingdom of the Two Scillies, the Republic of Genoa, Mexico and Peru.[117] The wreck of the Portuguese ship *Sacramento* carried mixed Portuguese and Spanish issues.[118]

The problem of drawing a simplistic line between coin mints and ship nationalities is exemplified by the Dutch East Indiaman *Nassau*, lost in the Battle of Cape Rachado, Malacca, in 1606. Five mints were detected amongst the 3,607 coins: Potosi (29%) and Mexico (20.5%) in the New World, and Seville (12.5%), Toledo (3.4%) and Segovia (1.1%).[119] The majority date to between 1580 and 1598, and both geographically and chronologically offer a misleading picture of the Dutch ship's nationality and date of wreckage.

Moving forward in time, the same cosmopolitan use of Spanish coins across Europe, the Americas and New World manifests on the English man-of-war *Association,* wrecked off the Scilly Isles, England, in 1707. This British shipwreck contained 4,000 Portuguese *reis,* thousands of Spanish-American 8 *reales*, and English silver crowns, half-crowns, shillings and sixpences.[120]

Built in Amsterdam in 1738 for the Dutch East India Company, the 850-ton *Reigersdaal* ran aground on an offshore reef at Springfontein Point, South Africa, in 1747. Her cargo included Spanish pieces-of-eight, silver Mexican pillar dollars in denominations of 8 and 4 *reals* dating between 1732 and 1744, as well as Guatemalan, Mexican, Potosi and Lima silver cobs.[121] The excavation of the French first-rate *L'Orient* blown up in Aboukir Bay

[117] Glover, W., 'The Spanish Armada Wrecks of Ireland'. In M. Bound (ed.), *Excavating Ships of War* (International Maritime Arch Series 2, 1988, Oswestry), 55, 57.
[118] Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *International Journal of Nautical Archaeology* 8.3 (1979), 211.
[119] Bound, M., Soo Hin, O. and Pickford, N., 'The Dutch East Indiaman *Nassau*, Lost at the Battle of Cape Rachado, Straits of Malacca, 1606'. In M. Bound (ed.), *Excavating Ships of War* (International Maritime Arch Series 2, 1988, Oswestry), 104.
[120] Larn, R., 'The Loss of HM Man of war *Association* in 1707, its Relocation and Place in Nautical Archaeology'. In M. Bound (ed.), *The Archaeology of Ships of War* (International Maritime Arch Series 1, 1995, Oswestry), 56.
[121] http://www.vocshipwrecks.nl/out_voyages7/reigersdaal.html.

in 1798 carried a mixed selection of coins: gold coins from Portugal (Joseph I, 1722 and Johannes V, 1733), Spain, Venice, France (Louis XVI, r. 1774-92) and even Istanbul.[122] Finally, the 64-gun British Royal Navy warship HMS *Tilbury*, lost off the southeast coast of Cape Breton Island, Canada, in 1757, was carrying an estimated 0.5 million silver Spanish pillar dollars.[123] Geographically and chronologically, the character of these coin cargoes does not reflect the nationality of the ship from which they were excavated.

While the Black Swan coin mints suggest South American production for the coins so far analyzed, which dovetails with the historically-attested coin cargo on the *Mercedes*, scientifically the specie does not currently provide a *de facto* origin or date for the ship represented by the site. Study of a much larger, statistically random sample of coins is necessary to produce an unbiased picture, although what single 'joker in the pack' post-dating 1804 may exist amongst this massive assemblage will not be clarified – positively or negatively – until the entire cargo is catalogued.

17. Ship Identity

The Black Swan site comprises a unique disposition of archaeological material scattered over an unusually wide area of seabed. At the current state of investigation it would be highly speculative to reach any firm conclusions about the ship's identity based on scientific lines of enquiry. Precious little correlation can be perceived between the *Mercedes* and the physical remains at the Black Swan site. The case against this being the *Mercedes* can be summarized thus:

1. The pottery is surprisingly meagre for a vessel of *Mercedes*' size. The olive jars are not exclusively indicative of a Spanish provenance and are massively insufficient for the quantity that would be needed on a Spanish vessel. Oriental table wares typically used by officers and sailors are absent.

[122] Foreman, L., Phillips, E.B. and Goddio, F., *Napoleon's Lost Fleet: Bonaparte, Nelson and the Battle of the Nile* (Discovery Books, 1999), 206-209.
[123] http://www.sea-int.com/ProjectPortfolio/Tilbury.asp.

2. As many as half of the coins stowed on the *Mercedes* are unaccounted for.

3. The *Mercedes* was designed to carry 50 cannon; only 18 (45%) are present on the Black Swan site. Such low quantities are not exclusively typical of warships. Frederick Chapman's *Architectura Navalis Mercatoria* of 1768 reproduced plans of a privateering frigate designed as a deep-water commerce-raider that was armed with 40 guns.[124]

4. Ships regularly carried mixed gun assemblages, often over a century old, including ordnance seized as prizes from enemy craft and cannon ordered from foreign foundries. Unless an exact or close fit can be proven for a wreck's cannon assemblage through stamps or inscriptions embossed into the metal, in the absence of other diagnostic artifacts the Black Swan guns can in no way be certified as deriving from the *Mercedes*.

5. No inscription expressing producers' marks, dates or royal crests have been recorded on any object on the seabed, including the 13 iron and 5 brass cannon and the copper and tin ingots. Inscriptions indicative of ship origins known from rudders, pumps, regiment buttons and other identifiable artifact forms are not present on the Black Swan site.

6. Large iron cooking stoves are highly characteristic features of late 18th and 19th century shipwrecks. No such object is visible on the Black Swan site.

7. The comparative examples of the explosions on-board the French warship *L'Orient*, the Spanish warship *San Juan de Sicilia* and the Napoleonic *Mercure*, and their historically and archaeologically-verified wreckage dispositions, prove that blown-up vessels deposit coherent sections of hull planking on the seabed. No

[124] Konstam, A., *Scourge of the Seas. Buccaneers, Pirates and Privateeers* (Oxford, 2007), 199, 201.

single coherent plank, interconnected section of timbers or vessel structure or any of the hardwood cargo on *Mercedes* exists on the Black Swan site.

8. The *Mercedes*' hull was ballasted with 150 *quintiles* (6.9 tons) of gravel-stone. A small number of untested and thus unverified circular stones, presumably not indigenous to the local seabed, exist on-site. This is insufficient to comprise even a minor percentage of the full ballast of *Mercedes*. The type of rectangular iron pigs favoured for iron ballast, such as *Mercedes*' 549 *quintiles* of iron ballast (25.25 tons), are similarly missing.

9. The volume of copper sheathing necessary to protect a hull like *Mercedes* is not in evidence.

10. Within her hull, the *Mercedes* was carrying at least 19 chests of high-value commodities, ranging from 200 bottles of alpaca sap, perfume and socks, shoes to a gold disc in the royal chest of Arequipa destined for the Church, a gold mortar, 12 silver cups and gold and silver coins. At least 7 chests contained 'treasure', yet only 1 nucleus of plates, cutlery and candlesticks of pewter/silver alongside a gold candlestick were documented on the Black Swan site (see Exhibition E, footnote 59). 95% of this high-value commercial cargo is absent.

11. Not 1 of the 34 rifles, 68 pistols or 68 swords historically recorded to have accompanied the *Mercedes* (letter of Squadron Leader Ugarte written at Montevideo, 8 June 1804; de Leste Contreras annex 15) is verified on the Black Swan site.

To positively identify a shipwreck's origins (name or nationality and date) demands the recovery of specifically diagnostic material culture. Because shipwrecks are fine-grained assemblages that permit high-level artifactual preservation, such material is common underwater. Examples of the parallel classes of data required to positively identify the Black Swan as the *Mercedes* would include:

A. Spanish shipwrecks are positively identified thanks to the prevalent pattern of stamping pewter or silver cutlery and plates with owner's names, manufacturer's marks and dates. A ring on the *Girona* is inscribed 'Madam de Champagney 1524', who was the grandmother of Jean Thomas Perronet, who drowned on this ship.[125] A fork stamped with the initials 'SM' at the end of the handle from a Spanish Armada shipwreck of 1588 off northwest Ireland is believed to define the ship in question as the *Santa Maria de la Rosa*.[126]

   Acutely definitive is a pair of 8-inch diameter pewter plates from the same wreck that bear the six letters 'MATUTE' for Francisco Ruiz Matute (Annex 13.1), the senior military officer aboard the *Santa Maria* when she sank. As Colin Martin, the leading expert on the Spanish Armada in Britain, emphasizes, 'There was no longer any question as to the identity of our wreck; a man dead for four centuries now confirmed it for us.'[127]

B. Though featuring an English maker's marks and a Rose, (related to producer Edward Roe, Master of the London Company of Pewterers in 1582 and 1588), a pewter plate from the wreck of *La Trinidad Valencera* is engraved with the owner's initials 'JZ' for Juan Zapota, whose son, Sebastian, was on board this vessel.[128]

C. Dated seals, such as an iron example inscribed with the name 'Nelson' recovered from the 1809 wreck of the *Agamemnon* in Maldonado Bay, Uruguay. Nelson commanded this vessel from 1793-96.[129]

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[125] Sténuit, R., *Treasures of the Armada* (E.P. Dutton & CO, Newton Abbot, 1972), 264; Flanagan, L., *Ireland's Armada Legacy* (Sutton, Gill and Macmillan, Dublin, 1988), 195.
[126] Glover, W., 'The Spanish Armada Wrecks of Ireland'. In M. Bound (ed.), *Excavating Ships of War* (International Maritime Arch Series 2, 1988, Oswestry), 59.
[127] Martin, C., *Full Fathom Five. Wrecks of the Spanish Armada* (Chatto & Windus, London, 1975), 114.
[128] Flanagan, L., *Ireland's Armada Legacy* (Sutton, Gill and Macmillan, Dublin, 1988, 124.
[129] Nasti, A. *HMS Agamemnon* (2001): www.abc.se/~m10354/publ/agamemno.pdf.

D. An inscription found on a rudder pintle in Aboukir Bay, Egypt, reads 'Le Dauphin Royal', the former name of first-rate *L'Orient* before the French Revolution (Annex 8).

E. Two Royal Navy broad arrow marks on a bronze rudder pintle inscribed with the English manufacturer's name, 'Forbes', recovered from a wreck on the Great Barrier Reef provided proof of an English nationality and for ascribing the site to HMS *Pandora*, lost in August 1791 en route from Tahiti to England.[130] A silver pocket watch from this wreck is also incised with an English watchmaker's name, J. & J. Jackson, London, the number 9866 and a 1788 hallmark. Definitive evidence was secured in the form of a lead name stamp from First Lieutenant John Larkan's cabin area bearing the letters 'Larkan'.[131]

F. A Portuguese coat-of-arms carved on wood and excavated from the wreck of the Portuguese *Santo Antonio da Tanna*, lost in 1697 off Fort Jesus, Mombasa, Kenya, provided proof of nationality.[132]

G. Pewter uniform buttons are known from the Cornwallis Cave wreck[133] and feature regiment numbers on the 74-gun *Invincible*, which sank in the Solent in 1758 while carrying army personnel to Canada. In England, a clothing warrant of 1767 standardized the dress for the whole army.[134] Spanish brass round and octagonal military buttons emerged even earlier and are known from the 1733 Florida Plate Fleet. Insignia bearing the exact names of regiments, including naval services, first appeared on Spanish military buttons between *c*. 1770 and 1785, with

[130] Henderson, G., 'Finds from the Wreck of HMS Pandora', *International Journal of Nautical Archaeology* 9.3 (1980), 237-9, figs. 1-3.
[131] http://www.qm.qld.gov.au/features/pandora/artefacts/01_artefacts.asp.
[132] Piercy, R.C.M., 'Mombasa Wreck Excavation. Fourth Preliminary Report, 1980', *International Journal of Nautical Archaeology* 10.2 (1981). 115, fig. 7.
[133] Johnston, P.F., Sands, J.O. and Steffy, J.R., 'The Cornwallis Cave Shipwreck, Yorktown, Virginia. Preliminary Report', *The International Journal of Nautical Archaeology* 7.3 (1978), 223, fig. 17).
[134] Bingeman, J.M. and Mack, A.T., 'The Dating of Military Buttons: Second Interim Report Based on Artefacts Recovered from the 18th-century Wreck *Invincible*, Between 1979 and 1990', *International Journal of Nautical Archaeology* 26.1 (1997), 46.

regimental insignia.[135] Naval buttons are inscribed 'REAL MARINA' or feature an anchor motif (Annex 21).[136]

H. Copper hull sheathing recovered from HMS *Pomone*, lost in 1811 off the Needles, England, is stamped with the manufacturer's marks 'MR 32' and 'MR 28', an abbreviation for the British 'Mines Royal Company', and the weight of sheet. One of the sheets is stamped 'DEC 1804', which dovetails with the date of the ship's construction.[137]

I. A 'head pump' on HMS *Swift*, sunk in 1770 off the coast of Patagonia, southern Argentina, and used to pump seawater into the ship for washing down decks, is inscribed 'G.R.^{3} 1769' for King George III.[138]

J. The wreck of HMS *Colossus* has yielded a wooden shot box marked 'G3R' for King George III.[139]

K. Remains of 36 leather buckets on the *Invincible*, wrecked in the Solent in 1758, are inscribed 'G2R' for King George II, as well as with gun numbers.[140]

Without a single artifact falling into the above categories, scientifically the nationality and name of the ship represented by the Black Swan site will remain speculative. Only two sets of data potentially point in the direction of the presence of the *Mercedes*: the

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[135] Deagan, K., *Artifacts of the Spanish Colonies of Florida and the Caribbean, 1500-1800. Volume 2: Portable Personal Possessions* (Smithsonian Institution Press, Washington, 2002), 168-9

[136] http://www.artifacts.org/Marked_Buttons.htm.

[137] Bingeman, J.M., Bethell, J.P., Goodwin, P. and Mack, A.T., 'Copper and other Sheathing in the Royal Navy', *IJNA* 29.2 (2000), 224, 227, fig. 3, nos. 1 and 15.

[138] Elkin, D., Argueso, A., Grosso, M., Murray, C., Vainstub, D., Bastida, R. and Dellino-Musgrave, V., 'Archaeological Research on HMS Swift: a British Sloop-of War Lost off Patagonia, Southern Argentina, in 1770', *International Journal of Nautical Archaeology* 36.1 (2007), 40.

[139] Birchall, A., 'HMS Colossus'. In M. Bound (ed.), *Excavating Ships of War* (Oswestry, 1998), 239.

[140] Bingeman, J.M., 1985. 'Interim Report on Artefacts from *Invincible* (1758) between 1979 and 1984', *International Journal of Nautical Archaeology* 14.3 (1985), 191, 195.

unusually scattered character of the site and the coins. The latter currently cluster around 1804 and contain mints from South America. Coin circulation at the time, however, coupled with the very biased size of the coins studied to date, do not provide a definitive date for the wreck or necessarily for the totality of mints represented. Caution must continue to be exercized at the current stage of the numismatic collection's study.

Cargo from the site is widely diffused over an area of 368 x 110 meters. This distribution is unusual other than in highly dynamic marine environments subjected to either severe wave motion or extreme currents. In theory, the pattern of artifacts could be imagined to have resulted from a catastrophic explosion. However, because no debris field from a comparable wreck site formed by such an event has been published, defining the causes underlying the Black Swan's site formation is currently a highly subjective exercise. Delgado has testified that large sections of wooden hull are symptomatic of exploded warships, and archaeological evidence from *L'Orient*, the *San Juan de Sicilia* and the *Mercure* confirm this fact. The absence of any planking on the Black Swan site, not to mention traces of a ferocious fire, remains highly suspicious and does not point towards this site being the *Mercedes* or at least the main shipwreck nucleus.

The supposition that the Black Swan site must be the *Mercedes* also fails to consider the site within its broader geographic context. As part of its side-scan and magnetometry survey of the 'Amsterdam' area, Odyssey searched approximately 1,600 square kilometers of seabed and identified 71 targets. 7 have been confirmed as shipwrecks, including another uninvestigated iron cannon site; 32 sites still await visual examination. The Black Swan site is thus not an isolated archaeological feature on a barren seabed, and it remains conceivable that the *Mercedes*, as well as the wooden hull from the Black Swan site, may lie within this unexplored cluster or elsewhere.

The sea lanes around Spain and Portugal were amongst the most heavily sailed between the 16th and 19th centuries. Historically- and archaeologically-attested shipwrecks off Portugal number 3,483 sites: 164 in the indeterminate area (4.7%), 2,540 in the Continental zone (72.9%), 62 off the Madeira Islands (1.8%) and 717 off the Azores

Islands (20.6%).[141] Shipwreck statistics for Spain, a vital piece of information for cultural resource management, are unavailable, but given her profound influence on the global maritime stage, a similar wreck loss ratio – at a minimum – must be realistic. To ignore this vast database and its unknown content in the *Mercedes* case is to misrepresent the evidence.

A solid example of the seriousness of this problem is exemplified by the ongoing conviction of Claudio Bonifacio, an Italian naval historian, that he already discovered the wreck of the *Mercedes* off Portugal in 1982 after studying detailed navigational information for the *Mercedes*' final hours in relation to the location of the Battle of Cape St. Mary in the *Life of Diego de Alvear*. Based on this data, a 9 x 6-mile rectangle was surveyed underwater and resulted in the discovery of a wreck with cannon at 70 meters depth, which his team is certain is the *Mercedes.* (Annex 22.1). A 'smoking gun' in this case was the dramatic similarity between the mountains opposite the wreck site and their contours, as drawn according to Alvear's account of the Battle of Cape St. Mary (Annex 22.2). As an expert in mathematics, astronomy, topography and surveying, Alvear's testimony carries great weight.[142] By contrast, land was not sighted from the Black Swan site.

The Portuguese Institute of Cultural Patrimony within the Ministry of Culture stamped an official 90-day project license on 19 March 1984 after the wreck was visually identified. This official document specifically acknowledged this wreck to be the 'Nuestra Senora de las Mercedes, afundada em 1804 ao Largo do Cabo de St-Maria' (Annex 22.3). Yet despite the scientific collaboration of Dr. Alice Freschi as project leader (the Director of Cooperativa Aquarius, an organization contracted to Italy's Ministry of Culture for over 20 years in marine archaeological projects), Portugal subsequently revoked the license for

[141] Alves, F.J.S., 'Underwater Cultural Heritage Management and Ship Archaeology – The Portuguese Experience'. In Satchell, J and Palma, P. (eds.), *Managing the Marine Cultural Heritage: Defining, Accessing and Managing the Resource* (CBA Research Report 153, 2007), 42, fig. 5.3.

[142] Alvear was also the respected author of *Descripción de Buenos Aires* and *Demarcación de los Territorios de España y Portugal*.

unknown reasons.[143] To this day, Bonifacio remains adamant that he – and not Odyssey – has discovered the physical remains of the *Mercedes* 28 miles north of the Black Swan site. Bonifacio's find spot coincides with Alvear's eyewitness account and drawing of the area where the *Mercedes* was lost.

In conclusion, Article 29 of the Law of the Sea Convention (Subsection C, Rules Applicable to Warships and other Government Ships Operated for Non-Commercial Purposes) states that:

> 'For the purposes of this Convention, "warship" means a ship belonging to the armed forces of a State bearing the external marks distinguishing such ships of its nationality, under the command of an officer duly commissioned by the government of the State and whose name appears in the appropriate service list or its equivalent, and manned by a crew which is under regular armed forces discipline.'

Similarly, Article 8 of the United Nations' Conference on the Law of the Sea (1958) stipulates that such military craft must bear 'the external marks distinguishing warships of its nationality'.

I hereby certify that the archaeology of the Black Swan site displays no such 'external marks' (ship's name on any artifact, dates on any vessel structural fitting, including cannon, rudder, pewter/silver plates, ingots). Other than the unrepresentative and problematic sample of coins, no set of material culture on the Black Swan site is demonstrably Spanish.

[143] Bonifacio, C., *Galeones con Tesoros. Dónde Están Hundidos. Qué llevaban* (Muñoz Moya Editores Extremeños, 2007), 212-23.

Black Swan Report Annexes

Annex 1
Sean Kingsley Curriculum Vitae.

Annex 2

2.1. Photomosaic of the Black Swan site within its geospatial grid.
2.2-2.39. Select photographs of the Black Swan site.

Description of Images on the Black Swan Site:

2.2. Typical view of highly scattered and discontinuous artifacts. Ingots, coin clumps and iron concretions are distributed across the seabed at random.
2.3. Impressions left by the Remotely Operated Vehicle (ROV) Zeus' skids (sledge-like feet) on the seabed. Despite its 8-ton weight, this robot is able to sit on the compact seabed.
2.4-2.5. Impressions left by ROV Zeus' skids on the seabed, with extensive evidence of the seabed, which is visibly composed of clumps of consolidated bluish mud and not mobile sand.
2.6. Detail of the upper 15 centimeters maximum of the seabed, which visibly consist of compact bluish mud deposits. Note the presence of a sea urchin, which is indigenous to non-dynamic environments.
2.7. Modern fishing net and the visible bluish mud of the seabed.
2.8. Iron cannon the Black Swan site do not create the classic form of hard concretion because no mobile sand is present for its composition. Iron cannon (cascable button visible at far right) surrounded by a dense corrosion pedestal. The iron has leached downwards, leaving rust-coloured deposits in the mud strate.
2.9. Highly deteriorated iron object on a corrosion pedestal. Note the downward leaching of metal.
2.10. Once iron objects are so badly corroded that the underlying weight of leached metal that has penetrated the mud exceeds the weight of the decayed object, the pedestals fall over sideways on the Black Swan site.
2.11. Dense corrosion pedestal and extensive sponge life are indicative of a hydronamically stable marine environment.
2.12. A copper ingot corroding *in situ*.
2.13. A complete olive jar.
2.14. Flat-bottomed base of a jar.
2.15-2.16. A small concentration of gravel, probably ballast, next to a gold box. No wood remains are visible.
2.17. Cannon C8 tapering from left to right. Two iron rings are concreted to the gun at the cascable and mid-way along its length. One section of rope extends perpendicular to the cannon.
2.18. Length of rope, presumably contemporary with the commercial cargo on the site.
2.19. The muzzle of cannon C7 lies adjacent to a one-armed iron anchor and a dense area of concretions, possibly rigging. Copper tubing at right.

2.20. Unidentifiable iron concretion.
2.21. The Black Swan site contains several copper artifacts, whose identity is unverifiable without recovery.
2.22. Corroded iron (top right), a miscellaneous copper artifact (tope left) and concentration of high-value metallic cargo at bottom right (pewter/silver plates, spoons, silver and gold candlesticks).
2.23. Unidentifiable bluish-green artifact (bottom left).
2.24. Copper tubing of unknown function alongside possible rigging.
2.25. Detail of copper tubing in 2.24. No holes for attachment to a hull are visible.
2.26. Lead sheet on the seabed, possibly from a ship's galley oven area.
2.27. Bronze pintle *in situ*. Note how the object is broken into 2 pieces.
2.28. Area of miscellaneous copper sheet, concretion, rope and a bronze reinforcement element.
2.29. Detail of the bronze reinforcement element. Note its symmetrical construction: the item retains its original shape and has not been bent out of shape by any impact.
2.30. Broken iron anchor on a corrosion pedestal, with its palm at left.
2.31. Detail of the palm of the iron anchor (2.30).
2.32. Detail of one-armed iron anchor.
2.33. Copper and tin ingots, a coin clump, and a possibly copper ship's structural spike in between.
2.34-2.35. Possible copper ship's spikes.
2.36. Lead tubing alongside cannon C10. Note the dense corrosion platform formed at one end of the gun.
2.37. Lead tubing on the seabed.
2.38. Copper ingot, iron corrosion pedestal and coin clump.
2.39. Concentration of high-value cargo: pewter/silver plates, spoons and a gold candlestick.

Annex 3
Black Swan Project. Gibraltar Artifact Summary (Odyssey Marine Exploration, 2008).

Annex 4
4.1. Classification of wreck classes from Muckelroy, K., *Maritime Archaeology* (Cambridge University Press, 1978), 158, 164.
4.2. Stewart, D.J., 'Formation Processes Affecting Submerged Archaeological Sites: An Overview', *Geoarchaeology* 14.6 (1999), 569.
4.3. Ward, I.A.K., Larcombe, P. and Veth, P., 'A New Process-based Model for Wreck Site Formation', *Journal of Archaeological Science* 26 (1999), 567.

Annex 5
Catalogue of iron and bronze cannon on the Black Swan site.

Annex 6

6.1. Plan of the *Sacramento*, Brazil, 1668: Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *International Journal of Nautical Archaeology* 8.3 (1979), 213.

6.2. Plan of the *Hazardous*, England, 1703: Owen, N.C., '*Hazardous* 1990-1991 Interim Report', *International Journal of Nautical Archaeology* 20.4 (1991), 326, 328.

6.3. Plan of the coherent wreck site of the *Conde de Tolosa*, wrecked 1724, off Hispanola: James, S.R., 'A Reassessment of the Chronological and Typological Framework of the Spanish Olive Jar', *Historical Archaeology* 22 (1988), fig. 3.

Annex 7

7.1. Typically heavily concreted cannon from HMS *Colossus*, England, 1798: Camidge, K., HMS *Colossus*. *CISMAS Debris Field Survey 2004*, 15-16.

7.2. Typically heavily concreted iron cannon from HMS *Sapphire*, Australia, 1695: Muckelroy, K., *Maritime Archaeology* (Cambridge University Press, 1978), fig. 3.27.

Annex 8

A photographic survey of the French shipwreck *L'Orient*, blown up in Aboukir, Bay, Egypt, in 1798, with coherent, inter-connected wooden hull remains intact.

Annex 9

Excavation report on the *Mercure*, a Napoleonic warship blown up off Lignano, Italy, in 1812: Beltrame, C. and Gaddi, D., 'Report on the First Research Campaign on the Napoleonic Brick, *Mercure*, wrecked off Lignano, Udine, Italy in 1812', *International Journal of Nautical Archaeology* 31.1 (2002), 60-73.

Annex 10

10.1. Cannon terminology from Blackmore's *The Armouries of the Tower of London. I. Ordnance* (London, 1976), 216.

10.2. Cannon (olive jars and Chinese pottery) from the *Sacramento*, Brazil, 1688: Pernambucano de Mello, U., 'The Shipwreck of the Galleon Sacramento-1668 off Brazil', *International Journal of Nautical Archaeology* 8.3 (1979), 213-223.

10.3. Examples of foreign cannon typologically similar to Spanish culverins and *obuses*, and non-Spanish cannon with dolphin handles from Blackmore's *The Armouries of the Tower of London. I. Ordnance*, London, 1976.

10.4. English short-barreled bronze cannon similar to Spanish *obuses* (catalogued by Rudi Roth): http://www.cannons.ch/verkaufe.htm.

10.5. European iron cannon comparable to Delgado annex 9.25 from Caruana, A.B., *The History of English Sea Ordnance 1523-1875. Volume I: 1523-1715, the Age of Evolution*, Rotherfield, 1994.

10.6. Inscription dated 1803 on an iron cannon stripped of its outer concretion from HMS *Pomone*, England, 1811: Tomalin, D.J., Simpson, P. and

Bingeman, J.M. 'Excavation Versus Sustainability *In Situ*: a Conclusion on 25 Years of Archaeological Investigations at Goose Rock, a Designated Wreck-Site at the Needles, Isle of Wight, England', *International Journal of Nautical Archaeology* 29.1 (2000), 8, fig. 7.

Annex 11

Spanish olive jars from the Danish wreck of the *Sainte Dorothea*, 1693: L'Hour, M., 'La Sainte Dorothéa (1693). 'Un Vaisseau Marchand Danois en Rade de Villefranche', *Cahiers d'Archéologie Subaquatique* 11 (1993a), 22-23.

Annex 12

Select images of supposed wooden hull structure from Delgado annex 9 to exhibit D.

Annex 13

13.1. Wooden hull remains of Spanish shipwrecks off Ireland, 1588, and pewter wares: *La Trinidad Valencera* and *Santa Maria de la Rosa*: Breen, C. and Forsythe, *Boats and Shipwrecks of Ireland* (Tempus, 2004), figs. 53. 55; Martin, C., *Full Fathom Five. Wrecks of the Spanish Armada* (Chatto & Windus, London, 1975), figs. 7b, 8, 9; Martin, C.J.M., 'La Trinidad Valencera: an Armada Invasion Transport Lost off Donegal. Interim Site Report, 1971-76', *International Journal of Nautical Archaeology* 8.1 (1979), figs. 11, 13, 15.

13.2. Wooden hull remains and anchors from the *Atocha*, Florida, 1622: Mathewson, R.D. *Treasure of the Atocha* (Key Largo, 1986).

13.3. Wooden hull remains, logwood cargo, concretions and iron gudgeon from the *El Nuevo Constante*, Louisiana, 1766: Pearson, C.E. and Hoffman, P.E. *The Last Voyage of El Nuevo Constante. The Wreck and Recovery of an Eighteenth-Century Spanish Ship off the Louisiana Coast* (Louisiana State University, 1995).

13.4. Wooden hull remains of the *Nuestra Senora de Balvaneda*, Florida, 1733.

13.5. Wooden hull remains from the Spanish galleon off the Dry Tortugas wreck, Florida, 1622: Kingsley, S., 'Odyssey Marine Exploration and Deep-Sea Shipwreck Archaeology: the State of the Art', *Minerva* 14.3 (2003), figs. 12, 14.

13.6. Wooden hull remains from the Azores, Portugal, 15th-19th centuries: Alves, F.J.S., 'Underwater Cultural Heritage Management and Ship Archaeology – The Portuguese Experience'. In Satchell, J and Palma, P. (eds.), *Managing the Marine Cultural Heritage: Defining, Accessing and Managing the Resource* (CBA Research Report 153, 2007), 42, figs. 5.5, 5.6.

13.7. Wood report for the Arade 1 shipwreck, Portugal, 16th/17th century: Loureiro, V. and Gachet Alves, J.G., 'The Arade 1 Shipwreck: Preliminary Results of the 2004 and 2005 Field Seasons', *International Journal of Nautical Archaeology* 37.2 (2008).

Annex 14

14.1. Stammers, M.K., 'Iron Knees in Wooden Vessels – an Attempt at a Typology', *International Journal of Nautical Archaeology* 30.1 (2001), 115-21.

14.2. A supposed iron knee from Delgado annex 9.9.

14.3. A supposed iron knee from Delgado 9.24.

Annex 15

Examples of ballast heaps defining shipwreck sites.

15.1. Rectangular iron ballast blocks from HMS *Fowey*, Florida, 1748: Skowronek, R.K., Johnson, R.E., Vernon, R.H. and Fischer, G.R., 'The Legare Anchorage Shipwreck Site – Grave of HMS *Fowey*, Biscayne national Park, Florida', *International Journal of Nautical Archaeology* 16.4 (1987), figs.3, 7.

15.2. Rectangular iron ballast blocks on HMS *Pomone*, England, 1811: Tomalin, D.J., Simpson, P. and Bingeman, J.M. 'Excavation Versus Sustainability *In Situ*: a Conclusion on 25 Years of Archaeological Investigations at Goose Rock, a Designated Wreck-Site at the Needles, Isle of Wight, England', *International Journal of Nautical Archaeology* 29.1 (2000), fig. 15.

Annex 16

Photographs of a model of the frigate *Diana*, built in 1792.

Annex 17

Bronze pintle and copper tubing from HMS *Pandora,* Great Barrier Reef, 1791: Henderson, G., 'Finds from the Wreck of HMS Pandora', *International Journal of Nautical Archaeology* 9.3, 1980.

Annex 18

18.1. La Trinidad Valencera anchors, 1588: Martin, C.J.M., 'La Trinidad Valencera: an Armada Invasion Transport Lost off Donegal. Interim Site Report, 1971-76', *International Journal of Nautical Archaeology* 8.1 (1979), fig. 16.

18.2. Santa Maria de la Rosa anchors, 1588: Breen, C. and Forsythe, *Boats and Shipwrecks of Ireland* (Tempus, 2004), fig. 52.

18.3. Atocha, 1622: Mathewson, R.D. *Treasure of the Atocha* (Key Largo, 1986), 38-9.

18.4. El Nuevo Constante anchors: Pearson, C.E. and Hoffman, P.E. *The Last Voyage of El Nuevo Constante. The Wreck and Recovery of an Eighteenth-Century Spanish Ship off the Louisiana Coast* (Louisiana State University, 1995), fig. 28.

18.5. Mid-18th century anchors in Spain: Harbron, J.D. *Trafalgar and the Spanish Navy* (London, 1988).

Annex 19

19.1. Iron stove on the wreck of HMS *Pandora*, Great Barrier Reef, 1791: http://www.qm.qld.gov.au/features/pandora/wreck/03_wreck.asp.

19.2. Iron stove on the Mardi Gras shipwreck, Gulf of Mexico, early 19th century: http://www.flpublicarchaeology.org/mardigras/artifacts/stove.

Annex 20

Black Swan Coin Conservation Report.

Annex 21

Spanish naval regiment buttons: Deagan, K. *Artifacts of the Spanish Colonies of Florida and the Caribbean, 1500-1800. Volume 2: Portable Personal Possessions* (Smithsonian Institution Press, Washington, 2002), 168-70.

Annex 22

22.1. Bonifacio, C. *Galeones con Tesoros. Dónde Están Hundidos. Qué llevaban* (Muñoz Moya Editores Extremeños, 2007), 212-23.

22.2. A frame grab from a Spanish television documentary (Radio Television Portugal, May 1997), superimposing Alvear's drawing of the coastal landscape of Cape St. Mary with that visible from the wreck site located off Portugal by Bonifacio's team.

22.3. An official Portuguese survey license for Bonifacio's team to examine a wreck named here as the 'Nuestra Senora de las Mercedes.'