

Bang Bang! Cannons, Carronades, and the Gun Carriage from the Storm Wreck

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In December 2010, four cannons and two carronades were discovered on the Storm Wreck, apparently jettisoned in an attempt to re-float the grounded ship. One 4-pounder cannon and one 9-pounder carronade were raised in 2011 and have been conserved. The carronade, whose serial number was identified in Carron Company records, was dated 1780 and is believed to be the second-oldest surviving example. In 2015, excavations revealed another cannon, 12 meters away from the main cannon pile. It was still attached to the partially preserved remains of its carriage. This paper presents an overview of these seven guns and the carriage.

Introduction

The Storm Wreck, identified as a transport carrying civilian refugees and British soldiers during the December 1782 evacuation of Charleston, subsequently lost off St. Augustine, Florida, has undergone six seasons of excavation by the Lighthouse Archaeological Maritime Program (LAMP) (Meide et al. 2011; Meide et al. 2014; Meide 2015a, 2015b). On 17 December 2010, during a routine monitoring dive after the close of the initial excavation season, four cannons and a carronade, along with the ship's bell, were unexpectedly encountered at the shipwreck site (Meide et al. 2011:144-150; Turner and Meide 2013). Previously buried just four meters

north of the 2010 excavation area, they had been partially exposed by shifting sands sometime after 9 September. After this discovery, the primary objective of the 2011 season was to fully expose and record all of the artillery in order to choose two representative specimens to raise for conservation, analysis, and display (Meide et al. 2014:160-179). During that excavation, an additional carronade was revealed, making a total of six guns: four 4-pounder cannons (one of which might be a 3-pounder) and two 9-pounder carronades. These were assigned numbers 1-6 to facilitate field recording and easy reference. Cannons 1 and 6, a long gun and a carronade, were recovered on 28 June 2011 (Veilleux and Meide, this volume: Figure 1) and, after almost four

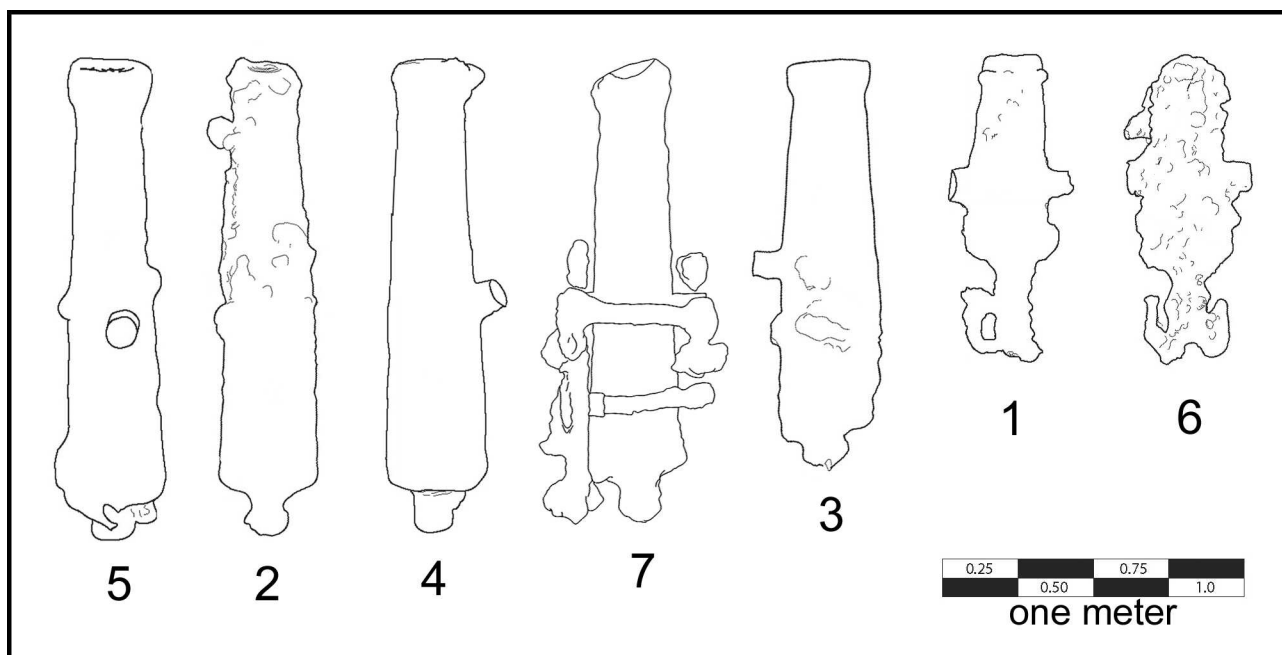


Figure 1. The 9-pounder carronade, designated Cannon 6 or 11S-154.1, recovered from Storm Wreck on 28 June 2011. Photographs were taken after initial de-concretion; this carronade has since undergone four years of electrolysis and as of March 2016 is in the final stage of treatment (Photographs courtesy of LAMP, 2011. Illustration by Brian McNamara and Tim Jackson, courtesy of LAMP, 2012).

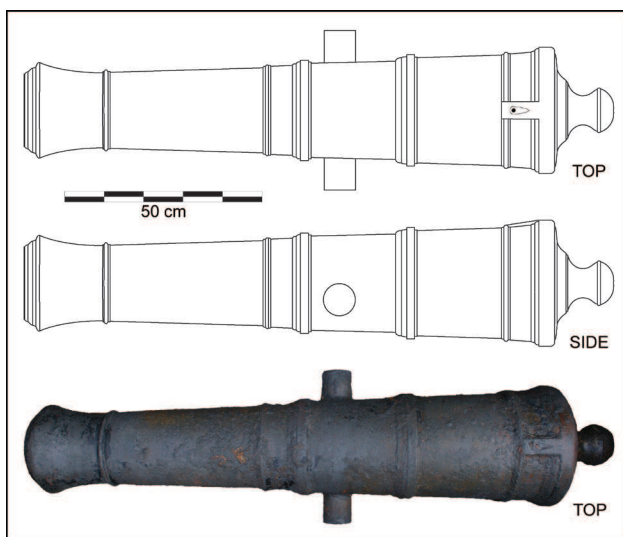


Figure 2. Cannon 2 (11S-153.14), the 4-pounder long gun recovered from Storm Wreck on 28 June 2011. Photograph was taken after initial deconcretion; this cannon has since undergone almost four years of electrolysis and as of February 2016 has been fully conserved. (Photograph courtesy of LAMP, 2011. Illustration by Brian McNamara and Tim Jackson, courtesy of LAMP, 2012).

years of electrolysis in sodium carbonate solution, they have been successfully conserved and are currently on display at the St. Augustine Lighthouse & Maritime Museum.

During 2015, the final season of major excavation at the site, a seventh piece of ordnance was discovered. Cannon 7 is another long gun, like the others believed to be a 4-pounder. It is unique in that it was found isolated from main portion of the site and from the other guns, and it featured the remnants of its carriage still attached.

Cannons 1-6 were found in a pile near the center of the site or where the scattered wreckage is most concentrated (Veilleux and Meide, this volume: Figure 2). The distribution and orientation of these guns appears consistent with a spill or dump pattern, leading researchers to believe that the cannons were jettisoned by the crew after the ship ran aground, to lighten the vessel in an attempt to save it. This hypothesis was strengthened when evidence was uncovered that other heavy ship fittings were indeed jettisoned in this manner (Meide 2015b:180; also see discussion of the deck pump in Andes, this volume). No evidence for gun carriages has been uncovered in association with these cannons, though it is believed that these guns were originally mounted for use. These guns were discarded at the same time, perhaps after removing them from their carriages, and it remains a mystery why Cannon 7 was

jettisoned separately while still in its carriage (or perhaps accidentally lost during grounding).

The Storm Wreck guns comprise a typical armament for a small to medium-sized merchant vessel of the late 18th century. Before the discovery of Cannon 7, it was noted that the known battery from the wreck was almost identical to that reported on board the 190-ton vessel *Sally*, which like the Storm Wreck was a member of the Charleston evacuation fleet. *Sally* was armed with four 3-pounder cannons and two 9-pounder carronades (Lloyd's 1782: entry S623). Ships chartered by the British government during the war, including the 122 transports used for the evacuation of Charleston, were required by the Navy Board to have a minimum number of guns and amount of ammunition on board: "at least six Carriage Guns of six pounders, or less bore as the Board shall think proper according to the size of the ship" (Syrett 1970:115). This mandate was modified on 29 November 1779 "to permit the owners of the transports to fit them with carronades instead of common guns, taking care they are not less than 12 pounders" (Syrett 1970:115). The seven guns found thus far reflect the requirement for at least six cannon or carronades, and the fact that their calibers are lower than the standard might suggest that the Storm Wreck was a relatively small vessel. The discovery of Cannon 7 makes the battery as we now know it odd-numbered. This may indicate there is another cannon on the site yet to be discovered, or that the odd cannon out served as a bow or stern chaser.

Table 1 presents measurements taken of various attributes of each gun, recorded *in situ*. Because these measurements were from concreted specimens, they are only relatively representative of the original dimensions of the guns. Table 2 shows the actual dimensions of the two guns that were recovered and de-concreted. Comparison of the two tables shows that measuring a concreted gun can easily exaggerate attribute size by between 10 and 35%, and sometimes significantly more. Overall length measurements were only minimally larger, though, by only 3.9% and 7.2% in the case of the two de-concreted guns. The weights of the concreted guns were estimated mathematically with a customized spreadsheet formula, which greatly exaggerated weight. In part this was done deliberately, as the weights of the concreted guns were being calculated for lifting purposes, and it was necessary to overestimate for safety reasons. But this process did significantly exaggerate the weight of each gun, by 36.6% for Cannon 2 and 89.4% in the case of Cannon 6.

Attribute	Cannon 1	Cannon 2	Cannon 3	Cannon 4	Cannon 5	Cannon 6	Cannon 7
Type of Gun	Carronade	Cannon	Cannon	Cannon	Cannon	Carronade	Cannon
Cascabel to Breech Reinforce	20.0	20.0	22.0	25	20.0	26.0	18.0
Cascabel to Trunnion	63.0	81.0	78.0	73.0	72.0	n/a	89.0
Overall Length	105.0	165.5	142.0	161.0	166.0	105.0	153.8
Trunnion to Muzzle Length	48.0	75.0	70.0	86.0	85.0	n/a	69.5
Muzzle Diameter	31.0	25.0	22.0	21.0	25.0	27.0	29.5
Bore Diameter	9.0	5.5	n/a	7.0	7.0	10.0	8.2
Bore Depth	n/a	18.0	n/a	9.0	n/a	n/a	n/a
Diameter Behind Muzzle Flare	27.0	22.0	8.0	22.0	20.0	n/a	25.3
Diameter in Front of Breech Reinforce	30.0	29.0	40.0	36.0	34.0	32.0	n/a
Diameter of Tube at Trunnions	44.0	27.0	54.0	34.0	30.0	n/a	n/a
Diameter of Cascabel	27.0	13.0	20.0	9.0	12.0	n/a	14.1
Length of Trunnions	Left: 8.0 Right: 8.0	Left: n/a Right: 11.5	Left: 9.0 Right: n/a	Left: 10.0 Right: n/a	Left: 9.0 Right: n/a	n/a	n/a
Estimated Weight (Exaggerated for lifting calculations)	900 lbs	1283.7 lbs	1449.9 lbs	1402.7 lbs	1515.3 lbs	833.2 lbs	n/a

TABLE 1. Measurements of the Concreted Storm Wreck Cannons Taken in Situ (in cm)

Long Guns

Five long guns or traditional cannons have been found on the Storm Wreck (Figure 3). The long guns all appear mostly similar in form to each other and are typical representatives of 18th-century cannons. All feature

trunnions and the usual rounded knob-like button at the cascabel. Their dimensions are included in Tables 1-2. Four of the guns, Cannons 2, 4, 5, and 7, are similar in length and diameter, and likely all 4-pounders. The other long gun, Cannon 3, is shorter, by approximately 7.9 in. (20.0 cm), but also more robust than the others,

Attribute	Cannon 2 (11S-153.14)		Cannon 6 (11S-154.1)	
Type of Gun	Cannon		Carronade	
	cm	inches	cm	inches
Cascabel to Breech Reinforce	14.7 cm	5.79	31.5	12.40
Cascabel to Trunnion	73.6	28.98	53.5	21.06
Overall Length	154.4	60.79	101.0	39.96
Trunnion to Muzzle Length	80.1	31.54	40.5	15.94
Muzzle Diameter	24.0	9.45	15.0	5.91
Bore Diameter	8.41	3.31	10.5	4.13
Bore Depth	21.0	8.27	7.5	2.95
Diameter Behind Muzzle Flare	18.8	7.40	20.6	8.11
Diameter in Front of Breech Reinforce	29.0	11.42	24.7	9.72
Diameter of Tube at Trunnions	25.6	10.08	22.0	8.66
Diameter of Cascabel	11.2	4.41	10.3	4.06
Length of Trunnions	Left: 8.8	Left: 3.46	Left: 8.2	Left: 3.23
	Right: 8.6	Right: 3.39	Right: 8.6	Right: 3.39
Weight	426.4 kg	940 lbs	199.6 kg	440 lbs

TABLE 2. Measurements of the Recovered and De-concreted Storm Wreck Cannons

displaying a notably wider diameter along its length. Its shorter length may indicate that it is a smaller caliber gun, perhaps a 3-pounder. Its concreted length, 4.66 ft. or 1.42 m, is slightly longer than the length of 4 ½ ft. (1.52 m) mandated by Thomas Walton in 1780 for a 3-pounder (Caruana 1997:219). If Cannon 3 is a

3-pounder, it could be that another similarly-sized gun is yet to be found on the site, or it may simply indicate the ship had slightly mismatched armament. Alternatively, Cannon 3 could represent another 4-pounder, as its dimensions still fall within the range of that caliber. It should be noted that while many 4-pound (1.81 kg) and

9-pound (4.08 kg) cannonballs have been found on the site, no 3-pound (1.36 kg) shot has been encountered.

Cannon 5 displays an anomalous feature: a breeching ring or loop at its cascabel. The presence of a breeching ring on a long gun is unexpected on a shipwreck dated to 1782 and raises an interesting implication. While breeching rings were already standard on carronades at this time, their first use on long guns is attributed to Thomas Blomefield, who was appointed as Britain's Inspector of Artillery in 1780 and started to experiment with a new style of cannon in 1786, the Blomefield pattern (Lavery 1989:22-27; Caruana 1997:257-271). The addition of a loop to the breech was intended to facilitate firing at an angle to the side of the ship (Lavery 1989:24). Previously, the breech rope had been spliced over the cascabel, so that the length of rope on either side was fixed. This meant that when the cannon was fired at an angle to the ship one side of the breeching rope took the full brunt of the recoil, a dangerously enormous strain. When the rope could be passed through a ring in the breech, it was free to run and both ends of the rope could restrain the recoil at any angle. By 1787, the advantage of the breeching loop was recognized by the Royal Navy, as reported by Blomefield himself in a letter dated 10 January of that year: "the Board of Ordnance wish to have loops on all sea service guns, and have wrote to the founders to cast them accordingly" (Lavery 1989:24). What makes Cannon 5 so interesting is that while it has a breeching loop, it pre-dates the Blomefield pattern gun by at least four years. This suggests that Blomefield was probably not the earliest to use this innovation on a long gun. It is speculated that perhaps the Carron Company, which had been using breeching rings in their carronades since at least 1779, was the first to incorporate this feature on a long gun (Turner and Meide 2013:31). It should be noted, however, that cascabel dolphins serving the same purpose as 18th-century breeching loops were known on 16th and 17th-century cannons, evidenced by guns from *Trinidad Valencera* (1588), *Atocha* and *Santa Margarita* (1622), and *Vasa* (1628) (Padfield 1973; Mathewson 1986:74; Martin 1997:5; Shaughnessy 2004:38-39).

Cannon 2, afterwards designated Field Specimen 11S-153.14, was the long gun chosen for recovery (Figure 2). When first deconcreted, no markings were visible on its surface, which is typical of a cannon meant for the civilian market. After electrolysis, however, faint markings were observed at the breech end of the gun. The number "9" and the number "3" can be discerned, along with another mark that could represent either

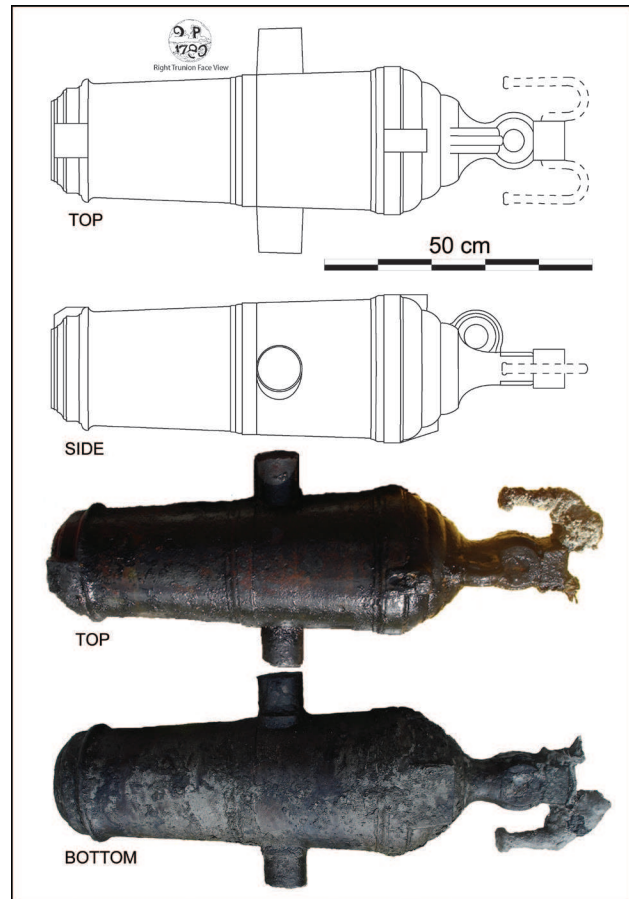


Figure 3. Comparative view of the five cannons and two carronades on the Storm Wreck on the site plan. Guns are shown to scale and arranged by length. Numbers refer to the gun designation (i.e., Cannon 5 is at far left) (Illustration by Chuck Meide and Tim Jackson, courtesy of LAMP, 2015).

a "1" or a "4" between them, on the first reinforce towards the right of centerline. If these indeed are three numbers, it is most likely they represent the weight of the gun in hundredweights, quarters, and pounds. If this is the case it should have weighed 1,039 lbs. (471.28 kg), which suggest that this cannon, weighed with a hydraulic hanging scale at 940 lbs. (426.4 kg), has lost about 9.5% of its original weight. This scope of weight loss is plausible; Australian conservators working on six 4-pounder cannons from the HMB *Endeavor* grounding site and two 18-pounder carronades from HMS *Sirius* have reported weight loss ranging between 4.75% and 26.88% (Pearson 1972:Table 4; MacLeod 1996:113).

The diameter of the cannon's bore upon initial deconcretion was recorded as only 2.95 in. (7.49 cm), slightly too small too small to accept a four pound cannonball, according to a gunnery table published in 1780 by Thomas Walton which indicated a required

bore diameter of 3.21 in. (8.15 cm) (Caruana 1997:218-219). This had been a standard size since at least 1725, when John Armstrong's 4-pounder design mandated the identical bore diameter (Caruana 1997:66), and it conforms closely to his predecessor Albert Borgard's required bore measuring $\frac{21}{20}$ of the shot's diameter, or 3.20 in. (8.13 cm) for a 4-pdr (Collins 2014). The discrepancy between the bore measurement and the historical standard was reconciled after further airscribing of the muzzle, which still displayed remnants of concretion. After this final cleaning, the bore was definitively measured at 3.31 in. (8.41 cm). This confirms the cannon is indeed a 4-pounder, with its bore exceeding the required diameter by only 0.1 in. (0.25 cm).

Carronades

First developed by the Carron Company in Falkirk, Scotland, carronades were shorter and lighter than traditional cannons and featured a large bore—and thus fired a heavy shot—relative to their weight (Lavery 1987:104-109, 1989; McConnell 1988:103-111; Tucker 1989:120-130; Caruana 1997:161-214; Watters 1998; Turner and Meide 2013:28-30). Their radical design represented the most important innovation in naval artillery of the late 18th century. Carronades were significantly lighter than traditional cannons of the same firepower, which meant that they were cheaper to manufacture and required fewer men to operate in battle. They could be used to significantly increase the firepower of a ship (by four- or five-fold) while maintaining or even reducing the overall weight of its armament, thus improving both sailing qualities and its fighting prowess. Their savings in weight, space, and manpower made them especially popular on smaller vessels, and they were adopted early by merchant ship owners.

Carronades did have a few disadvantages, due primarily to their light weight and diminutive size. Their recoil was violent and sometimes resulted in carriage damage or dismounting, and their short barrels presented a fire hazard to the outer hull and rigging. Their greatest drawback was their limited range, which could result in a devastating situation when facing a maneuverable foe armed with long guns. But despite these problems, the carronade grew steadily in popularity after its introduction to the market in December 1778. A more detailed treatment of the characteristics of carronades and the history of their development can be found in

Turner and Meide 2013 and Meide et al. 2014:168-172.

Two carronades were found on the Storm Wreck, Cannons 1 and 6, and the latter was recovered and conserved. They appear to be a matched set, identical in form and size. They can be seen in Figures 1 and 3 and their dimensions are presented in Tables 1-2. Both were equipped with a pair of handles on the cascabel (neither of which survived intact), a feature referred to by ordnance specialist Ruth Rhynas Brown (2011:1) as a "double handlebar tiller." These short handles projected back and then curved forward. They were wrought-iron and attached to a collar screwed onto the threaded end of the button. No other archaeological examples of this particular handle arrangement are known, though a few specimens exist in museum collections (Blackmore 1976:145) along with at least one historical drawing (Turner and Meide 2013:Figure 4).

Cannon 6 (Field Specimen 11S-154.1) was chosen for recovery since its handlebar tiller was intact, though one handle had deteriorated and fell away once deconcreted. The other handle survived electrolysis, and in other respects the carronade like the cannon has survived in an excellent state of preservation. It is a cast-iron, trunnioned, 9-pounder carronade with its barrel divided in two by a broad band with ogee curves just in front of the trunnions (Brown 2011:1). The button is pierced for an elevating screw and has a ribbed breeching loop. The breech of the gun has the typical three convex curved ribs. There is a raised rectangular patch with oval indent at the touch-hole and a flat plate or quoin patch below on the underside. The muzzle is very short, with no muzzle cup or nozzle, and displays a strong flare and a raised sight. A number of markings cast into the surface of the gun have been observed on the two trunnions. On the right trunnion appears "9 P" over "1780" which represents the caliber and date of manufacture (Veilleaux and Meide, this volume:Figure 4). On the left trunnion is the serial number "34478." The Carron Company always inscribed this number on the trunnion face, until around ca. 1782-1783 when the trunnions were eliminated from the carronade design. At that point it was placed on the quoin patch on the bottom of the gun (Watters 1998:184; Caruana 1997:185). Serial numbers were assigned to guns as they were cast, irrespective of their model or type (Watters 1998:184).

Archival research carried out in the Scottish National Archives by LAMP researcher Loren Clark in January 2014 resulted in the discovery of the Company's Invoice Book dated 1778-1781. Volume 2, which includes all products inventoried in 1780, includes the Storm

Wreck carronade (Carron Company Invoice Books 1778-1781[2]:229). Carronade no. 34478 is described as one of “17 Carronades 9 pounders 6 diameters with Snugs at the Mediun [sic] Weight of 3..3..26 Each.” The 17 carronades of this lot are listed with serial numbers (often non-consecutive) ranging between 34448 and 34483. The “6 diameters” refers to the length of the bore or the gun itself expressed in calibers (bore diameters). The “snugs” which are mentioned have not been identified and remain somewhat of a mystery, though they could possibly refer to the handlebar tiller. Other carronades in the inventoried shipment are described as having either “Joints & Screws” or “Joints & Cheeks,” as opposed to snugs. As the term “joint” is associated with the loop mounting which became ubiquitous on carronades (Watters 1998:173), it is possible that snugs refer to trunnions.

The averaged or median weight of the guns in this lot of 9-pdr carronades is expressed in the standard British manner, comprised of hundredweights (112 lbs.), quarters (28 lbs.) and pounds. Thus “3..3..26” refers to hundredweights, quarters, and pounds for a total of 446 lbs. (202.30 kg), which is only six pounds heavier than the weight of the carronade (440 lbs. or 199.58 kg) as measured with a hydraulic hanging scale. The

weight of the entire lot was 3 tons, 7 hundredweights, 2 quarterweights, and 22 lbs., which total 7,582 lbs. (3,439.14 kg). The value assigned for this lot of 17 carronades is 34 pounds, 13 shillings, and 10 pence. This listed price per ton is 10 pounds, 3 shillings, though the total listed value for the lot actually represents a price of 10 pounds, 5 shillings per ton, suggesting that the company clerks rounded up their calculations to Carron’s favor. At the listed price of 10 pounds, 3 shillings per ton, the Storm Wreck carronades should have cost around 2 pounds, 5 pence apiece.

According to the Invoice Book (1778-1781[2]:229), this lot of 17 carronades was included with a total shipment of “99 Guns & Carronades” transported to London on the company ship *Carron* under command of “Robert Paterson & consigned to Mr. Robert Sinclair per Bill of Loading.” When or to whom carronade number 34478 was sold after its arrival in the Carron warehouse in London remains unknown.

Archaeologists had also expected to find the word “CARRON” on the Storm carronade trunnion in conjunction with the serial number (Brown 2011:1; Watters 1998:184), but no legible trace of this inscription was visible. Another visible marking is the casting seam, running along its sides over the entire length of the gun,

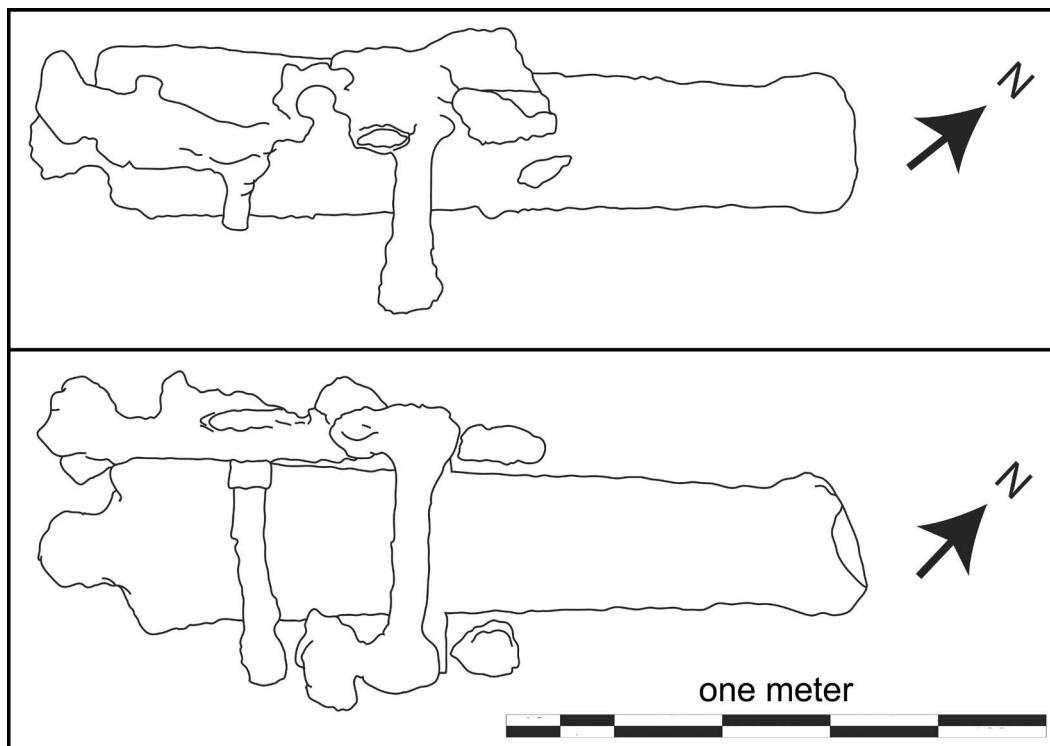


Figure 4. Two plan views of Cannon 7 with its attached gun carriage. Top: View of Cannon 7 as it originally appeared in situ. Bottom: View of Cannon 7 after it shifted and rolled as a consequence of excavation. (Illustration by Chuck Meide and Tim Jackson, courtesy of LAMP, 2015).

bisecting the trunnions.

No broad arrow mark appears on this carronade, indicating it was not marked as British government property. This is not surprising, because 9-pounder carronades were marketed exclusively to the private sector and were never adopted by the Royal Navy.

The diameter of the bore, measured after electrolytic cleaning, at 4.13 in. (10.49 cm) is almost the exact size required for a 9-pounder carronade. Carron Company engineers reduced the windage of the carronade by using a bore sized $\frac{35}{34}$ of the shot diameter, which for a 9-pounder shot of 4 in. (10.16 cm) results in a bore diameter of 4.12 in. (10.46 cm) (Collins 2014).

The recovered carronade, cast sometime in the seven months before 31 July 1780, was believed to be the oldest carronade to have survived anywhere in the world, until LAMP researchers were contacted in 2014 by Wopke Roukema and Roy Håvard Løseth from Flekkefjord, Norway (23 April 2014, 8 May 2014, elec. comm.). These two are affiliated with a local naval historical society which had just cast two working replicas of a 12-pdr carronade dated 1779. Like the Storm Wreck carronade, this example featured its caliber (12-pdr) and date on the right trunnion, along with the serial number (30077) on the left trunnion. The Flekkefjord carronade was made for the Royal Navy, evidenced by the British Broad Arrow on its upper surface. It was probably captured from a British ship or salvaged from a wreck, before ending up in a local Napoleonic War-era fort in southern Norway.

Other examples of early, trunnioned carronades have been encountered on shipwreck sites, most notably from two Royal Navy vessels lost in Australia, the *Sirius* lost in 1790 and the *Pandora* wrecked the following year (Carpenter 1986; Stanbury 1994:74-77; Andy Viduka 21 November 2011, elec. comm.; Ruth Rhynas Brown 21 November 2011, elec. comm.). Both wrecks produced very early 18-pdr carronades that were recovered for conservation and analysis; two were raised from *Sirius*, and one was recovered from *Pandora* while a second was left *in situ* attached to a sacrificial anode (Andy Viduka, 12 February 2016, elec. comm.). Other than their greater size, these examples appear similar in form to those from the Storm Wreck, though they did not feature a threaded hole in the button and therefore were not intended for use with an elevation screw. One of the *Sirius* carronades, SI 58, also bears a Carron serial number. Like the Storm and Flekkefjord carronades, this serial number on the left trunnion was depicted with its first two digits positioned over the remaining three. Its

number, 37953, was also found in the Carron Company Invoice Book. It was one of 57 carronades inventoried on 13 August 1781 (1778-1781[2]:378). It is believed that five years later, in 1786, *Sirius* was renamed and outfitted with its carronades before departing for Australia in May 1787 (Lyon 1993:230; Stanbury 1994:1).

A few other early trunnioned carronades still exist, including one at Dover Castle and another at Bamburgh Castle, both in England (Carpenter 1986:44; Lavery 1989:18; Stanbury 1994:75).

Gun Carriage

Cannon 7 was discovered on 19 June 2015; upon initial inspection, divers observed a mass of concretion with two transverse linear extensions attached to the gun. It soon was realized that this concretion was actually the remains of a gun carriage, with the linear components apparently representing the two axles (historically known as axletrees). After recording it *in situ*, excavation continued around the cannon to document as much of the carriage as possible. This had an unintended consequence: enough sand was removed from one side of the gun that it shifted, rotating about 40° downwards and towards the northwest. This was not a catastrophic collapse and was not even noticed until a subsequent dive. In fact, the repositioning of the cannon was fortuitous, as it resulted in the gun and carriage reoriented on a level plane, so researchers looking down on it could now see the gun carriage as if from directly below. This new perspective greatly aided the interpretation and understanding of the structural remains of the carriage, especially given the poor visibility. Figure 4 shows both the original and repositioned views of the gun in its carriage.

The remaining wood components, while apparently well-preserved, are obscured by a layer of concretion, so that no timber is visible. Much of the right side or cheek of the carriage has survived, measuring 3.02 ft. (92 cm) in overall length with a surviving height as great as 11.82 in. (30 cm) at the forward axletree. Less of the left side remains, spanning only 2.03 ft. (62 cm). The extant overall width of the carriage, measured along the forward axletree and including the width of both cheeks, is around 2.03 ft. (62 cm). The cheeks are about 3.54 in. or 9 cm thick. Considering that this measurement has been exaggerated by concretion, this is almost exactly the correct size for a 4-pounder. Carriage cheeks were designed to be the same thickness as the bore of the gun they supported (Manucy 1962:49; Caruana 1997:359),

and Cannon 2 had a bore diameter of 3.31 in. (8.41 cm).

The capsquares are visible, still locked to the trunnions. The forward axletree, which is situated just aft of and below the trunnions, measures 2.56 in. (6.5 cm) in diameter. The trucks or wheels of the carriage are no longer extant. What was initially believed to be the aft axletree is now understood to be a robust transverse bolt, known as the bed-bolt, which held the two cheeks together and is located 12.40 in. (31.5 cm) behind the forward axletree. It measures 1.97 in. (5 cm) in diameter and has a collar or wider portion (2.95 in. or 7.5 cm in diameter) where it meets the right cheek. The aft axletree, which would have been positioned under the base ring or forward portion of the cascabel, has not survived.

Conclusion

The Storm Wreck was likely a relatively small merchantman in service to the British crown as a military transport. Its armament was typical for a vessel of this class, though there are certainly some atypical aspects of its archaeological assemblage. While the 4-pounder cannon recovered and conserved does appear to be a standard and even rather generic piece made for the civilian market, some of the other long guns stand out as more than ordinary. Cannon 3, which is shorter and robust, presents something of a mystery. Was this a 4-pounder of a different design, or was it a 3-pounder? If the latter, was there an asymmetrical battery, or could there be another matching piece? A similar question can be posed given the odd number of long guns encountered to date; was an extra cannon used as a bow or stern chaser, or is there yet another undiscovered cannon on the site somewhere? The most intriguing question regarding the cannons pertains to the apparent breeching loop on Cannon 5. If this is indeed a ring cast onto the cascabel, then it pre-dates the Blomefield pattern by at least four years. While there are no current plans to raise and conserve another cannon from the wreck, an argument could be made to recover this gun, given its potential to rewrite what we know of British artillery history. Further study may also be warranted on the carriage attached to Cannon 7, as it may represent one of the few examples of a civilian gun carriage in the archaeological record. Why this cannon was deposited separately and still in its carriage, compared to the other guns jettisoned without carriages, remains an unanswered question.

The carronades are also of interest and worthy of further study. Their discovery provided the first reliable

means of narrowing the date range for the shipwreck. The recovered carronade, the first object found with an inscribed year, provided what remains the *terminus post quem* for the shipwreck. The significance of this piece, one of the earliest known carronades to have survived anywhere, cannot be overstated. Further study of this carronade and the Carron Company records will continue to lend insight into this unique weapon and the ship that carried it.

Acknowledgements

The successful raising of the cannons was a group effort but one that relied particularly on the exceptional talents and experience of Brendan Burke. St. Johns County, Leonardi's Nursery, and Xynides Boatyard provided heavy machinery to move the cannons. Ruth Rhynas Brown undertook a long-distance analysis of the carronade which proved very helpful. Dave Howe and the Institute of Maritime History provided the research vessel *Roper* and acquired the lifting davit to raise these cannons. My sincere thanks to the superlative team of LAMP/Lighthouse staff, students, and volunteers who have given their time, talent, and passion to this shipwreck.

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