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Amidships Assembly of the Sixteenth-Century Emanuel Point II Shipwreck

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Abstract
The Emanuel Point II (EP II) shipwreck was part of a 1559 Spanish colonizing expedition along the coast of Florida, under Tristán de Luna y Arellano. Initially discovered by University of West Florida archaeologists in 2006, over the last decade EP II has provided several generations of undergraduates and graduate students a platform for learning practical underwater techniques. Recent funding has allowed year-around work that included uncovering articulated hull structure in the amidships area. Archaeologists recorded the mainmast step and its associated pump well construction. Results from this analysis suggest that EP II was a relatively new ship with unique features, when compared to other known sixteenth-century vessels.

Keywords Mainmast step · Pump well · Luna expedition · Shipwreck · Sixteenth century

Introduction

Over the last several years a dedicated team of archaeologists at the University of West Florida has been investigating a mid-sixteenth century shipwreck associated with the Tristán de Luna y Arellano expedition. These efforts have provided an opportunity to record intact hull remains from a large ship, known as Emanuel Point II (EP II), which sank in 1559 due to a powerful hurricane. This article addresses the historical context of the initial Luna expedition and the subsequent discovery of the Emanuel Point shipwrecks. Recent focus on EP II at amidships included uncovering surviving components from the mainmast step assembly and pump well enclosure. These components provide additional information for archaeologists in understanding the development of

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shipbuilding practices along the European-Atlantic coastline at the beginning of modern globalization.

Historical Background

On December 29, 1557, King Philip II of Spain (1556–98), wrote a letter to his Viceroy of New Spain, D. Luís de Velasco (1550–64), informing him that he had decided to lift the eight-year ban on colonizing the province known as *La Florida*, a region in North America incorporating everything north and east from the Rio de las Palmas (modern Rio Soto la Marina). Although Philip II did not include the reason why the ban was lifted, he was confident that placing his Viceroy in charge of all decision making and selecting a governor to oversee the colonization would lead to a successful extension of his empire (Priestley 1928a, I:42–47). After the loss of three ships from the 1554 fleet along the modern Texas coastline and the fate of the survivors that were forced to walk south, many had petitioned the Crown for a new settlement beside the Gulf of Mexico to act as a safe haven for shipwreck victims (McDonald and Arnold 1979:147; Priestley 1936:267). Moreover, several members of the ecclesiastical community had sent requests to renew attempts at proselytizing the Spanish frontiers, especially in *La Florida*, after the failure of 1549 Cancer expedition. Fray Luis Cancer de Barbastro, a disciple of Bartolomé de las Casas, obtained a license to missionize the Florida natives (Worth 2014:185), but his efforts were unsuccessful and he was murdered by the same Indians he sought to convert along peninsular Florida. His failure did not prevent many others from urging that new efforts should be made to visit the province (Priestley 1936:55; Weddle, 1985:252). Despite the reasons emphasized in these petitions for the colonization of *La Florida*, it seems that Philip II's decision was based predominantly on a military stratagem.

Throughout the 1550s, France and Spain remained at war in Europe and during these conflicts French corsairs had some moderate success in the Caribbean, even managing to attack Havana and Cartagena (Hoffman 1990:128–130). After the French crown managed to establish a colony at the mouth of Guanabara Bay, Brazil, which could provide a staging place for raiding into the Caribbean, rumors circulated that another location was being sought to colonize along the North American coastline (Bennett and Milanich 2001:13; Eccles 1998:10). This location was intended to mimic the southern French colony in providing a base of operations for raiding and preying upon Spanish ships in the Florida Straits. Philip II allowed D. Velasco to choose a point along the Gulf coast to establish a settlement as a safe haven for shipwreck survivors, but he also ordered the Viceroy to send another group overland and establish a second colony at Santa Elena (Priestley 1928b, II:256–261). Santa Elena was the site of an earlier failed expedition in 1526 by Lucas Vázquez de Ayllón, who originally claimed that the location had immense wealth and was an ideal port facing the Atlantic (Hoffman 1992:32).

Velasco responded to the king at the end of September 1558, claiming that he had sent a scouting expedition the previous month under Guido de la Vaçares to survey the Gulf coast for a suitable harbor (Priestley 1928b, II:256–261). In the meantime, the Viceroy had chosen a new governor for *La Florida*, Tristán de Luna y Arellano. Luna was born in Borobia, Spain around 1514 and was the second son to a wealthy aristocratic family. Spanish tradition at the time followed primogeniture, allowing Luna's older brother, Pedro, to inherit the family's possessions. Since there was little for Luna to gain by staying in Spain, he chose the opportunities of a military and political career in the New World and became a citizen of Mexico City by 1537 (Boyd-Bowman 1968:318).

Luna volunteered as a cavalry captain on the Francisco Vázquez de Coronado y Luján expedition (1540–42) searching for the fabled city of Cibola. Although Coronado returned from the American Southwest without finding many reasons why Spain should extend its empire into the North American continent, Luna's leadership allowed him to rise to *maestre de campo* (master of the camp), and eventually lieutenant-general of the expedition (Flint and Flint 2005:331, 392). In 1545, he married the twice widowed Dona Isabel de Rojas, whose *encomienda* holdings from her previous husbands provided her with a small fortune (Gerhard 1993:164). Marrying into the New World high society and relying on family ties in Spain facilitated Luna's political career and he became close friends with New Spain's first Viceroy, D. Antonio de Mendoza y Pacheco (1535–50). During a 1548 uprising in Tetiequipa and Coatlan near Oaxaca, Mendoza sent Luna at his own expense to pacify the natives (Priestley 1928b, II:198–207). His success in the venture was awarded by becoming the administrator of the Marquesado del Valle de Oaxaca's holdings in 1551. Documentary evidence suggests that Tristán de Luna was also a close friend of the new Viceroy, D. Luís de Velasco (Weddle 1985:266). The earlier successes and his noble status made Luna appear as a capable choice for the Florida expedition.

Over the course of winter and into the spring of 1559, Velasco and Luna went to work organizing the expedition. Most of the supplies and labor came from New Spain (Fig. 1), relying on the local economy to support the colonizing effort (Yugoyen 1569). Fertile lands surrounding Puebla and Xalapa produced crops of maize and wheat to feed the colonists. Livestock from ranches near Perote supplied dried beef and meat to supplement the diet. Finished goods came from Mexico City or Veracruz, and were transported to San Juan de Ulúa. Grapes for wine and olive production were nascent in the New World, requiring higher payments for import from Europe (Crosby 2003:72–

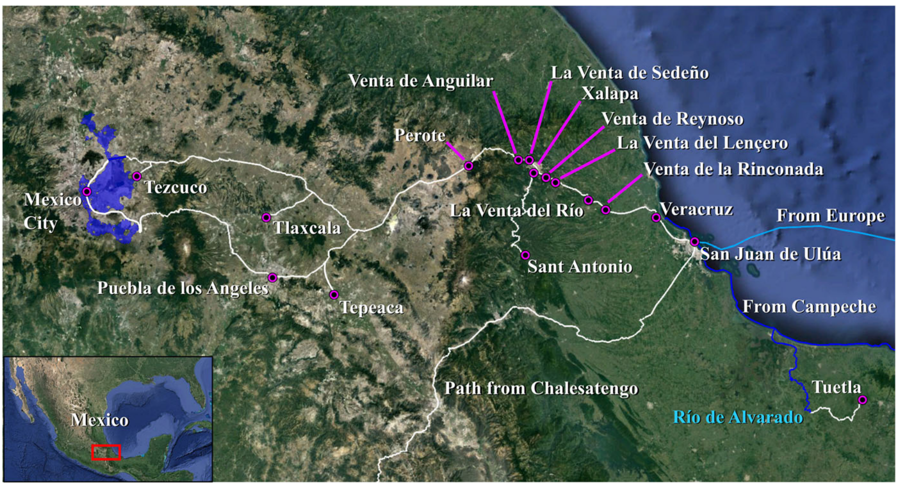

Fig. 1 New Spain colonial supply routes for the Luna Expedition. (after Google Earth, 2017)

73). Compared with previous secular colonization attempts, the Luna expedition was unique for having the Crown provide funding for its success. The majority of the materials bought by royal officials were communal items that colonists would share. These materials included candles, medicinal items, grinding stones, and plowshares. Over 500 axes were bought to cut timber, under the assumption that any other tools for constructing the settlements would be brought by individual craftsmen (Yugoyen 1569:f.525). Native Mexicans from several *encomiendas* were paid for their services in constructing stables, collecting grass to feed horses, and assisting in ship construction.

There was some initial difficulty in finding colonists for the expedition, because many of the men initially did not wish to move and start a new colony (Ybarra 1560). These issues seem to have been resolved by May 1559, when Luna wrote to the king informing him that he had accumulated roughly 550 soldiers, 240 horses, and 1,000 serving people in attendance (Priestley 1928a, I:4–5). The serving people Luna mentioned probably included the many families that traveled with the soldiers, along with the African slaves, and Mexican Indians that volunteered to go as warriors, farmers, servants, or skilled artisans. When the Viceroy originally organized the expedition, he planned to build six *barcas* at San Juan de Ulúa, the port for Veracruz during the sixteenth century (Priestley 1928b, II:256–261). As time progressed, it became obvious that the small *barcas*, being shallow rowing and sailing vessels, were not large enough to accommodate the supplies and colonists. It was eventually decided that four new ships: two *barcas*, a galleon, and a *fragata* would be built, along with a new shipyard paid at the Crown's expense (Bendig, 2016:136–138; Yugoyen 1569:f.353). Three other ships were purchased by crown officials, and five more were chartered to carry the expedition's supplies (Table 1). When the colonists departed San Juan de Ulúa on June 11, 1559, most of the personnel and supplies were carried in the 11 larger vessels. The smallest ship, the new *fragata*, possibly known as the *San Juan*, was towed behind.

Table 1 Ships of Tristán de Luna y Arellano's fleet

Ship Name	Typology	*Tonelada*	Crew Size	Procurement	Status After Hurricane
San Juan (de Ulua)	*galleon*	651[a]	43	Purchased	Lost
San Juan de Ulua	*galleon*	484.5[a]	32[a]	Built	Survived
Jesus	*urca*	570	38[a]	Rental	Lost
San Andres	*nao*	492.5	31[a]	Rental	Lost
Espiritu Santo / Santi Espiritus	*nao*	238[a]	15[a]	Purchased	Lost
San Amaro	*navio*	145	10[a]	Rental	Lost
Santa Maria de Ayuda	*navio*	100	17[a]	Rental	Lost
Sancti Espiritus	*caravel*	242	24[a]	Rental	Survived
Corpus Cristi	*barca*	150[a]	10[a]	Purchased	Survived
San Luis Aragon	*barca*	150[a]	10[a]	Built	Survived
San Salvador / La Salvadora	*barca*	150[a]	10[a]	Built	Lost
San Juan	*fragata*	105[a]	–	Built	Survived

[a] Estimated based on known crew sizes and payment totals

The Luna expedition was one of the most promising attempts at colonization through a combination of state and private capital. Previous expeditions usually relied solely on private equity and a contract allowing the beneficiary to receive concessions as a reward for conquest in the name of the Crown. Many who traveled with Luna were veterans from the earlier Hernando de Soto expedition (1539–43), which traveled through much of the American Southeast, or from other conquests. One example was the cavalry Captain, Juan Xaramillo, whom originally accompanied Luna on the Coronado expedition. Initially, the Luna fleet was plagued by contrary winds, causing the ships to be blown toward the Yucatan Peninsula before successfully sailing across the Gulf and reaching Pensacola Bay on August 15, 1559. Only five weeks into establishing the settlement, a hurricane destroyed seven of the twelve vessels, most still loaded with the food supply for the colony (Priestley 1928b, II:244–245). Florida's settlement, however, proved to be difficult and did not offer as many opportunities for the settlers as the vast and rich territories that were being established in Central and South America.

Luna struggled in *La Florida* for two years, until he was replaced by Ángel de Villafañe on Velasco's orders (Priestley 1928a, I:8–9). Villafañe removed most of the colonists, leaving only a small contingent of soldiers as he sailed east to locate Santa Elena. When his attempts at locating the port ended in failure, he returned to Veracuz, along with the surviving colonists from Pensacola (Hoffman 1992:179–180). The unfortunate failure of the Luna expedition prevented further attempts at colonizing *La Florida* along the Gulf coast. Pensacola would not be revisited until the Spanish settled the area permanently in 1698 (Coker 1999:8–9).

Discovery of the Emanuel Point Shipwrecks

Beginning in 1990, the Florida Bureau of Archaeological Research (FBAR), under the Florida Division of Historical Resources, received several federal grants through the Florida Coastal Management Program to conduct shipwreck surveys within Pensacola Bay. Led by Dr. Roger Smith, the archaeological team was able to locate 33 sites dating from the colonial period to the modern age (Smith et al. 1995:15–19). Returning to Pensacola in the summer of 1992, the team continued to survey within Pensacola proper in the hope of locating ships from the Luna expedition. Operations at the end of August focused on a shallow water area off Emanuel Point, near the mouth of Bayou Texar. Most anomalies were associated with modern debris, but a large magnetometer reading turned out to be a submerged ballast pile.

Further preliminary excavations of the site in October 1992, and in the following February, revealed intact hull assembly, as well as artifacts consistent with similar sixteenth-century assemblages. Original excavations focused on uncovering a portion of the mainmast step, surviving outline of the stern, and discovering the ship's rudder, along with numerous artifacts. Further work on the Emanuel Point (8ES1980) ship, later known as EP I, was conducted between 1997-98, after the Florida Division of Historical Resources granted funding in the form of a Special Categories Grant (No. SC751) to continue excavation. The Division chose to award the grant to the University of West Florida (UWF) with Dr. Smith remaining as the principal investigator (Smith et al. 1998:3–6). Subsequent excavation focused on uncovering the bow of the ship and to locate the extent of the keel to provide dimensions for the vessel. Previous work on the site uncovered copper cauldrons forward of amidships, these locations were investigated further to possibly locate galley hardware. Operations ended in March 1998, when the team reburied any components previously open for recording.

Over the course of the later excavation on EP I, UWF developed a working relationship with FBAR to build a robust research program in maritime archaeology. Each year undergraduates and graduate students operated along Pensacola's surrounding waterways conducting remote sensing surveys, recording, and excavation of historic shipwrecks. Toward the end of a 2006 maritime field school, students and faculty were investigating magnetic anomalies near Emanuel Point. One such anomaly, magnetic target 17, turned out to be another ballast mound approximately 400 yards [366 m] from the location of EP I (Cook, 2009:93). Preliminary excavations in the fall of 2006 uncovered articulated hull structure and associated Spanish olive jar, tin-glazed pottery, and Columbian plain majolica. The new find, designated Emanuel Point II, or EP II (8ES3345), was tentatively identified as another ship from the Luna expedition. Almost every summer since its discovery, EP II has been used by principal investigators, Drs. John Bratten and Gregory Cook, as a teaching platform for students to learn practical underwater field techniques in a low visibility environment. For the first several field seasons, UWF archaeologists focused on finding the outline of the ship by locating the bow, stern, and digging a trench across the hull forward of amidships (Fig. 2).

Amid continued work at the site, UWF was awarded another Special Categories Grant (SC503) in 2014 by the Division of Historical Resources. The terms of the grant provided funding for two-consecutive years of excavation, with additional surveying for the other missing Luna vessels. Following this award, UWF students were hired as archaeological technicians, who worked year around on uncovering specific components of the hull. Efforts included locating the mainmast step, uncovering the sternpost, and understanding articulated hull structure found in 2012 that was situated off of the stern (Atkinson 2017:66; Bendig 2016:142; Willard 2017, pers. comm.).

Methodology

Fieldwork was conducted using a steel 7 x 11 m double pontoon barge anchored adjacent to the site. The barge acted as the diving platform and included several compartments to hold tools and dredging equipment. Excavation was carried out using a 1 x 1 m grid system that was tied into a permanent baseline running along the north-south axis. Grid units were composed of square aluminum tubing with vertical posts driven into the bottom sediment. Tags labeled with the northern and eastern coordinates of each unit in relation to an offsite datum point were tied to the top of the northeastern corner post. Divers began and ended each dive by collecting the depth measurement from all four corners and the center of a unit. Measurements relied upon a string and line level attached to the northeast corner. Sediment removal utilized a water induction dredge in concordance with hand fanning and moving ballast. Any small artifacts that may have been missed by personnel were caught in a double mesh bag attached at the dredge exhaust and later sorted using a 3-mm standard mesh screen. Ballast was routinely placed into plastic crates and carried offsite to a previously designated dump area.

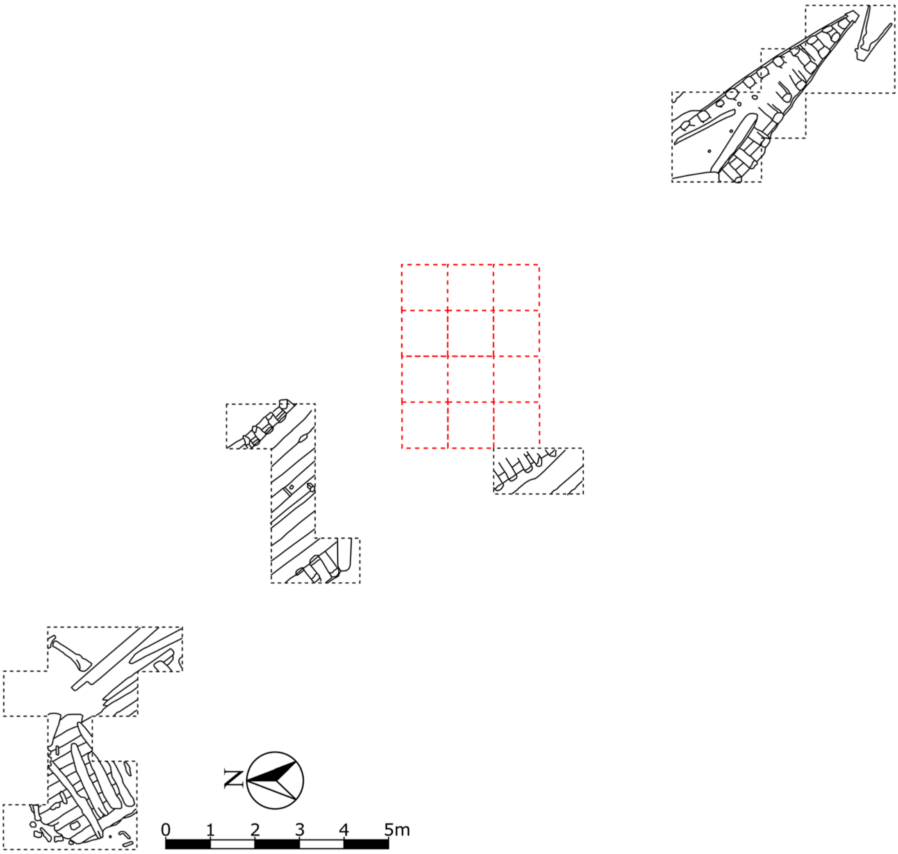

Fig. 2 Emanuel Point II site plan prior to 2014 excavations. Note: recent excavation area highlighted in red. (after Cook, 2009:92)

Artifacts that were discovered in situ were offset measured to the nearest two edges of the unit and provided a depth measurement. Due to the significant depth at amidships from the top of the units (90–150 cm), mapping the hull structure relied on offset measurements through the use of a metal dowel rod zip tied with a folding ruler and two horizontal levels. These measurements collected the relative points indicating where the seams or outlines of components were located. The low visibility environment required this portion of the mapping to be repeated several times until enough points provided overlapping accuracy. After the units surrounding the main-mast step were completely excavated, the inside unit frames were removed. This removal provided better access to the lower extremities of the hull, where scantling measurements were collected and fastener locations recorded using baseline offsets from significant features.

During excavation, archaeologists encountered fragments of the ship's pump well. Over 30 pieces were mapped in place before being lifted and transported to the wet conservation laboratory at UWF. Only two large planks were left on site, after being lifted to the barge, cleaned, and recorded with a GoPro Hero 3 and 4 to collect stills for creating a 3D model. Each timber was given a provenience number and the location of the specific unit(s) it originated from. Labels were printed on a DYMO Express Pro Handheld Embosser and attached using stainless steel Monell staples on the closest section to the northeastern corner of the unit as it was found in situ. Further information was collected in a timber removal log that included basic measurements, the original location of the piece, and where it would be reinterred on site. All fragments were recorded on specific mylar forms prior to removal and subsequently photographed before and after labels were attached.

Pump well components that were brought to the conservation lab went through a series of cleaning procedures to remove clay and sediment. Each piece was then placed on a 3-m diameter turntable with seamstress tape glued along the edge. Photos were taken at 5 cm intervals using a Nikon D3200 with an AF-S Nikkor 35 mm 1.18G lens. Depending on the size of the timber, photos collected ranged from 300 to over 1000 pictures per piece. Post-processing was completed in Pixanode Inc.'s Phoduit using filters and adjustments to provide better image quality and produce alpha channel masks. Edited photos were then put into AGI's PhotoScan to create highly detailed 3D representations. Orthographic images from traditional archaeological angles were exported from PhotoScan into Phoduit to create accurate scale "drawings." Every 3D model was imported into Blender to reassemble the pump well. During laboratory recording, scantling measurements were obtained, along with the number, size, and angle of fastener holes. Once data collection was complete, all timbers were individually wrapped with geotextiles and zip tied before being reburied in sterile excavation units outside the hull.

Site Description

Emanuel Point II is located 7.5 km south of the northern coastline of Pensacola Bay (Fig. 3), near the recently discovered location of the Luna settlement (Worth 2016:4). Surviving hull remains suggest the ship was anchored directly southeast from its current location before the 1559 hurricane drove it onto the edge of a submerged sandbar at the

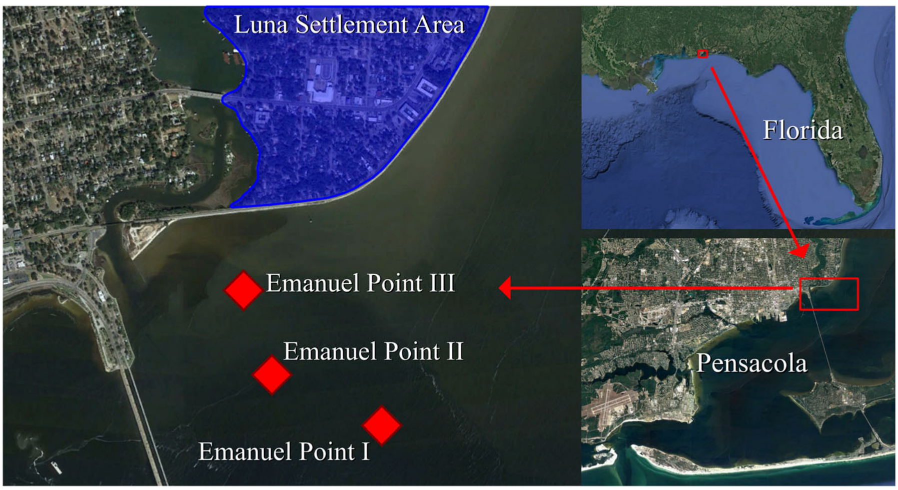

Fig. 3 Locations of the Emanuel Point shipwrecks and terrestrial site. (after Google Earth, 2017)

original entrance to Bayou Texar. The remains are only 4.5 m deep and approximately 400 m northwest from EP I. Conditions on site vary depending on the season, with a continuous influx of sediment arriving at the bay as the terminus for various northern river networks. Over the summer months, visibility can range between 0.01 to 2 m, usually improving during the winter months when temperatures drop and less rainfall takes place.

Current on site is typically less than one knot and runs along the bottom in a northwest to southeast direction. Even so far from the Gulf entrance to the Bay, the site is impacted by tide, which sometimes acts favorably to increase visibility. Surviving hull structure begins just below the seafloor, where the top of the ballast mound follows the natural contours. Pensacola Bay has no natural rock formations, which makes identifying ballast piles considerably easier. Sediment consists of mud, sand, and clay, providing an ideal anaerobic environment where archaeologists have been able to recover various organic artifacts. Most of the lower hull remains have little or no evidence of marine organism attack. Over the course of the last several years, archaeologists opened an area 4 × 3 m at amidships that uncovered the mainmast step (Fig. 4). Remains included the expanded keelson, four pairs of buttresses, bilge board, ceiling, floors, first futtocks, and filler planks. None of the remains were taken apart, except for the bilge boards, which provided limited access to the bilge and recording underneath the ceiling.

Ship Construction

Opening such a wide area at amidships provided archaeologists with a number of individual components to a highly complex construction sequence. Figure 5 provides

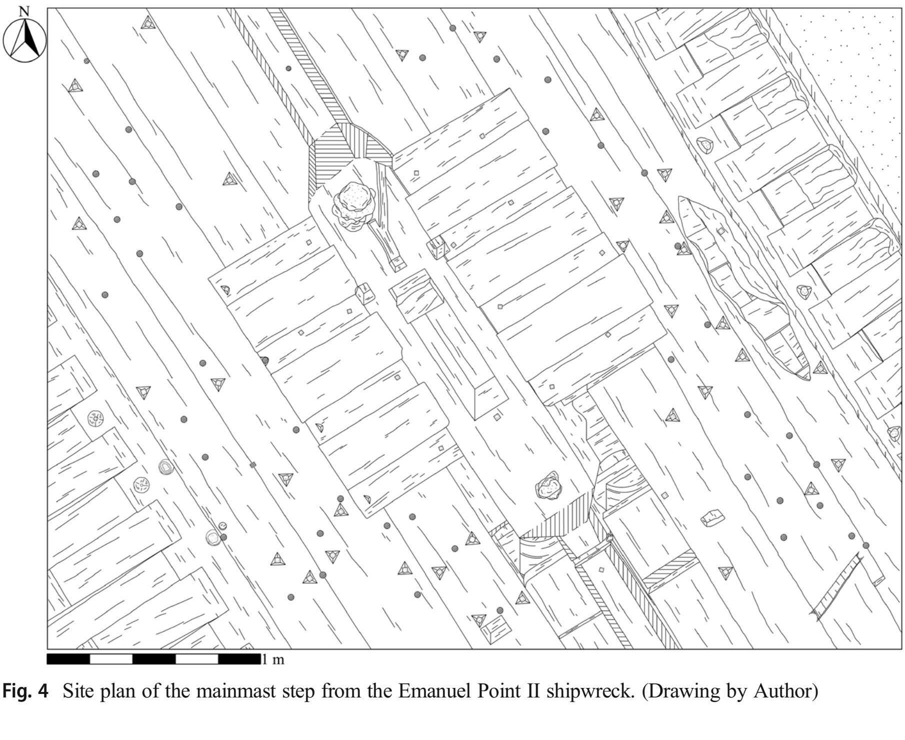

Fig. 4 Site plan of the mainmast step from the Emanuel Point II shipwreck. (Drawing by Author)

an altered version of the amidships site plan with reference codes attached for each of the major timbers described below. These function codes are divided into three parts: the first is the shipbuilding term for the individual component, next is whether the timber is located on port or starboard, and the final part is a traditional sequential letter if located forward of the master frame or numerical if behind it. Ceiling, such as the foot wales, bilge clamps, and sills were given numerical numbers, since the terminus of most of these individual timbers were not located at amidships. Keel, keelson, and floor timbers were given only sequential lettering or numbers depending on their location in reference to the master frame. Only floor timber 3 (FT.3) is shown on Fig. 5, due to the nature of the excavation not including disassembly of the hull.

Keel and Garboards

Access to the keel at amidships was restricted to what could be observed beneath the expanded keelson and between floor timbers. Table 2 provides individual scantlings for major structural timbers that were recorded. The keel is 30–33 cm sided and has separate accompanying garboards - the starboard is 30.5 cm wide and 34 cm on the portside. Accompanying outer hull strakes are 29–36 cm wide and 5–6 cm thick at the surviving edge of the hull. Previous excavations at the bow uncovered the forward end of the keel, measuring 30 cm sided by 27 cm molded (Cook 2009:94). Investigators described the outward face of the forward section of the keel as rounded, possibly from wear or grounding of the ship. Recent excavations at the stern have also described a similar rounded shape for the outboard face of the heel (Atkinson 2015, pers. comm.). Whether this rounded feature can be found at amidships cannot be discerned without taking apart the hull, but the description at the bow and stern may suggest a trapezoidal shape with little wood removed beyond the bark as seen on other contemporary keels from Studland

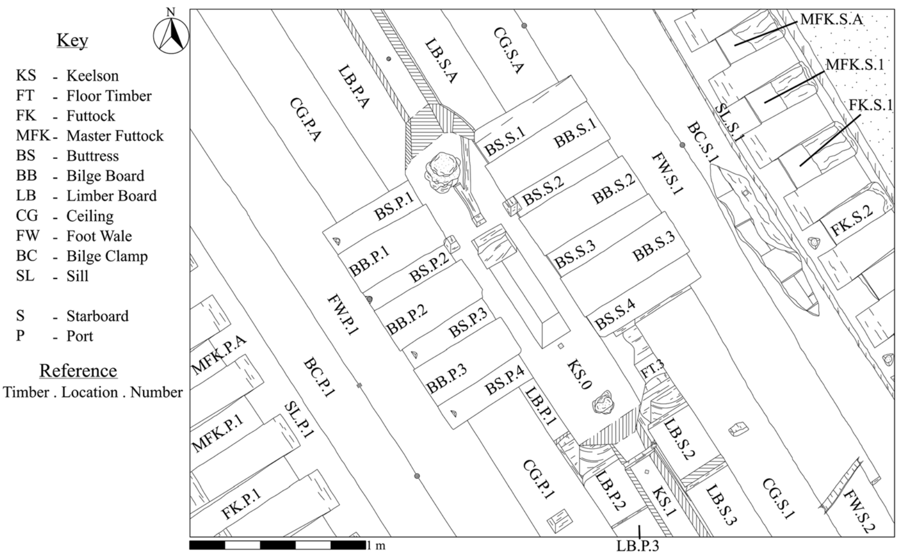

Fig. 5 Site plan with reference codes of individual components at amidships from the Emanuel Point II shipwreck. (Drawing by Author)

Table 2 Scantlings of Structural Timbers

Timber	Reference Code	Length (m)	Sided (cm)	Molded (cm)
Keel	KL.0		33	
Keelson	KS.0	2.15 (expanded)	23–44	16–39
	KS.1		23	20–28.5
Floor Timbers	FT.A		19	26
	MFT.0	3.22 (est.)	22	25
	FT.1		23	25
	FT.2		25	26
	FT.3		19	24
	FT.4		19.5	25
First Futtocks	MFK.S.A		18	20.5
	MFK.S.1		15	23
	FK.S.1		17.5	22
	MFK.P.A		14	20
	MFK.P.1		14	19
	FK.P.1		18	23.5

Bay, the possible *San Juan*, *Mary Rose*, and Western Ledge Reef (Bojakowski 2011:23; Loewen 2007:31; McElvogue 2009a:81; Thomsen 2000:70). Both garboards lay flat against the keel and are relatively flush with the second strakes. Recent excavations at the stern of EP II have uncovered the bottom of the sternpost, thus providing for an overall length of the keel at approximately 22.52 m (Bendig 2016:173).

Floors Timbers and Futtocks

The level of preservation of EP II's hull meant that almost the entire ceiling is virtually intact and would require removal to access the floor timbers and first futtock connection. Only removing the unfastened bilge boards between buttresses and the openings of the pump sumps provided an opportunity to examine inside the bilge. The master frame is located beneath the second pair of buttresses (BS.P.2 and BS.S.2) and is the only floor timber found with first futtocks attached on the fore and aft faces. Floor timbers fore and aft from the master frame are 25–26 cm molded, but their sided dimensions vary depending on the location. Room and space for floor timbers beneath the expanded keelson is 41 cm, but decreases to 36.5 cm starting from floor timber FT.3 going aft. Every floor timber has evidence of being trimmed with an adze to create smooth faces and none have any visible inscribed lines. Along the center of each floor timber above the keel is a 4-cm high by 6-cm wide rectangular limber hole. Most limber holes have been blocked due to excess amounts of wood debris and brittle concretion. Only a single wronghead on floor timber FT.3 is exposed from damage to the starboard bilge clamp that occurred prior to the wrecking event. The wronghead has a 13.5 cm wide recess cut 13 cm square into the edge of the floor, allowing 5 cm of material cut at an angle to remain for driving an iron fastener into the accompanying first futtock (Fig. 6).

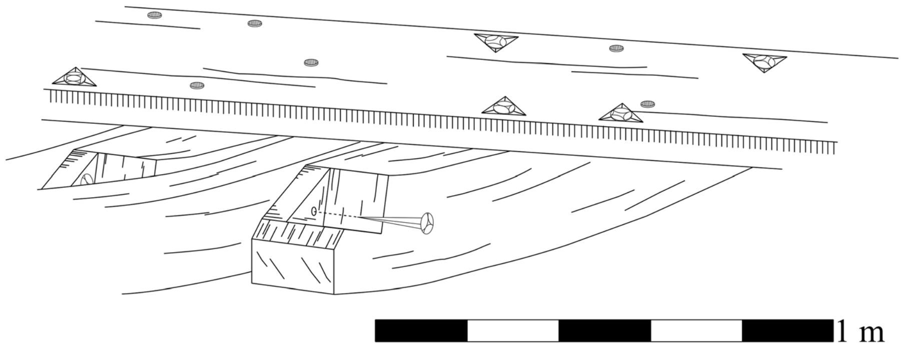

Fig. 6 Example of the wrongheads at amidships. (Drawing by Author)

Only three pairs of first futtocks were examined connecting to the floors beneath the expanded keelson. Carpenters who originally worked on the starboard futtocks roughly fashioned the inboard ends with an axe into an angular point against the corresponding floor timbers. Extra care was taken in fashioning the end of the forward starboard futtock (MFK.S.A) against the master frame, due to the carpenter cutting a tab rebate to insert a 2-cm square iron fastener. Portside futtocks appear to be fashioned by a different individual. Rather than cut the futtock ends into a rough point, the portside futtocks are clean cut with an adze sloping towards the adjoining floor timbers with rough countersinks for fasteners.

When examining the portside futtocks, there is clear damage, especially to the two attached to the master floor timber (MFK.P.A and MFK.P.1), which show splitting lengthwise. Considering the 14.5° tilt to port and the greater preservation of the hull along this side, there should be evidence for stress on all the futtocks, however, only the master first futtocks were observed split and the same damage was not seen on the futtock at the port pump sump. Evidence suggests that these timbers were damaged from the impact of the ship against the sandbar by the hurricane. One final feature was the discovery of an incomplete 2.5 cm diameter treenail hole drilled into the top face of the master futtock MFK.P.1 located just above the sill, which is interpreted as originally used for bracing the frame during the assembly of the hull.

Keelson

Approximately 3.53 m of the keelson was uncovered at amidships, including the expanded section for the mainmast step. Along both the forward and aft arms of the keelson are 5 cm wide chamfers cut to remove the top edges of the timber. There is a single 2.5 cm diameter treenail along the centerline of the forward arm connecting it to the floor below. Between floor timbers, the underside of the expanded keelson extends creating the notched profile with scalloped bottom edges 6–8 cm wide. Along the top face of the expanded keelson are two through bolts on either end that are approximately 5 cm in diameter and connect the expanded keelson to the floor timber and keel below. Aft of the forward through bolt is a modified deck stanchion mortise 31 cm long. Evidence on the end of the mortise towards the stern suggests the last 6 cm by 5 cm section, 3.5 cm deep, was cut but never used. The remaining forward section is 6–7.5 cm wide and only 2 cm deep.

There is an additional channel cut with similar dimensions connected to the mortise at a 65° angle toward starboard that terminates at the edge of the beveled forward face of buttress BS.S.1. Originally, the channel was perceived as part of the wrecking event, however, the surviving deck stanchion (62 cm long and 10.3 x 13 cm) was found in situ with a 11.3 x 5 cm tenon (Fig. 7). Rather than impact damage, it appears the channel was a modification by the shipwrights, due to the positioning of the pump well. When the pump well was installed, the forward wall was blocked by the deck stanchion, requiring the craftsmen to cut a channel and reposition the stanchion further forward. Two robust mallet handles (described below) were found in the vicinity with broken tenons, suggesting that the upper deck may have already been installed requiring the stanchion to be knocked out with manual force. It should also be noted that the deck stanchion tenon is still too thick for the shallow mortise and no wedge was found to keep it from unstepping.

On either side of the expanded keelson, just aft from the deck stanchion mortise, are two pump well stanchion mortises cut into the keelson and mainmast step components after the assembly was complete. The portside mortise is 9 x 7 cm and 5–6 cm deep, it is cut into the first bilge board (BB.P.1) and the second buttress (BS.P.2). Along the starboard side, there is a similar mortise 9 x 8 cm and 6–6.5 cm deep, but the starboard version is cut further outward into the corresponding second buttress (BS.S.2).

Fig. 7 Deck stanchion originally located forward of the mainmast step. (Drawing by Author)

Consequently, the bottom of the starboard mortise has a central seam where the buttress and keelson connect. Five centimeters behind the deck stanchion mortise is the 75 x 19.5 cm mainmast mortise which had been roughly cut with an adze 16 cm deep. The walls appear to have been smoothed more than the bottom of the mortise. There is a single 1.5 cm diameter drainage hole near the starboard aft face to allow water to enter the bilge between floor timbers FT.1 and FT.2.

Excavations uncovered a forward shim and chock for the mainmast tenon still in situ (Fig. 8). Both timbers were roughly hewn with adzes to fit the mortise. The forward shim was located between the front face of the mainmast mortise and the forward chock (see Table 3 for dimensions). It was driven into the mortise at an angle where the starboard side was deeper. When the forward chock was removed, it was found that it had been lifted 1–2 cm from the bottom of the mortise. The chock is smooth and the front is rounded based on the natural curvature of the wood. There is a circular notch 3.5 cm in diameter on the starboard edge.

Further investigation revealed another shim and chock near the aft face of the mainmast mortise. The aft shim was found sitting above the sediment and concretion in the mortise. Compared with the front shim, which was shaped with an axe, the aft shim has been sawn off a square timber centered on the pith. The aft shim reduces to a thinner broken end, which suggests it once tapered to a point. There is a concretion on one of the flat faces, a similar large brittle concretion was found at the bottom along the

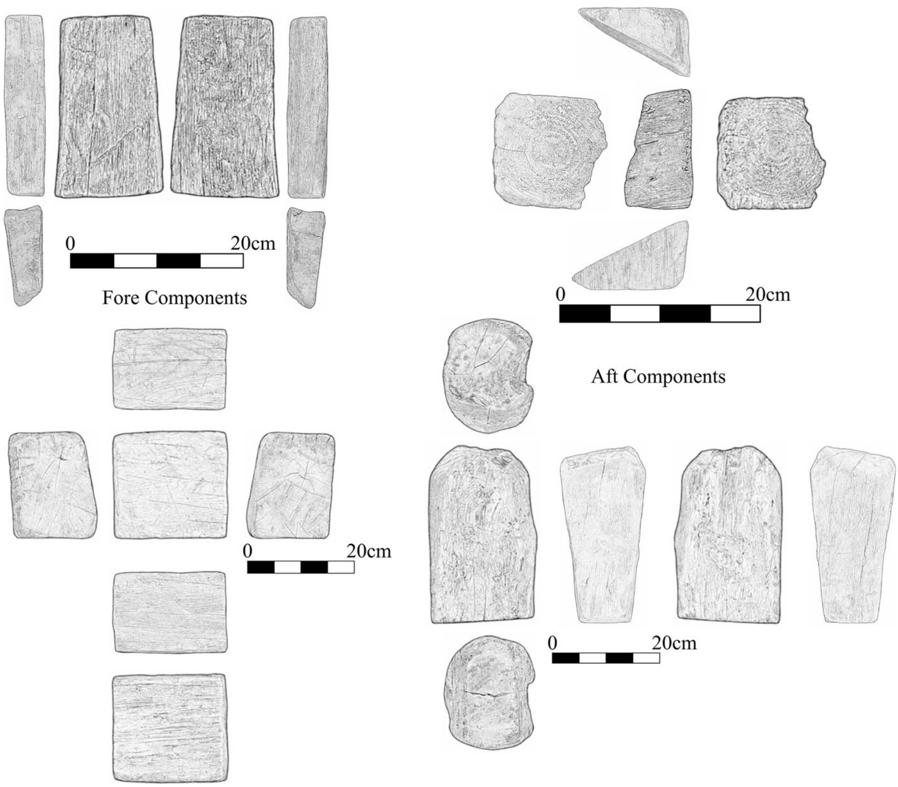

Fig. 8 The wedges (top) and chock (below) for the mainmast mortise. (Drawing by Author)

Table 3 Measurements for Shims and Chocks of the Mainmast Step

Timber	Length (cm)	Width (cm)	Thickness (cm)
Forward Shim	18.8	10.9	4.5
Forward Chock	12.5	18.9	18
Aft Shim	10	10.5	2.2–6.1
Aft Chock	29	17	8.5–15

aft face of the mainmast mortise. The concretion did not have a definitive shape and later was found to contain no surviving iron or form, except for a single small tack.

The aft mainmast chock was found lying on the keelson between the mainmast mortise and the aft through bolt. It appears slightly wedge shaped and much larger compared to the square forward chock. There is evidence for concretion on both faces, with the inner face containing a small 7-cm oval that may have been the remains of some small tackle. Near the top of the inboard face is a 5-cm square portion of missing wood. Based on the remains, it appears that the mainmast tenon was removed from the mainmast with such force as to partially damage the aft chock and unseat it from its original position. The same action affected the forward chock and shim by raising them slightly out of the mortise with the direction indicating that the mainmast fell forward.

Considering the thickness of the shims and chocks, these components reduce the amount of space in the mortise to 40 cm in length. Both chocks are taller than the mortise and would have prevented a larger mast from being seated properly. Removal of the aft chock and shim makes it difficult to know how deeply the aft shim was inserted. The broken off lip of the aft shim is 2.2-cm thick and suggests how deep it was inserted between the mainmast and aft chock. The last feature of the expanded keelson is a 2-cm square iron fastener that was driven straight into the top of the keelson just aft of the mainmast mortise.

The remaining exposed section of the keelson is reduced through a series of chamfers. Over the 70-cm aft arm is a 40-cm long horizontal-flat scarf beginning behind the expanded keelson. The scarf is made by cutting each timber 5 cm deep into the outer face and fashioned at an angle to fit the two pieces together perfectly. There is a single 2-cm square iron fastener located 6 cm aft from the beginning of the second keelson timber (KS.1). The lack of additional fasteners led to the single fastener being snapped in half and the scarf becoming disjoined so that a 6-cm gap now exists.

Buttresses

Transverse support for the expanded keelson is provided with four pairs of triangular buttresses that share similar, but varying dimensions, as shown in Table 4. All of the buttresses are positioned above floor timbers with their outboard ends accommodated by notches into the adjacent foot wales. The inboard face of each buttress has 2.5–4 cm wide rebates cut on most of the fore and aft edges to allow bilge boards to rest flush and create a smooth profile. Subtle differences between the starboard and portside buttresses suggest two different carpenters oversaw their installation. On the starboard side, the first buttress (BS.S.1) includes a 7-cm wide chamfer edge. All of the starboard buttresses are installed with two 2–2.5 cm square iron fasteners. The first fastener near the top inboard edge is on an angle to connect the buttresses to the expanded keelson. Another fastener, near the bottom outboard edge, connects each buttress to the floor timber

Table 4 Measurements of Buttresses

Buttress	Length (cm)	Sided (cm)	Hypotenuse (cm)	Inboard Molded (cm)	Outboard Molded (cm)	Risen from Floor (cm)
BS.S.1	63	21	66.5	29	7.5	4
BS.S.2	64	19	65	23	7	6
BS.S.3	65	19	67.5	32	7	0
BS.S.4	65	19	67	30	8	0
BS.P.1	62	19	66	26	7.5	2.5
BS.P.2	61	19.5	65	28	7.5	0
BS.P.3	62	21	66.5	29	8	2.5
BS.P.4	63.5	20	66	26	8	1

underneath. Installation of the portside buttresses is similar, with all four components having a single fastener at the top to connect it with the expanded keelson. All four portside buttresses have countersunk notches cut near their truncated outboard ends. The first buttress (BS.P.1) has an iron fastener in the countersink, but the second buttress (BS.P.2) has a 2-cm diameter round treenail instead. There is no evidence for concreted fasteners on the outboard edges of the third (BS.P.3) or fourth (BS.P.4) buttresses.

Several buttresses on either side of the expanded keelson were lifted from their inward bottom edges on the floor timbers. Most portside buttresses were 1–2.5 cm above the floor, except the second buttress (BS.P.2), which is sitting flat. Only the first two buttresses on the starboard side were affected, the first buttress (BS.S.1) being lifted 4 cm and the second buttress (BS.S.2) 6 cm respectively. Although all the top inboard faces of the buttresses were still pressed against the expanded keelson, the lift from the bottom of these components suggest the impact of the ship against the sandbar was forceful enough to shift them.

Bilge Boards

As part of the process to seal off the bilge from debris, carpenters cut bilge boards that were seated between the buttresses. None of the boards were fastened down, but each was sawn to custom fit the surrounding structural timbers (Table 5). Rebates cut into the expanded keelson, buttresses, and accompanying foot wales allow the mainmast step to have a smooth profile without any hard edges that may have allowed cargo or ballast to damage structural components. Over the past four centuries, the boards have warped due to the amount of ballast and weight being placed on them. The swelling of the wood also made it difficult to remove the boards. Internal rot from an unidentified white material was seen on the underside of all of the bilge boards.

Ceiling

Most of what was recorded at amidships on EP II is the intact ceiling, but this section in particular refers to ceiling planks that did not provide a specific purpose beyond encapsulating the bilge and protecting the hull structure. Four ceiling planks running

Table 5 Measurements of Bilge Boards

Bilge Board	Length (cm)	Width (cm)	Thickness (cm)	Keelson Rebate (cm)	Foot wale Rebate (cm)	Buttress Rebate (cm)
BB.S.1	68.5	23–25.5	2.5–3	2.5	8	2.5–3.5
BB.S.2	68.5	26–26.5	2.5	2	9	2.5–4
BB.S.3	70.5	26–27	2.5–3	3	10	3–4
BB.P.1	67.5	25–26	3.5	2.5–4.5	10	3.5–4
BB.P.2	67.5	25–27	2–3	2	10	3–3.5
BB.P.3	66	23.5–25	2–3.5	1.5	11	2.5–4

fore and aft were found positioned between the limber boards and foot wales forward and aft of the buttresses. Table 6 includes the dimensions of the planks. The forward two ceiling planks (CG.P.A and CG.S.A) rest their aft edge on the first forward floor timber, which has offset the first buttresses BS.P.1 and BS.S.1 on either side to sit further aft. This arrangement is mirrored with the aft ceiling planks (CG.P.1 and CG.S.1) resting on the floor timber FT.3 and shifting the fourth buttresses BS.P.4 and BS.S.4 slightly forward longitudinally. Fastening patterns on the ceiling planks suggest different installments, as the forward port ceiling has two 2–2.5 cm square iron fasteners triangularly countersunk, while the starboard equivalent has a single treenail. Along the face of the port ceiling CG.P.1 there are additional countersunk fasteners and treenails, while the starboard ceiling CG.S.1 only has fasteners (one not countersunk). There does not seem to be a corresponding pattern to affixing the generic ceiling, except that almost all the iron fasteners were triangularly countersunk and driven from the inside, while most of the 2–3 cm diameter treenails found throughout the hull were driven through from the outside. There are also several instances of stopwaters where treenails and a rectangular 2 by 2.5 cm wooden nail are present along the seams between ceiling, foot wales, and bilge clamps.

Foot Wales

Some of the more unusual components on EP II are the first longitudinal stringers (FW.P.1 and FW.S.1) closest to the keelson. Rather than have pronounced foot wales, the carpenters on EP II chose instead to install wider planks. Both foot wales are held in place with a series of 2.5–3 cm diameter treenails and triangular countersunk iron fasteners. Compared with all of the ceiling, the foot wales are the widest and their positioning is directly above the connection between the floor timbers and first futtocks at amidships. There is also a two-part foot wale scarf connecting FW.S.1 to FW.S.2 going aft. The outboard section is a 8-cm flat horizontal scarf 5 cm deep, while the remaining 33 cm is a longer angle scarf. Based on what has been uncovered, it appears that the foot wale is reduced further away from the mainmast step and the bilge clamp is widened. Other examples of wide stringers can be seen on most medieval cogs, the 10 wide stringer planks on the 15th-century Newport shipwreck, and two wide bilge stringers on the mid or late 15th-century Ria de Aveiro A (Alves et al. 1998:338–340; Nayling and Jones 2014:18–21). These earlier stringers include some evidence of

Table 6 Scantlings of Ceiling Components

Timber	Reference Code	Length (m)	Width (cm)	Thickness (cm)
Ceiling	CG.S.A		35	7
	CG.S.1		38	5
	CG.P.A		36	7
	CG.P.1		35	7
Foot Wale	FW.S.1		40	7
	FW.P.1		40	7
Bilge Clamp	BC.S.1		34	7
	BC.P.1		32	7
Sill	SL.S.1		24	7
	SL.P.1		26	5
Limber Boards	LB.S.A		28.5	7
	LB.S.1	35	16.5	5
	LB.S.2	38.5	27.5	4.5
	LB.S.3		28	5
	LB.P.A		26	7
	LB.P.1	40.5	19.5	2.5
	LB.P.2	30	25	7
	LB.P.3		25	7
Filler Planks		.50–.57	19–22	5–7

rebates on their undersides to fit over the floor timbers, but there is no evidence of this on EP II.

There is little evidence for repairs on any of the components found at amidships, but a single preventative procedure was found located beneath the portside bilge board BB.P.1. Due to the space between the bottom face of the foot wale and the top face of the forward master frame futtock MFK.P.A, the wooden tab between the recesses cut for the corresponding buttresses began to crack. As a preventative measure, a carpenter modified a normal treenail into a wedge and hammered it into the space to support the foot wale. Whether this wedge was installed during construction or later in life is debatable, but the extra effort in an area that would have been regularly covered over with a bilge board suggests the former.

Bilge Clamp

Bilge clamps are ceiling planks located alongside the outboard edge of the foot wales and complement them by clamping the wrongheads of the floor timbers to the rising first futtocks. These boards are held in place through a series of treenails and iron fasteners counter sunk into the wood. Most countersunks across all of the ceiling have been filled in by the fastener concretions, but enough shape still exists to indicate a 7 cm per side triangular cut made by an adze or axe. There is damage to the starboard bilge clamp (BC.S.1) where a section of the board has been broken away revealing parts of the floor timbers and futtocks below. Evidence of ballast stone and ceramics, including Native American pottery, found deep within the hole indicate the damage was created prior to the ship sinking.

Sill and Filler Planks

The uppermost strake of ceiling planking in the hold consists of boards crenellated along the outboard edge to cap off the bilge between first futtocks. There appears to be a difference in fastening patterns between the two sills, as the starboard sill SL.S.1 has countersunk iron fasteners in triangular rebates positioned toward the center of the plank over the first futtocks. Along the portside, there are round 6.5 cm diameter countersinks at the inboard edge over the first futtocks and two secondary round countersinks in a similar position as on the starboard version. Only one of the two further outboard countersinks has evidence for an iron fastener in the center.

Filler planks cap off the wrongheads of the floors and prevent debris from entering the bilge that could possibly clog the bilge pumps. Each of the first futtocks measurements vary, thus the filler planks were custom fit to specific crenellations along the sill. Almost all of the filler planks have no evidence of being fastened into place, except the possibility of a single concretion on the starboard side. Every filler plank is beveled so that the inboard end creates a smooth profile with the sill and the outboard ends have a reverse bevel to match the curvature of the hull.

Limber Boards

Limber boards were found on either side of the keelson before and after the mainmast step. None of these boards have fasteners present, indicating their use as boards to seal off the bilge and could be removed easily to provide access. The boards are positioned to sit on the lip created by offsetting the first and fourth buttresses. Compared with limber boards found further forward, these boards were custom cut to fit the expanded section of the keelson. Due to the presence of the pump sumps, there are shorter limber boards aft of the fourth buttresses. There is a missing limber board on the starboard side, fortunately the equivalent board (LB.S.2) on the other side of the pump sump survives. The surviving board has a 4.5 cm chamfer on its aft edge and there is a 2.5 cm gap between it and beginning of limber board LB.S.3.

On the portside, a single short limber board (LB.P.1) is positioned behind the fourth buttress (BS.P.4). There is a chamfered curve on the end of the board near the pump sump. The limber board LB.P.2 found directly aft has 1.5 cm space between it and the next consecutive limber board. The presence of these shorter limber boards suggest that the carpenters wished to have adjustable boards that could shift slightly depending on the shape of the bilge pump tube. Both aft short limber boards were found moved slightly forward covering the pump sumps and may be a result from when the bilge pumps were salvaged.

Bilge Pumps and Sumps

Behind the mainmast step are two pump sumps located on either side of the keelson. Neither pump sump has the remains of the bilge pumps or associated artifacts, which suggests these were probably still serviceable and removed as part of the salvaging efforts after the wrecking event. Documentary evidence from the royal accounts for the Luna expedition include sending additional pumps with the first relief squadron (Yebra 1569:f.32). Surviving pumps were probably combined with new pumps to remove water for salvaging work or for attempts at refloating other vessels of the fleet.

Both pump sumps are 31 cm deep from the top of the ceiling to the inboard face of the outer hull and include semi-circular cuts 24 cm deep into the aft face of floor timber FT.3 (Fig. 9) and the forward face of floor timber FT.4. These semi-circular mortises create a 7-cm high step on either side of the 17.5 cm space between floors. The depth of the circular notches into the floors varies, making the starboard pump sump 32.5 cm in diameter and the portside 29.5 cm. There is no significant modification of the keelson to compensate for the pumps, as the carpenters positioned them at the reduction of the expanded keelson. The underside of the keelson between the pump sumps was fashioned into a 7–8 cm high chevron rather than the scalloped recesses seen beneath the expanded keelson. Limber boards associated with the pump sumps provided a 27-cm square opening for the insertion of both pump tubes.

This box opening could be interpreted as the lower tube having been fashioned square, as seen on the possible *San Juan* (Waddell 1985:250), although the circular cut of the forward portside limber board (LB.P.1) would suggest that the tubes were rounded throughout. Most contemporary examples show the pump foot resting on the outer hull (Bojakowski 2011:29; Garcia and Monteiro 2001:443; Nayling and Jones 2014:248, fig. 24; Oertling 1989:249). Evidence from the Cais do Sodré and EP I

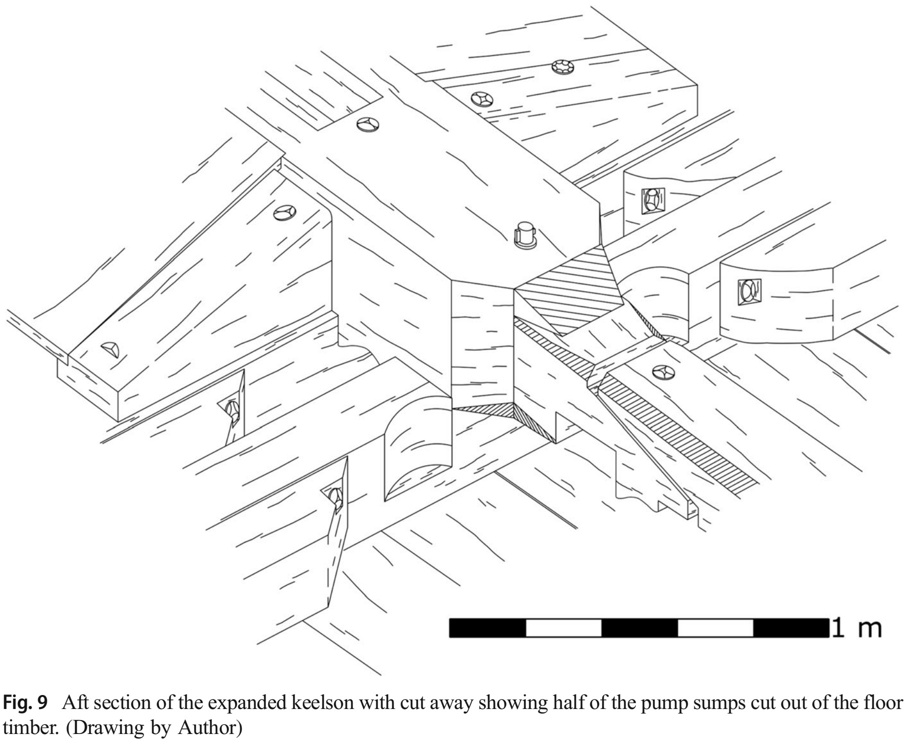

Fig. 9 Aft section of the expanded keelson with cut away showing half of the pump sumps cut out of the floor timber. (Drawing by Author)

shipwreck indicate burr pump foot valves in the Mediterranean tradition (see Cazenave de la Roche 2010:46–53 for an example), where the foot valve relied on arms resting to the floor timbers for support rather than sit on the outer hull (Castro et al. 2011:340; Smith et al. 1995:29). There is a single similar example to the EP II pump sump design from *Mary Rose*, which has a step at the bottom of the main pump sump (McElvogue 2009b:289).

Most examples of surviving bilge pumps emphasize a burr pump configuration, although *Mary Rose* may have had the earliest example of an intact suction pump tube on board. Almost all the burr foot valves require sitting on the outer hull and include four notches on the underside to allow the movement of bilge water. The pump sumps on EP II provide a minimum of 7 cm of water to move under the pump without the need for notches to be cut into the pump tube. If surviving examples of foot valves with underside notches were installed on EP II, it would only allow two notches to be effective. Compared to burr pumps, which relied upon the separate foot valves, the positioning of the pump sumps on EP II would suggest a pump tube with internal valves as found in common suction pump design (Oertling 1996:23–24).

Pump Well

Initial excavations surrounding the mainmast step uncovered 31 disarticulated planks, stanchions, and various small wooden pieces. Out of these timbers, 24 pieces were identified as part of the lower pump well construction. Four stanchions were uncovered in the vicinity of their respective mortises, Table 7 includes dimensions for each, along with the walls of the pump well. All of the pump well stanchions include several fastener holes along two faces that are 1-cm square. Each of the pump well stanchions, including the single deck stanchion, have significant damage from teredo worms on their upper half. The fact that the aft portside stanchion has a greater intact length than the others also provided evidence for the ladder system. There is a triangular rebate on the stanchion that is 2.6 x 2.1 cm. This rebate corresponds with other surviving fragments from the forward starboard pump well stanchion that includes two rebates (Fig. 10). These indicate that access to the inside of the pump well was through climbing on the stanchions themselves.

Mortises for the pump well stanchions were cut into the lower hull structure after the assembly was complete. Both forward mortises, as described earlier, are cut into the surrounding expanded keelson, edges of the first bilge boards, and second buttresses.

Table 7 Measurements of the Pump Well

Components	Overall Length (cm)	Width (cm)	Thickness (cm)	Tenons (cm)
Starboard Stanchions	63–66.5 (surviving)	14	12	7–9 by 5.5
Portside Stanchions	57.5–78 (surviving)	15.5	13.5	7–11 by 5–6.5
Forward Wall	56.6	16.5–24	2.5	
Aft Wall	129.5	24–28	2.5	
Starboard Wall	135	12–20	3	
Portside Wall	183.5	23–25.5	5	

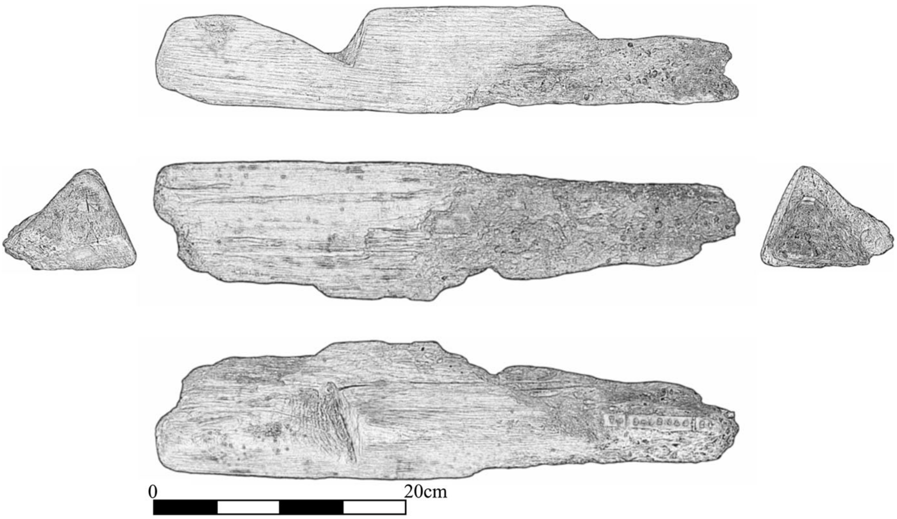

Fig. 10 Fragment from the forward starboard pump well stanchion with two notches to act as steps for climbing. (Drawing by Author)

The forward mortises are 33 cm apart and run longitudinally, while the aft pump stanchions were cut transversally into the ceiling. Aft pump well stanchion mortises are 6 cm deep. Carpenters cut the ceiling deep enough to leave only 1 cm remaining in thickness for the bottom of the mortise on the portside, while the starboard mortise was cut all the way through and positioned between floors. Compared with the relatively closely spaced forward mortises, the aft mortises are 1.02 m apart, causing the pump well to take on a long trapezoidal shape that incorporates the mainmast and pump sumps (Fig. 11). Based on tool marks, it appears the planks were sawn lengthwise with all of the front planks and one of the starboard planks beveled on the edges with an adze.

Most of the pump well planks are around 2.5 cm thick, except the portside, which are 4–5.5 cm thick. The portside planks are a similar thickness as the outer hull planking on EP II and several other aspects of these boards emphasize them as outer hull planking reused from another vessel. Each portside plank has multiple 1-cm square fastener holes spaced equally apart along the edge and both planks include the remains of pitch used to seal the outer hull from marine organisms. One end of a plank has been cut for a vertical flat scarf to connect this board with another. Several of the starboard side planks and both remaining aft planks include additional fastener holes 50–100 mm square located in areas where no stanchions are present. These fastener holes emphasize more reworked wood used to build the pump well. One of the aft planks has two notches cut on its upper edge surrounded by fastener holes, suggesting this may have been a sill or for another purpose.

When considering the placement of the mainmast and pump tubes, very little space was available to move and service the pump sumps (Fig. 12). If the mainmast was 40 cm in diameter, it would only leave 16 cm on either side to move past and reach the pumps. The portside pump tube allowed 25 x 19 cm of clearance and the starboard is 22 x 25.5 cm. These compact spaces required either the pumps to be pulled out for service or a small individual, perhaps a cabin boy, to be sent down to clean the pump sumps. The trapezoidal shape of the pump well also covered part of the bilge boards

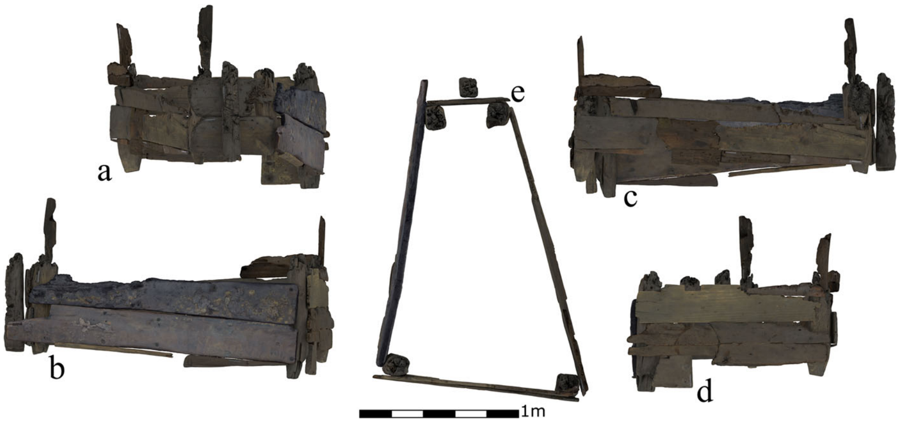

Fig. 11 Reassembled pieces of the pump well showcasing the long trapezoidal shape looking from the *a*) bow, *b*) port, *c*) starboard, *d*) stern, and *e*) above. (Image by Author)

and would have made it very difficult for a sailor of any stature to clean the bilge in this area properly.

Although the robust stanchions and pump well planks indicate building an enclosure to keep ballast and cargo from damaging the pumps or mainmast step, there are enough smaller fashioned pieces of wood to suggest the ship carpenters were clearly concerned with sealing this area off from small debris as well. By constructing the pump well enclosure to include the mainmast, it reduced the number of planks needed and allowed carpenters to rely on smaller timber fragments to seal the space between the lowest

Fig. 12 The reassembled pump well angled over the site plan. (Image by Author)

plank and the ceiling aft of the buttresses. None of the pump well filler pieces have any standardization, it seems the carpenters chose whatever scrap timber was available. Only six filler pieces were recovered associated with either side of the pump well. There is evidence that more timber is still buried along the south walls of the excavated units. Most examples of filler pieces are reworked outer hull planks, strips of wood from varying trees, such as pine, and long wedges that contour with the lowest pump well plank towards the aft stanchions.

The deposition of the various pump well components provided another view into the wrecking event. All of the starboard pump well stanchions, planks, and filler pieces were spread out along the edge of the keelson, suggesting these components fell through natural decay and the tilt of the hull. The forward pump well stanchion was held in place by accompanying planks, ballast, and sedimentation. Only the aft portside pump well indicates that force was applied in this area, causing all pump well components to be clustered toward the keelson rather than outward, as would be expected. The aft portside stanchion was found laying away from its associated mortise and the upper end on top of the aft wall planks towards the stern. The back end of the portside pump well planks also swung inward toward the keelson. This context suggests that when the ship grounded against the sand bar, the forward port stanchion was less affected due to its position being supported by the accompanying deck and starboard stanchions, along with support from the heavier portside planks. The aft portside stanchion did not have this similar close support and was displaced from the mortise toward the centerline of the ship with adjacent assembly in tow.

Possible Carpenter Tools

Out of the other disarticulated timbers found among the ballast at amidships, two may have been the remains of carpentry tools. The two pieces appear to be mallet handles that were discarded after the tenons were broken from use (Fig. 13). The first handle is 41.6 cm long and 6 x 5.6 cm with beveling along all the edges using an adze to create a round-octagonal profile. This handle only has a single broken tenon 4.5 x 2 cm on one end with the other side trimmed into a convex shape. There are three 50 mm square nail holes along one side without any evidence for their purpose. The second handle is 37.8 cm long and 6 x 5.5 cm with both ends trimmed for tenons. This latter piece is fashioned into a round-octagonal profile like the first handle, but there is a knot along one side the craftsman kept intentionally intact.

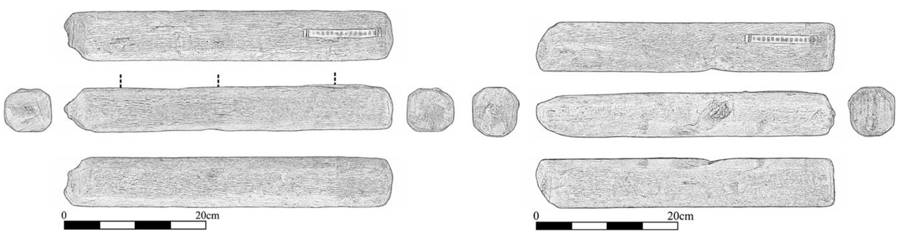

Fig. 13 Possible mallet handles found pinned beneath the ballast against the hull. Note: the three dotted lines point out the locations of fastener holes. (Drawing by Author)

The closest comparison for these artifacts come from the numerous mallet handles found near the armament on *Mary Rose* and amongst the ship carpenter's tool kit (Gardiner and Allen 2005:309–310). Although the length and shape of the two pieces found on EP II fit the characteristics of mallet handles, the 6-cm width makes them slightly larger than those found on *Mary Rose*. Both handles were found pinned to the ceiling beneath the ballast near each other, and because all the tenons are broken, these may have been discarded on purpose. The original location of the handles, directly adjacent to the channel cut into the expanded keelson for repositioning the deck stanchion, also suggests the handles were broken from this laborious task.

Discussion

Throughout the excavation phase and during the recording of the hull many idiosyncrasies became apparent, related to how the ship was constructed and to the events that unfolded around its demise. Based on differences seen in the fastening pattern from the buttresses, it appears that individual ship carpenters decided on how certain components of the hull were installed. The presence of an unused countersunk notch along the outboard edge of the portside buttresses further suggests that individual decisions affected how and whether fasteners were required. Other idiosyncrasies include the decision by ship carpenters to build a pump well enclosure that included the mainmast. By including the mainmast inside the pump well, craftsmen had to reposition the deck stanchion in front of the mainmast forward. Furthermore, a possible lack of available wood and the ingenuity of the ship carpenters are apparent in the choice of building the pump well with repurposed scrap wood removed from other ships.

Recording components individually and analyzing them cohesively has provided insight into the wrecking event. Based on the lifting of the buttresses, the splitting of portside first futtocks, and the damage to the aft portside pump well, the ship likely broke away from its mooring anchors somewhere southeast of its current location. The destruction within the hull emphasizes that the storm surge and wind drove the ship northwest into the sandbar with enough force that the aft scarf fastener for the keelson was sheared in two. Either during the wrecking event or prior to, because of hurricane winds, the mainmast was lifted out of its mortise causing the aft chock to be flung out and snapping off the edge of the aft wedge. An alternative scenario is that the mainmast was salvaged along with the bilge pumps, but the damage to the hull prevented direct access to the mainmast step.

There are also several observations that can be made about the vessel simply from the excavation. Throughout the ballast strata and accompanying sediment, most of the artifacts recovered were smaller incomplete ceramic fragments and barrel components, the largest of which was a barrel stave over a meter long. Most of these artifacts were located higher up in the strata, although there were still some artifacts recovered closer to the hull. Everything that survived the hurricane and remained in the ship was probably picked clean by the colonists, leaving behind only broken pottery and few barrel pieces that could not be reused. It still seems unusual though that more debris was not found and suggests that the ballast had been installed recently or the hold had been cleaned thoroughly prior to the voyage.

Another possibility is that the ship was already offloaded in Pensacola and may have been preparing to leave with little remaining on board. Cleaning out the bilge beneath the expanded keelson there were some expectations that artifacts would be found in this area. Only a few ceramics were located beneath the starboard third bilge board and none were recovered along the portside, where the tilt of the ship in situ made this area the deepest point for objects to settle. Excavation revealed concretions all along the top face of the keel clogging the limber holes, and dredge spoil was mainly composed of wood chips or excess worked wood. The investigation of the pump sumps included more ceramics, although these appear to be fragments that tumbled into the pump sumps after the pumps themselves were removed.

The only other area in the bilge where artifacts were found was behind the starboard fourth buttress, where the absence of a limber board left access for an animal bone and a bung to enter the bilge. Several pools of mercury were also found along the outer hull throughout the bilge, which is likely evidence from the original cargo of medicinal mercury the ship was probably carrying across the Atlantic. Cleaning the bilge and the pump sumps on this ship would have been extremely difficult, due to the positioning of the pump well and the lack of space to work even if the pumps were removed temporarily. The fact that little was found in the bilge under the expanded keelson and in the pump sumps may suggest that either the bilge was cleaned prior to the expedition or it may have been a recently built ship.

Other evidence that the ship was built recently includes an unused treenail that was found lying beneath the first portside bilge board. Removing the treenail revealed that carpenters repurposed the wooden fastener into a wedge with the head exposed and the remainder inserted in the space between the foot wale and the first futtock. The reason for the presence of the treenail wedge was due to a section of the foot wale being cracked between the first and second portside buttresses. As mentioned above, there were also the two mallet handles that were recovered, pinned to the hull beneath all of the ballast. Furthermore, there is a general lack of repairs at amidships, with little damage to the mainmast step components. Compared to EP I, which is believed to have lost the portside of the vessel beyond the end of the ceiling planking during the hurricane (Smith et al. 1995:34), additional sections of EP II's hull remain intact, thus allowing the greater possibility to find repairs along the ceiling or to the outer hull when accessible. The surviving sections at amidships indicate that the vessel was relatively new at the time of sinking, although a dendrochronological analysis may provide further answers on the age of the ship. Scantlings obtained during the amidships excavation and earlier work suggest EP II is one of the three largest ships of the fleet, presumably the *Jesus,* or *San Andres*.

Conclusion

The Luna expedition was part an expansionist policy by the Spanish Crown to install a permanent settlement in *La Florida*. Despite the fact that the expedition was well organized and funded, the constant struggles living on the frontier prevented Pensacola from extending Spanish influence into the North American continent. The hurricane setback, which destroyed much of the fleet at anchor while storing a large portion of the colony's food supplies on board, brought the expedition almost to a halt. In the end, the colony was eventually abandoned and the fate of the fleet was forgotten until the rediscovery of three vessels over the last few decades. Spain would resolve the French threat by founding St. Augustine, Florida in 1565 and focus its attention on the more profitable occupation of New Spain and Tierra Firme rather than returning to the Gulf coast.

Pensacola Bay has provided an anaerobic environment that allows an unprecedented amount of preservation of hull remains. Excavations on EP II at amidships uncovered a mainmast step complex that is typical for ships built along the European-Atlantic coastline. EP II does contain several unique features that have not been reported elsewhere on other contemporary vessels. For example, the significant amount of the surviving pump well has been reconstructed, revealing that the enclosure also encapsulated the mainmast. The possible unfamiliarity with this design could also be seen in the modification of the expanded keelson to readjust the forward deck stanchion.

Locating two possible mallet handles found in relation to the deck stanchion mortise also suggests that the entire ballast had never been removed from the hold. The pump well design also prevented access to the bilge between the buttresses, where excavation revealed an abundant amount of wood chips and waste products possibly from the original construction. Furthermore, the wide foot wales appear counterintuitive to their intended design as the first stringers and create a smooth profile for the entire ceiling. Further work will need to be done on understanding whether the wide planks could provide the same rigidity and whether this design stems from a different shipbuilding tradition.

Much has been learned about EP II from the amidships analysis, however, there is significantly more work that needs to be accomplished in the future. This article provides an investigation on only one aspect of the hull remains, other sections are currently being recorded or revisited as part of several research projects. The recent discovery of the third Luna ship only reminds archaeologists that there are still three more (the fourth being thrown on shore by the 1559 tidal surge) that are in the vicinity (St. Myer 2016). Observing the preservation on the known Emanuel Point shipwrecks, suggests that the additional vessels will provide significant new case studies towards better understanding the development of ship construction from this period.

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